Reach SOLAR ENERGY

SSD 18-9237

YARRABEE SOLAR PROJECT

Environmental Impact Statement

Volume 1 - MAIN REPORT

Prepared for:
Reach Solar énergy

Prepared by:
SLR Consulting Australia Pty Ltd

Ref: 610.17428-R02-v3.1
August 2018

SLR

PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
2 Lincoln Street
Lane Cove NSW 2066 Australia
(PO Box 176 Lane Cove NSW 1595 Australia)
+61 2 9427 8100 +61 2 9427 8200
sydney@slrconsulting.com www.slrconsulting.com

BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence. Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of Reach Solar énergy. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.17428-R02-v3.1	17 August 2018	Samantha Hayes	Steven Crick	Peter Georgiou
610.17428-R02-v3.0	14 August 2018	Samantha Hayes	Steven Crick	Peter Georgiou
610.17428-R02-v2.0	18 July 2018	Suzanne Jolly	Peter Georgiou	Peter Georgiou

SUBMISSION OF ENVIRONMENTAL IMPACT STATEMENT

Prepared under Part 4 of the *Environmental Planning and Assessment Act 1979*

Prepared By:

Name: Suzanne Jolly
Principal Consultant

Qualifications: Graduate Diploma of Environmental Law

Bachelor of Arts (Resource and Environmental Management)

Company: SLR Consulting Australia Pty Ltd

Address: 2 Lincoln Street, Lane Cove NSW 2066

Development Application

Applicant Name: Reach Solar énergy on behalf of Novos Project Co Pty atf the Novos Project Trust (hereinafter referred to as Reach Solar)

Applicant Address: Level 16, 461 Bourke Street, Melbourne, Victoria 3000

Land to be Developed: Local Government Area of Narrandera:

Lot	DP
Parts of 4, 6, 7, 9, 10, 12, 13, 15, 104, 105, 114, 115, 168, 169 and 170.	DP750889
All and whole of Lots 8, 11, 14, 100, 101, 102, 103, 106, 107, 108, 109, 110, 111, 112 and 113.	DP750889

Proposed Development: Yarrabee Solar Project
2354 Back Morundah Road, Morundah NSW 2700
(SSD 18-9237)

Description: Electricity Generation - Solar (refer **Section 5**)

Declaration

We hereby certify that we have prepared the contents of this document and to the best of our knowledge:

- It has been prepared in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*;
- It addresses the Secretary's Environmental Assessment Requirements (SSD 18-9237) dated 20 February 2018 provided by the NSW Department of Planning and Environment;
- It contains all available information that is relevant to the environmental assessment of the proposed development to which the document relates; and
- It is true in all material particulars and does not, by its presentation or omission of information, materially mislead.

Name: Suzanne Jolly
SLR Consulting Australia Pty Ltd

Signature:

Date: **17 August 2018**

Abbreviations

ABS	Australian Bureau of Statistics
ACHCR	Aboriginal Cultural Heritage Consultation Requirements
AHIMS	Aboriginal Heritage Information Management System
BAM	Biodiversity Assessment Method
BC Act	*Biodiversity Conservation Act 2016*
CEMP	Construction Environmental Management Plan
Cwth	Commonwealth of Australia
DPE	Department of Planning and Environment
EIS	Environmental Impact Statement
EMF	Electric and Magnetic Fields
ENA	Energy Networks Australia
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999 (Cwth)*
EP&A Act	*Environmental Planning and Assessment Act 1979*
ha	hectares (10,000 m2)
Heritage Act	*Heritage Act 1997*
ISEPP	State Environment Protection Policy (Infrastructure) 2007
km	kilometres
kV	kilovolt
LALC	Local Aboriginal Land Council
LEP	Local Environment Plan
LGA	Local Government Area
m	metres
MNES	Matters of National Environmental Significance under the EPBC Act (Cwth)
MW	megawatts
MWac	Megawatts Alternating Current
MWhr	Megawatt hour
MVA	Mega Volt Amps

Abbreviations

NEG	National Energy Guarantee
NPW Act	*National Parks and Wildlife Act 1974*
NSW	New South Wales
PCT	Plant Community Type
PMST	Protected Matters Search Tool (under EPBC Act)
PV	Photovoltaic
OEH	Office of Environment and Heritage
RAPs	Registered Aboriginal Parties
Reach Solar	Reach Solar energy Management Company Pty Ltd
RET	Renewable Energy Target
RMS	Roads and Maritime Services
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environment Planning Policy
SLR	SLR Consulting Australia Pty Ltd
SSD	State Significant Development
TEC	Threatened Ecological Communities (listed under the EPCB Act)
TNSP	Transmission Network Service Provider

Glossary

Applicant	Entity applying for development consent under the EP&A Act in this case, Novos Project Co Pty Ltd atf the Novos Project Trust (may also be termed proponent).
Alternating Current	Alternating current (AC) is an electric current which periodically reverses direction.
Direct Current	An electric current flowing in one direction only.
Electromagnetic Interference	Electromagnetic interference (EMI) is a disturbance generated by an external source that affects an electrical circuit by electromagnetic induction, electrostatic coupling, or conduction.
Inverters	An apparatus that converts direct current into alternating current.
L_{A90} (15 Minutes)	The A-weighted sound pressure level that is exceeded for 90% of a 15-minute measurement period, when measured in the absence of the construction works under consideration and excluding extraneous noise. This is considered to represent the background noise.
L_{Aeq} (15 Minutes)	The A- weighted equivalent continuous (energy average) sound pressure level of the construction works under consideration over a 15-minute period that excludes other noise sources such as from road, rail, industry and the community.
Power Conversion Unit	Device used to convert power from one form to another e.g. form DC to AC or changing the voltage or frequency.
Photovoltaic Cell	An electronic device consisting of layers of semiconductor materials fabricated to form a junction (adjacent layers of materials with different electronic characteristics) and electrical contacts and being capable of converting incident light directly into electricity (direct current).
Photovoltaic Modules	An integrated assembly of interconnected photovoltaic cells designed to deliver a selected level of working voltage and current at its output terminals, packaged for protection against environmental degradation, and suited for incorporation in photovoltaic power systems.
Project Boundary	The approximately 3000 hectare boundary around the land titles provided in Appendix B within which the Project site is located.
Project Footprint	The 2600 hectares that the Yarrabee Solar Project with occupy with in the project boundary. This includes the eastern and western access roads.
Risk Assessment	Risk assessment is the process of identifying, evaluating and controlling risks associated with hazards for the project, including identifying a clear pathway to one or more receptors, and assessing the potential impacts on the receptors as a result of the hazard.
Sensitive Receiver	A place or object that is sensitive to a particular environmental impact, e.g. school, residence, place of worship, heritage building/structure, archaeological site or public infrastructure such as pipeline. These may be defined by government and industry policies and guidelines.
Scada System	SCADA is an acronym for Supervisory Control and Data Acquisition. SCADA generally refers to an industrial computer system that monitors and controls a process. In the case of the transmission and distribution elements of electrical utilities, SCADA will monitor substations, transformers and other electrical assets.
Substation	a set of equipment reducing the high voltage of electrical power transmission to that suitable for supply to consumers.
Transformer	Transformers are used to increase or decrease the alternating voltages in electric power applications.

EXECUTIVE SUMMARY

Introduction

Reach Solar energy ("Reach Solar") is proposing the development of the 900 Megawatt Alternating Current (MWac) Yarrabee Solar Project (the "Project") to be located approximately 23 kilometre (km) southwest of Narrandera in Western NSW. The Project would connect to the 330 kilovolt (kV) Wagga to Darlington Point Transmission Line. The Project site is located in an area that has been identified as a priority renewable energy zone in the recent Independent Review into the Future Security of the National Electricity Market commissioned by the Federal Government ('The Finkel Review'). The scale and location of the Project means it can generate electricity at a price that is competitive with black coal, provide certain ancillary services which assist the grid, and provide a material contribution to meeting Australia's commitments to the Paris Accord.

This Environmental Impact Statement (EIS) has been prepared to support an application by Reach Solar seeking development consent under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Project. The structure and content of the EIS address the Secretary's Environmental Assessment Requirements (SEARs) provided by NSW Department of Planning and Environment (DPE) on 20 April 2018.

Project Overview

The Project comprises the construction of a 900 MWac PV solar plant to be developed in stages. The number of stages to be constructed is dependent on factors including:

- the contractual obligations for the purchase of electricity by one or more third parties;
- the capacity of the high voltage transmission network to which the Project will be connected for the export of generated electricity; and
- the future schedule for upgrading the high voltage transmission network.

The land required for the Project is the subject of constraints identified by site investigation completed prior to the submission of this EIS, including native vegetation, and areas of cultural or heritage significance. A concept plan has been developed following assessment of identified constraints and their impact on the projects layout.

The Project is expected to include the following elements:

- PV modules using solar panels and single axis tracking system;
- inverter stations and low-voltage and medium voltage reticulation systems;
- ancillary services equipment to assist the grid operations;
- synchronous condensers may be installed if required by the Transmission Network Service Provider (TNSP);
- a permanent office and maintenance building;
- internal access roads within the Project Boundary to enable site maintenance;
- access to the Project site from Yamma Road, Back Morundah Road, Main Canal Road and Old Morundah Road;
- a 330 kV substation to be constructed within close proximity to the existing 330 kV Wagga to Darlington Point transmission line, including the installation of an underground fibre optic cable for communication purposes;

EXECUTIVE SUMMARY

- a grid connection from the new substation to the existing 330 kV Wagga to Darlington Point transmission line;
- potential energy storage located adjacent to the substation that is likely to have a storage capacity of approximately 35MW / 70MWhr.
- designated buffer zones to areas of confirmed native vegetation and Washpen Creek riparian vegetation;
- designated buffer zones to areas of confirmed cultural and heritage significance;
- security perimeter fencing; and
- temporary construction laydown areas and ancillary facilities.

The Project is expected to operate for between 30 to 50 years providing near and long term local employment opportunities. As noted above, the Project will likely be undertaken in stages with differing MW capacities.

The Proponent would decommission the plant and rehabilitate the site at the end of its operational life if the lease is not renewed. This would remove all above ground infrastructure and return the site to its existing land use.

Key Environmental Issues

The assessment of environmental issues associated with the Project has been multi-disciplinary and involved consultation with key local and state government agencies and a pre-project risk assessment. Risks were identified for both the construction and operational phase of the Project and assessed in relation to their possible consequence and likelihood of occurrence. As facilitated by the risk assessment, where a potential environmental impact/risk was considered unacceptable, or where a knowledge gap was identified, a specialist study was commissioned and appropriate management responses nominated.

Four risk areas of higher potential impact were identified and given particular focus during the EIS phase. These four areas are:

- Potential impacts on biodiversity such as native grasslands as well as local habitat for threatened and endangered species;
- Potential impacts on Aboriginal cultural heritage;
- Potential impacts on hydrology and water resources; and
- Land use compatibility.

The Project is not anticipated to pose any significant or long-term adverse impact to the local environment or surrounding community. **Table 1** provides a summary of the key findings of the EIS, however additional information is contained within the body of this EIS and the appended specialist reports.

The potential impacts of the Project are expected to be a relatively low to moderate risk due to the nature of the project design and proposed construction and operational activities. The Project site has a long history of disturbance from current and historic agricultural activities. Reach Solar has adopted a constraints-based approach to the site, ensuring that areas identified as having high environmental and/or social value will be protected for the duration of the Project's life.

EXECUTIVE SUMMARY

Table 1 Overview of Environmental Assessment Issues

Environmental Aspect	Key Assessment Findings
Aboriginal Heritage	• Significant disturbance of the land within the Project site has previously occurred as a result of historical clearing and long-term agricultural production. • The Aboriginal consultation for this project has been undertaken by OzArk as part of the Aboriginal and Cultural heritage impact assessment. This consultation has followed the Aboriginal Cultural Heritage Consultation Requirements (ACHCRs) as part of this assessment. • A field survey of the Project site was undertaken 22-29 March 2018 by archaeologists from OzArk and representatives of Leeton and District Local Land Council and Bundyi Aboriginal Cultural knowledge. • Twenty-five Aboriginal sites were recorded during the survey: nine isolated finds, thirteen artefact scatters, one earthen mound, and two scarred trees. In addition, a further 22 sites were registered by Registered Aboriginal Parties (RAPs) during the survey which were not determined to be archaeological in nature. • Of the 25 Aboriginal sites identified, six are located on an existing access track and likely to be disturbed by the Project (three totally impacted and three partially impacted). All remaining sites, including the additional RAP-registered sites are outside the impact footprint but will require management measures to ensure that they are not inadvertently impacted.
Agricultural Land Use & Soil	• Soil types within the Project site are dominated by Dermosols and Vertosols, characterised by sodic subsoils. • The entire Project site has been mapped as having Class 4 land and soil capability (LSC), indicating moderate agricultural capability. • The Project site may continue to be utilised for grazing throughout the life of the Project. • The Project would not result in changes to soil type characteristics or drainage. • Upon completion and final rehabilitation of the Project there will be no impediments for continued agricultural production or a reduction in LSC.
Biodiversity	• Vegetation clearing has previously occurred throughout the Project site for agriculture. The vegetation that remains within the Project site consists of patches of remnant native woodland. The lack of large trees in some woodland areas indicates that the Project site may have been selectively logged at some point in the past thirty to fifty years. Construction of the Project would not require the removal of native vegetation or threatened species habitat within the Project site. • The Project site contains three shallow, constructed farm dams, all of which lack any emergent vegetation. No natural wetlands or other water courses occur. • Due to agricultural development, the native vegetation within the Project site has low internal and external connectivity. Patches of vegetation mapped within the Project site range in size from 3 ha to 35 ha. Gaps between vegetation patches range from 100 m to 5 km. The nearest patch of native vegetation lies approximately 750 m to the south of the site boundary.

EXECUTIVE SUMMARY

Environmental Aspect	Key Assessment Findings
	• All of the threatened fauna species recorded within the Project site, including threatened species for which habitat was identified, are highly mobile species that are likely to utilise the habitat as part of a much larger network of habitats. No woodland habitat or other habitats critical to the survival of threatened fauna species will be removed by the proposal. • There are no TECs or habitat for threatened candidate species that will be removed within the Project site. No habitat for threat-listed biota will be removed as a result of construction of the Project.
Hazards and Risk	• In relation to quantities and transportation of dangerous goods, the screening threshold levels specified under relevant Dangerous Goods handling specifications, including for the potential energy storage Li-ion batteries, will not be exceeded. • The Project does not meet the criteria for a potentially hazardous or offensive industry and hence a Preliminary Hazards Analysis (PHA) is not required. • The main hazard identified for the Project is the potential for bush fire which can be managed through the mitigation recommendations recommended in this EIS.
Hydrology & Flooding	• The Project site falls away from Washpen Creek and has been set-back via a dedicated buffer zone from ground areas which fall towards Washpen Creek. The Project would maintain a riparian zone of 40 m to the top of bank of Washpen Creek, and would not alter the distribution of flows, or involve any works that would directly impact on mainstream hydrology or flood behaviours along Washpen Creek • Due to the flatness of the Project site, there is a low potential for erosion which should be readily managed using standard erosion and sediment control practices. It is intended to retain the existing farm dam as a sediment basin, and to monitor site water quality. • The Project would not have any impact on groundwater resources since surface infiltration would be unchanged. Furthermore, no excavation would be undertaken that is likely to disturb any aquifers within the site.
Socio-economic	• There is the potential for positive and negative social and economic impacts as a result of the Project, including upon local land use, long term employment opportunities and ancillary support services. The Project area is located within the Narrandera Local Government Area (LGA). Negative impacts such as on existing agricultural production would be short-to-medium term with no impact following decommissioning of the site (also noting that the entire Project area comprises approximately 23% of Yarrabee Park). • The Project would have a temporary impact on the township of Narrandera and its surrounds during construction. • Each construction phase would have a peak work force of up to 450 workers on site. Work force numbers would be phased over the 12 month construction period, representing an average over the construction period of between 150 and 200 workers. • The operation workforce would likely consist of 10-15 full-time staff attending the site on a daily basis. The staff would have a range of skills to address any near-term defects, whilst long-term defects will be scheduled with the use of skilled technicians on a contract basis.

EXECUTIVE SUMMARY

Environmental Aspect	Key Assessment Findings
	• The Project would diversify the use of land in the area. The predominant land use in the area is agriculture. This Project would provide the landowner with an additional source of income that would be directed to enhancing the productivity and quality of the remaining farm. • The Project would also generate income for the broader business community in Narrandera Shire and surrounding areas.
Landscape & Visual Amenity	• The visual environment for the site and surrounding area is largely characterised by open, flat, rural land (mainly agricultural), that is broken up by stands of vegetation along creeks, roads and property boundaries. Although the vast majority of the land has been cleared of vegetation, the remaining stands break up the landscape and compartmentalise views that, in most cases are quite long and generally featureless (apart from the presence of vegetation). • The rural character is also enhanced by the presence of scattered agricultural buildings in the landscapes, but because of the large distances and the relative scale of these structures, these appear very sparse in the landscape. The landscape character of the site and its local context is typical of the local farming country and rural setting and plays an important role in the local sense of identity. • The site itself is quite contained and separated from any local public receptors (roads) due to the physical distance from them and the screening nature of the existing vegetation around it. There are no localised high points where the site can be seen as these are a reasonable distance from the site and encumbered by intervening stands of vegetation. • Typically, visual impacts diminish with distance and the site (and future works) is impacted by this in that there are a limited number of public receptors where the site can be viewed from a distance of less than 5 km away. At this distance the subject site is typically indiscernible from adjoining parcels of land with similar characteristics. • A visual impact assessment prepared for the EIS determined that the Project would have a negligible effect on the existing landscape character and values as well as its local context. • Local visual amenity would be maintained in surrounding areas as the Project would have minimal impact on views and vistas in the area.
Noise & Vibration	• An assessment has been undertaken using plant and equipment representative of the likely construction methodologies against the guidelines of the NSW Interim Construction Noise Guideline. The assessment identifies that no adverse impacts are expected due to the separation of the site to the surrounding receivers. • An assessment has been undertaken of the operational noise associated with the Project. The assessment has shown that – without any mitigation – cumulative noise emissions from the development are expected to comply with the relevant NPfI noise emission criteria.
Traffic & Transport	• Vehicular access to the Project site would occur via two existing access roads. A worst-case scenario whereby all project traffic has been assumed to utilise either of the two available access routes was used to assess traffic impacts.

EXECUTIVE SUMMARY

Environmental Aspect	Key Assessment Findings
	• The Project is anticipated to generate an average of 56 vehicle movements per day during the construction period (i.e. 28 vehicles travelling to the project site and 28 vehicles travelling from the Project site per day). Of the 28 vehicles associated with the project, 7 are anticipated to be light vehicles, 15 are anticipated to be Toyota Coaster (or similar) buses and the remaining 6 are anticipated to be freight vehicles such as B-doubles and 19 m articulated. Furthermore Reach has advised that the project will generate up to a peak of 145 vehicle movements per day. The peak generation is anticipated to occur during Phase Three of each constructed stage. Following completion of construction, it is anticipated that the Project will generate predominately light vehicle movements and limited heavy vehicle movements. • Several intersection upgrades and turn lanes would be constructed prior on the road access route(s) prior to significant construction activity commencing. The specific upgrade works to be implemented would be dependent on the access strategy ultimately adopted for the Project. • Reach Solar would ensure any pavement damage that might occur to the Council-controlled road networks is repaired during or following construction. • A Road-use Management Plan would be prepared to support safe and efficient movement of Project vehicles.
Waste Management	• During its construction phase, the Project is expected to generate significant quantities of timber, cardboard and plastic film, with smaller amounts of building material waste, such as concrete and steel, and organic waste, food waste associated with construction crews. • Emphasis has been placed on re-use and recycling of the bulk of this material and those that generate it being responsible for its disposal. • The Riverina is well served in terms of waste contractors and waste facilities and these will adequately handle all waste generated during the construction phase and which will be disposed off-site. • During its operational phase, the Project is expected to generate only a few types of waste and only in very small quantities. Emphasis again is placed on re-use and recycling of this material. • Riverina waste contractors and waste facilities will easily handle all waste generated on site during the operational phase which must be disposed off-site.

Justification and Conclusion

The location for the Project was selected after an extensive review of land availability and access; land ownership and existing land use; topography; geological formation; transmission grid access and capacity; and solar irradiation. Other factors that were considered include economic, social and environmental aspects. The assessment of each of these factors across numerous sites resulted in the selection of the Yarrabee Park site as the preferred site for the Project.

EXECUTIVE SUMMARY

The large size of the Project is to ensure economies of scale can be achieved for equipment procurement, construction efficiencies, and to offset the cost of potential new grid connection infrastructure to accommodate large volumes of power. The key benefits that would be created by this Project include a substantial contribution to national climate change objectives, improved electricity reliability and security, particularly for the local and surrounding areas of Narrandera, as well as a number of other local and regional social and economic benefits.

The assessment of Reach Solar's proposal to develop a solar project up to 900 MWac capacity over stages within the Project site, as detailed in this EIS, has been multi-disciplinary and involved consultation with various government agencies and key project stakeholders. The proposed 2600 ha footprint required for the Project is subject to constraints identified by site investigation, i.e. native vegetation, and areas of cultural or heritage significance. Emphasis has been placed on anticipation and prevention of potential impacts, with best practice operation and mitigation measures identified to ensure environmental due diligence and minimal potential for adverse impact. On this basis the Project would not result in significant or long-term adverse impacts to the local environment and surrounding community. The development would will be constructed and operated in accordance with a site-specific Operational Environmental Management Plan, which would ensure that the commitments made in this EIS, along with relevant statutory obligations and conditions of development consent are fully implemented and complied with.

Furthermore, the Project would generate a number of significant benefits including expenditure of almost $1Bn capital investment, making it a catalyst for significant and sustained economic activity within the Riverina region, including positive employment and flow-on benefits.

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

DOCUMENT REFERENCES

TABLES

CONTENTS

FIGURES

CONTENTS

PHOTOGRAPHS

APPENDICES

Reach SOLAR ENERGY

SECTION 1

INTRODUCTION

1 INTRODUCTION

Reach Solar energy ("Reach Solar") is proposing the development of a 900 MegaWatt alternating current (MWac) solar photovoltaic (PV) renewable energy product, potentially including energy storage, known as the Yarrabee Solar Project (the "Project") to be located approximately 23 km southwest of Narrandera in the Riverina Region of NSW.

Reach Solar estimate the development will occupy 2,600 ha within a 3,000 ha Project site with a generation capacity of 900 MWac. The Project site is in the Narrandera Local Government Area (LGA) in Western NSW (refer **Figure 1-1**) and would be located on the Yarrabee Park property approximately 23 km from the Narrandera Council Office.

The Project site is illustrated in **Figure 1-2**. The final layout for the Project's infrastructure elements will be developed based on detailed site investigations, assessments and planning, and finalised during the detail design phase.

1.1 Project Overview

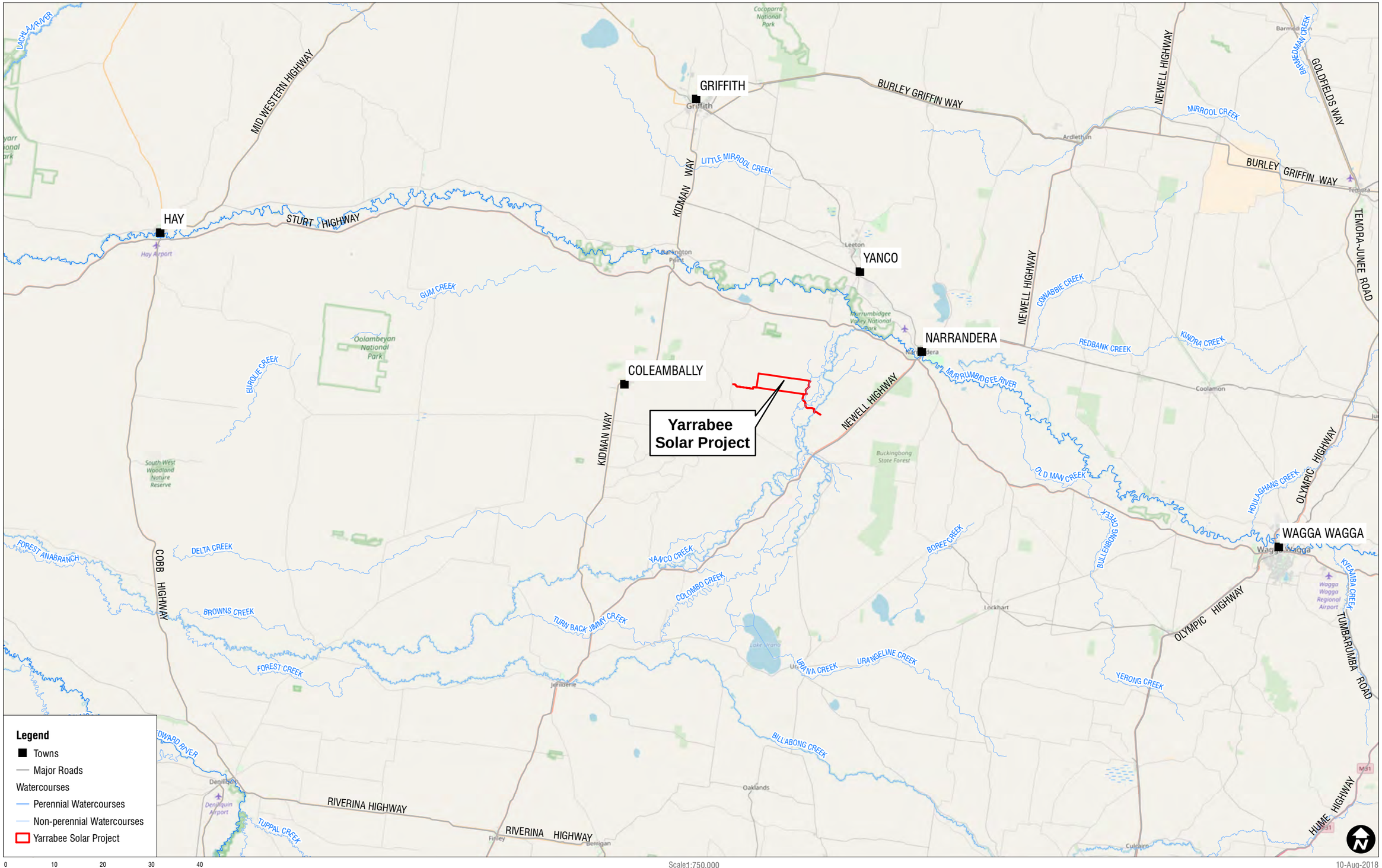
This EIS has been prepared to support an application by Reach Solar seeking development consent under Division 4.7 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to develop the Project.

The Project comprises the construction of a 900 MWac photovoltaic (PV) solar plant to be developed in stages. The number of stages to be constructed is dependent on factors including:

- the contractual obligations for the purchase of electricity by one or more third parties; and
- the capacity of the high voltage transmission network to which the Project will be connected for the export of generated electricity.

This Project is seeking approval over a 2600 ha area within a 3,000 ha site, as illustrated in **Figure 1-2**.

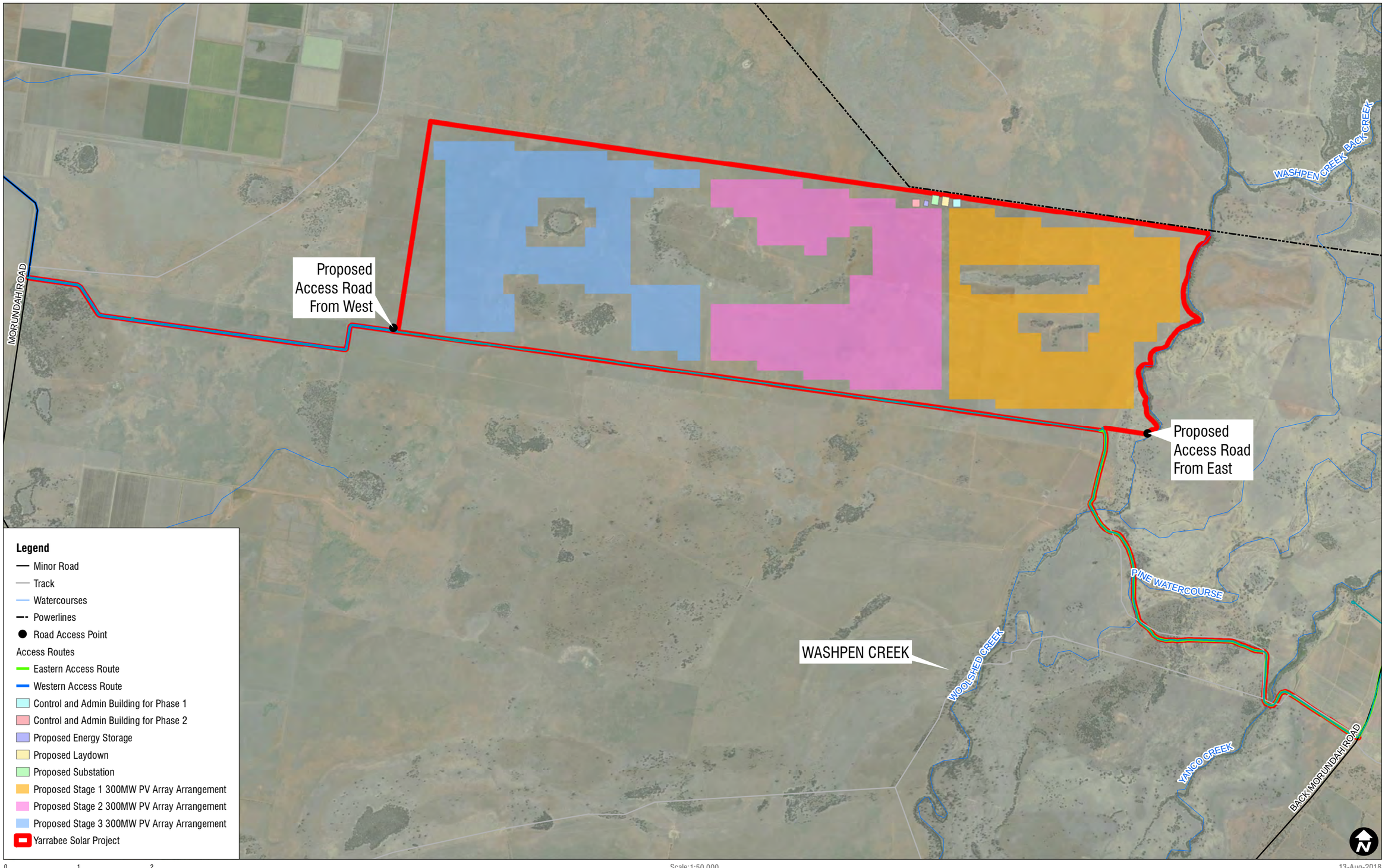
The land required for the Project is the subject of constraints identified by site investigations completed prior to the submission of this EIS, including native vegetation and areas of cultural or heritage significance. A concept plan has been developed for the Project following assessment of identified constraints and their impact on the projects layout.



SLR

Regional Locality

FIGURE 1.1



H:\Projects-SLR\620-BNE\610-SYD\610.17428\01 GIS\ArcGIS\SLR610.17428_EIS_Project_boundary_01.mxd

Scale:1:50,000
GDA 1994 MGA Zone 55

13-Aug-2018

SLR

Property Boundary and Indicative Layout

FIGURE 1.2

The Project is expected to include the following elements:

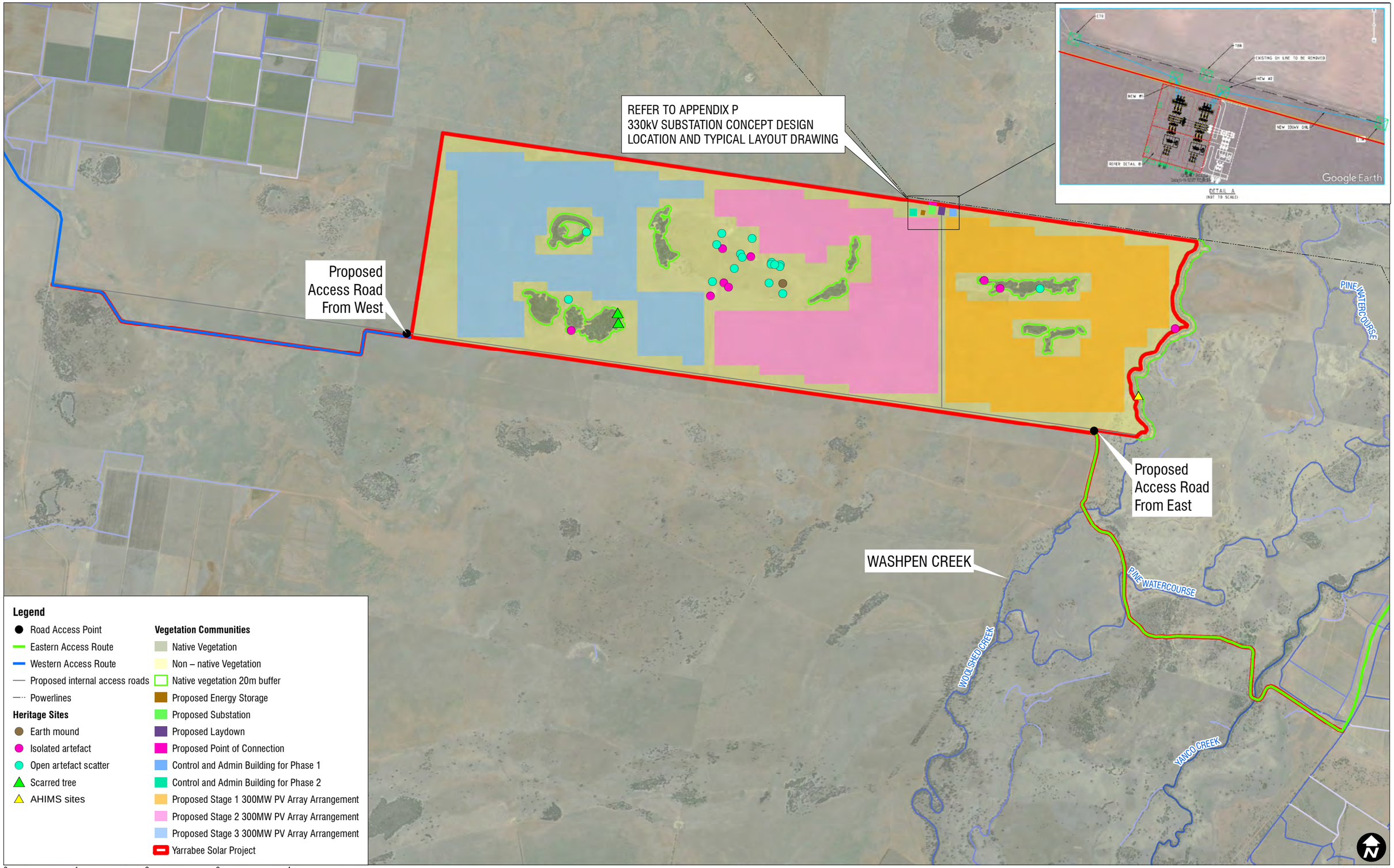
- PV modules using solar panels and single axis tracking system;
- inverter stations and low-voltage and medium voltage reticulation systems;
- ancillary services equipment to assist the grid operations;
- synchronous condensers may be installed if required by the System Network Provider;
- a permanent office and maintenance building;
- internal access roads to enable site maintenance;
- access to the Project site from Yamma Road, Back Morundah Road, Main Canal Road and Old Morundah Road;
- a 330 kV substation to be constructed within close proximity to the existing 330 kV Wagga to Darlington Point transmission line, including the installation of an underground fibre optic cable for communication purposes;
- potential energy storage located adjacent to the substation that is likely to have a storage capacity of approximately 35MW / 70MWhr.
- designated buffer zones to areas of confirmed native vegetation and Washpen Creek riparian vegetation;
- designated buffer zones to areas of confirmed cultural and heritage significance;
- security perimeter fencing; and
- temporary construction laydown areas and ancillary facilities.

An indicative layout for the 900 MWac Project is shown in **Figure 1-3**.

The Project is expected to operate for between 30 to 50 years providing near and long term local employment opportunities. The Proponent would decommission the plan and rehabilitate the site at the end of its operational life if the lease is not renewed. This would remove all above ground infrastructure and return the site to its existing land use.

1.2 Project Objectives

Reach Solar has proven expertise in the development of large scale solar PV and developed the 300MWac Bungala solar PV power station north of Port Augusta, SA which, at the time of writing, is the largest PV solar plant under construction in Australia. The Reach Solar website (www.reachsolarenergy.com.au) provides further information about this project. The Bungala solar project was arguably the first large-scale solar PV project structured to be commercial with no grant funding.



H:\Projects-SLR\620-BNE\610-SYD\610.17428\01 GIS\ArcGIS\SLR61017428_EIS_Proposed_Array_001.mxd

Scale: 1:50,000
GDA 1994 MGA Zone 55

13-Aug-2018

SLR

Indicative Layout

FIGURE 1.3

The Australian electricity market is in a state of change which would be driven by:

- Federal, State and Local government policy;
- Federal Government objectives, including the evolving National Energy Guarantee (the 'NEG') which is intended to draw climate and energy together;
- State Government renewable incentives;
- NSW Government objectives including its "*Transmission Strategy and Use of Energy Zones*"[1], the stimulation of renewable generation to counter the decline of coal-fired generation, increase competition, and explore the growth of distributed generation;
- The Paris Accord;
- The ongoing retirement of ageing coal fired generation plant; and
- A continuing and substantial decrease in the Lowest Cost of Energy (the 'LCOE') for solar PV.

Reach Solar has proven experience to develop and finance (in a staged manner) the 900 MWac Yarrabee solar PV project which in turn will assist the NSW Government meet the objectives set out in the Minister's speech dated 6 June 2018.

The Yarrabee Solar Project is in an "Energy Zone" as defined by the NSW Government's "Transmission Strategy and Use of Energy Zones"[2].

Reach Solar consider large-scale solar PV can provide electricity to customers at a rate that is competitive with coal and gas-fired generation (i.e. less than $60/MWh on a non-firm basis).

Reach Solar is currently short-listed with two tier 1 retailers for offtake agreements ranging from 200 MWac to 300 MWac for a term of 15 years.

1.3 Project History

The location for the Project was selected after an extensive review of land availability and access; land ownership and existing land use; topography; geological formation; transmission grid access and capacity; and solar irradiation. Other factors that were considered included: economic, social and environmental aspects. The assessment of each of these factors across numerous sites resulted in the selection of the Yarrabee Park site as the preferred site for the Project.

The size of the Project ensures economies of scale can be achieved for equipment procurement, construction efficiencies, and to offset the cost of potential new grid connection infrastructure to accommodate large volumes of power.

Reach Solar continues to work with equipment suppliers and industry specialists to review available technologies and plant configuration to provide an optimal plant design and configuration. This is likely to further minimise the overall Project "footprint" and drive the lowest cost renewable power generation.

[1] Presentation by Minister for Resources and Minister for Energy and Utilities dated 6 June 2018.
[2] Transmission Strategy and Use of Energy Zone Strategy, NSW Government June 2018, https://www.energy.nsw.gov.au/legislation-and-policy/energy-zones

In establishing the overall preliminary Project design to establish an optimal Project layout, existing site constraints including native flora and fauna, topographical, geological, hydrological, cultural heritage and other factors have been taken into consideration. Once confirmed, the detailed design phase would further refine the layout once all site investigations are concluded.

1.4 Secretary's Environmental Assessment Requirements

A Project Scoping Report and request for Secretary's Environmental Assessment Requirements (SEARs) relating to the content of the EIS required to accompany the development application for the Project was submitted to the NSW Department of Planning and Environment (DPE) in March 2018. The SEARs were subsequently issued by DPE on 20 April 2018 and are provided in **Appendix A**. **Table 2** presents the general requirements and key issues to be addressed in the EIS in accordance with the SEARs and identifies where each requirement is addressed in this EIS.

Table 2 Secretary's Environmental Assessment Requirements

NSW Department of Planning and Environment (SSD 18-9237) General Requirements	EIS Section
The Environmental Impact Statement (EIS) for the development must comply with the requirements in Schedule 2 of the Environmental Planning and Assessment Regulation 2000.	Cover Pages, Executive Summary and main body of this EIS
In particular, the EIS must include:	
• A standalone Executive Summary	Executive Summary

• A full description of the development including:
  • Details of construction, operation and decommissioning
  • A site plan a site plan showing all infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process);
  • a detailed constraints map identifying the key environmental and other land use constraints that have informed the final design of the development;
	Section 3

• a strategic justification of the development focusing on site selection and the suitability of the proposed site with respect to potential land use conflicts with existing and future surrounding land uses (including other proposed or approved solar projects, rural residential development and subdivision potential);	Executive Summary & Sections 2 & 4

• an assessment of the likely impacts of the development on the environment, focusing on the specific issues identified below, including:
  • a description of the existing environment likely to be affected by the development;
  • an assessment of the likely impacts of all stages of the development, (which is commensurate with the level of impact), including any cumulative impacts of the site and existing or proposed developments (including the Euroley Poultry Production Complex and the proposed Sandigo and Avonlie solar projects), taking into consideration any relevant legislation, environmental planning instruments, guidelines, policies, plans and industry codes of practice;
  • a description of the measures that would be implemented to avoid, mitigate and/or offset the impacts of the development (including draft management plans for specific issues as identified below); and
	Section 7

NSW Department of Planning and Environment (SSD 18-9237) General Requirements	EIS Section

• a description of the measures that would be implemented to monitor and report on the environmental performance of the development;
• a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; and
• the reasons why the development should be approved having regard to:
  • principles of ecologically sustainable development have been incorporated in the design, construction and ongoing operations of the development;
  • the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses; and
  • feasible alternatives to the development (and its key components),including the consequences of not carrying out the development.
• a detailed consideration of the capability of the project to contribute to the security and reliability of the National Electricity Market, having regard to local system conditions and the Department's guidance on the matter.
	Section 8
	Section 9
	Section 4.2

The EIS must also be accompanied by a report from a suitably qualified person providing: • a detailed calculation of the capital investment value (CIV) (as defined in clause 3 of the Regulation) of the proposal, including details of all assumptions and components from which the CIV calculation is derived; and • certification that the information provided is accurate at the date or preparation.	Section 1.9, Appendix F
The development application must be accompanied by the consent in writing of the owner/s of the land (as required in clause 49(1)(b) of the Regulation).	Appendix I
Specific Issues	
The EIS must address the following specific issues:	
• **Biodiversity** – including an assessment of the biodiversity values and the likely biodiversity impacts of the development in accordance with the Biodiversity Conservation Act 2016 (NSW), a detailed description of the proposed regime for minimising, managing and reporting on the biodiversity impacts of the development over time, and a strategy to offset any residual impacts of the development in accordance with the Biodiversity Conservation Act 2016 (NSW).	Section 7.1.1 & Appendix E
• **Heritage** – including an assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development, including adequate consultation with the local Aboriginal community;	Sections 7.1.2, 7.3.4 & Appendix C

• **Land** – including:
  • an assessment of the impact of the development on agricultural land (including possible cumulative impacts on agricultural enterprises and landholders) and flood prone land, an assessment of any impacts to Crown lands, a soil survey to consider the potential for erosion to occur, and paying particular attention to the compatibility of the development with the existing land uses on the site and adjacent land (e.g. operating mines, extractive industries, mineral or petroleum resources, exploration activities, aerial spraying, dust generation, and biosecurity risk) during operation and after decommissioning, with reference to the zoning provisions applying to the land, including subdivision; and
  • measures to remediate the land following decommissioning in accordance with State Environmental Planning Policy No 55 - Remediation of Land.
	Section 7.1.3, Appendix D

NSW Department of Planning and Environment (SSD 18-9237) General Requirements	EIS Section
• **Visual** – including an assessment of the likely visual impacts of the development (including any glare, reflectivity and night lighting) on surrounding residences, scenic or significant vistas, air traffic and road corridors in the public domain, including a draft landscaping plan for on-site perimeter planting, with evidence it has been developed in consultation with affected landowners;	Section 7.3.6, Appendix J
• **Noise** – including an assessment of the construction noise impacts of the development in accordance with the Interim Construction Noise Guideline (ICNG) and operational noise impacts in accordance with the NSW Noise Policy for Industry 2017 and a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria;	Section 7.3.5, Appendix K
• **Transport** – including an assessment of the site access routes (including Newell Highway, Sturt Highway, Morundah Road, Back Morundah Road and Yamma Road), site access points, any potential rail safety issues and likely transport impacts (including peak and average traffic generation, over dimensional vehicles and construction worker transportation) of the development on the capacity and condition of roads (including on any Crown land), a description of the measures that would be implemented to mitigate any impacts during construction (including cumulative impacts from nearby developments), and a description of any proposed road upgrades developed in consultation with the relevant road and rail authorities (if required);	Section 7.3.9, Appendix M

• **Water** – including:
  • an assessment of the likely impacts of the development (including flooding) on surface water and groundwater resources (including Washpen Creek, Yanco Creek, drainage channels, wetlands, riparian land, floodplains, key fish habitat, groundwater dependent ecosystems and acid sulfate soils), related infrastructure, adjacent licensed water users and basic landholder rights, and measures proposed to monitor, reduce and mitigate these impacts;
  • details of water requirements and supply arrangements for construction and operation; and
  • a description of the erosion and sediment control measures that would be implemented to mitigate any impacts in accordance with Managing Urban Stormwater: Soils & Construction (Landcom 2004);
	Section 7.1.4, Appendix H

• **Hazards and Risks** - including:
  • a preliminary risk screening in accordance with State Environmental Planning Policy No. 33 – Hazardous and Offensive Development and Applying SEPP 33 (DoP, 2011), and if the preliminary risk screening indicates the development is "potentially hazardous", a Preliminary Hazard Analysis (PHA) must be prepared in accordance with Hazard Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis (DoP, 2011) and Multi-Level Risk Assessment (DoP, 2011); and
  • an assessment of all potential hazards and risks including but not limited to bushfires, spontaneous ignition, electromagnetic fields or the proposed grid connection infrastructure (including the proposed transmission line and substation) against the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields.
	Sections 7.3.1, 7.3.2, 7.3.3, & Appendix G

• Socio-Economic – including an assessment of the likely impacts on the local community and a consideration of the construction workforce accommodation.	Section 7.3.8

NSW Department of Planning and Environment (SSD 18-9237) General Requirements	EIS Section
Consultation - During the preparation of the EIS, you must consult with the relevant local, State or Commonwealth Government authorities, infrastructure and service providers, community groups, affected landowners, exploration licence holders, quarry operators and mineral title holders. In particular, you must undertake detailed consultation with affected landowners surrounding the development and Narrandera Shire Council. The EIS must describe the consultation process and the issues raised, and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided.	Section 6

1.5 Purpose of this Report

This Environmental Impact Statement (EIS) identifies and assesses the potential environmental impacts associated with the construction, operation and decommissioning of the Project.

SLR Consulting Australia Pty Ltd (SLR) has prepared this EIS on behalf of the proponent, Reach Solar.

The objective of this EIS is to fulfil the EIS requirements for the Project provided in the SEARs issues by DPE and the general requirements outlined in Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) and Section 4.15 of the EP&A Act.

1.6 The Proponent

The project applicant, Reach Solar, is an Australian based developer of large-scale solar PV. Reach Solar has developed and financed Australia's largest solar PV in South Australia.

Reach Solar is focused on developing utility-scale, grid connected solar photo-voltaic projects which deliver a competitive and predictable electricity tariff, and renewable certificates, for its customers.

Table 3 Yarrabee Solar Project – Proponent's details

Full Name	Reach Solar Energy	
Postal Address	Level 16 461 Bourke Street MELBOURNE VIC 3000	
ABN	40 608 853 989	
Nominated Contact	Andy Biffen	
Contact Details	Email:	andy@reachsolarenergy.com.au
Project Contacts	Web page: Email:	www.yarrabeesolarpark.com.au info@yarrabeesolarpark.com.au
Land Owner	Morundah Land Trust	

1.7 The Project Site

The Project is located approximately 23 km southwest of Narrandera, Western NSW, and is sized to accommodate 900 MWac within a 2,600 ha footprint, including 100 ha for temporary construction laydown areas (non-permanent).

The Project is located in the Narrandera Local Government Area (LGA) on land owned by the Morundah Land Trust. The Project site occupies all or part of the parcels of land titles identified in **Appendix B**. The Project site is zoned "RU1 - Primary Production" under the provisions of the Narrandera Shire Council Local Environment Plan 2013 (Narrandera LEP).

The site is bounded to the north, south and west by flat, grassy landscapes that are rural in nature. The site is bounded on the eastern side by Washpen Creek. There are a number of small dams on-site as well as some sparse stands of existing vegetation.

The existing use of the Project site is traditional agricultural production and comprises fields that have been consistently cropped and grazed for many years as can be seen in **Photo 1**. The Project site is predominately surrounded by land used for agricultural purposes, which is the dominant land use in the region. The site is described in further detail in **Section 2**.

Photo 1 Cropped Land within the Project site Area

1.8 Capital Investment Value

The total cost for a Project of this nature is directly linked to the MegaWatt (MW) of installed capacity. As previously outlined, the Project will most likely be developed in stages, each possibly of different capacities.

The Project's Capital Investment Value (CIV) has been confirmed by Jacobs (independent quantity surveyor) as $956,910,000. Jacobs' independent quantity surveyor's report is provided in **Appendix F**.

Reach SOLAR ENERGY

SECTION 2

SITE DESCRIPTION

2 SITE DESCRIPTION

2.1 Overview

The Project site is situated within the Riverina Region of Western NSW. Reach Solar is proposing the development, construction, commissioning, operation and eventual decommissioning of the Project at Yarrabee Park property located approximately 23 km southwest of Narrandera in Western NSW. The Project would be comprised of PV modules mounted on single-axis tracking mounted on steel piles.

2.2 Land Ownership

The Project is located in the Narrandera LGA in Western NSW on land owned by the Morundah Land Trust as shown in **Figure 2-1**.

- The Project site occupies all or part of the parcels of land titles identified **Appendix B**.

Landowner consent has been obtained for the lodgement of the Development Application (DA) and supporting EIS documentation.

- The letter of consent from Morundah Land Trust is provided in **Appendix M**.

2.3 Existing Site Use

Yarrabee Park is made up of 11,326 ha of agricultural land predominately operated as a broadacre cropping enterprise, for mainly cereal cropping. There is some irrigated land within Yarrabee Park. The Project would not utilise any irrigated land.

The property in which the Project site is situated has been used for agricultural cropping for at least the past 7 to 10 years. Prior to this, the overall use of the property was for pastoral cattle and sheep grazing. The current use of Project site is for cultivating wheat and barley. The site has been ploughed significantly.

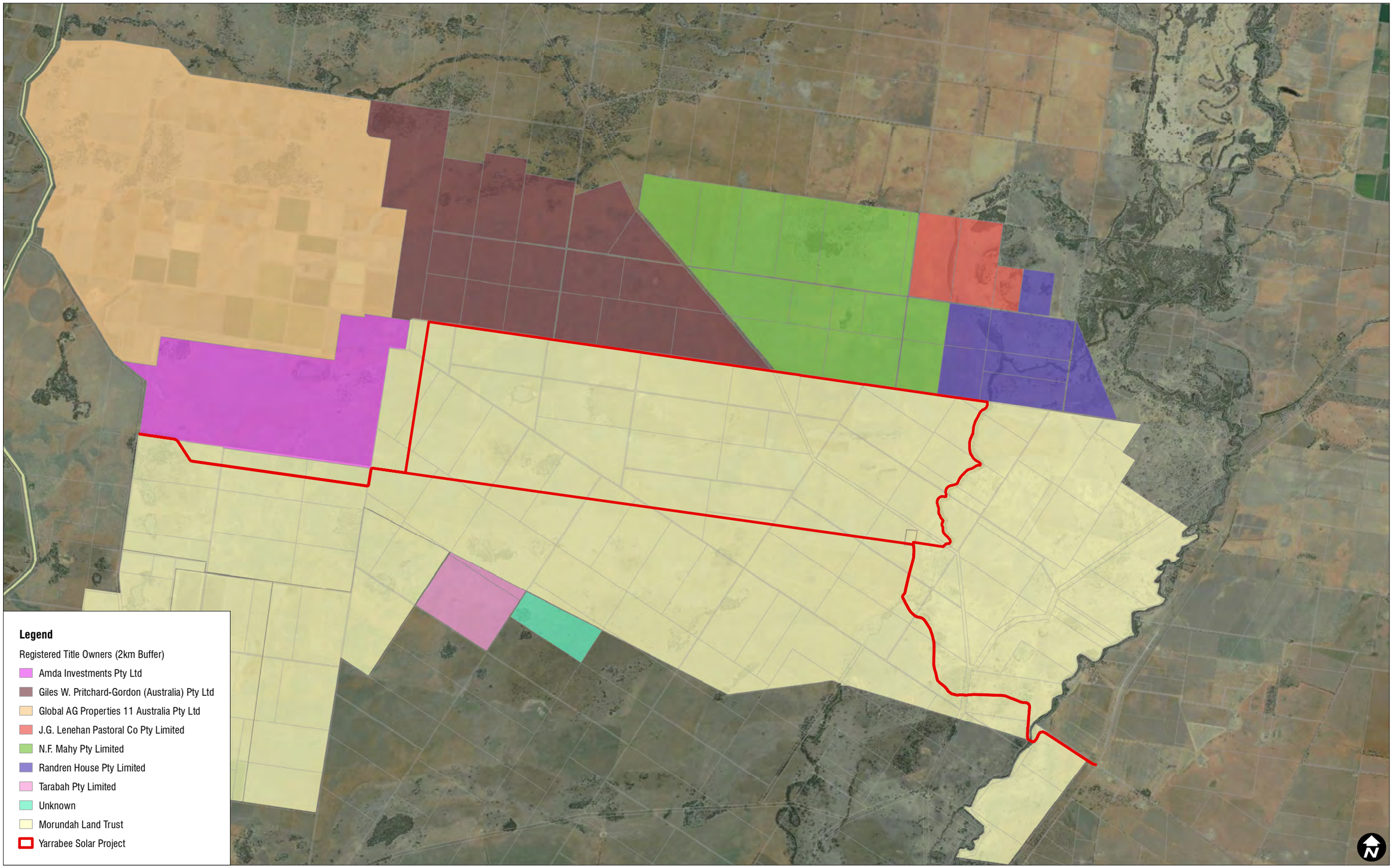
2.4 Existing Approvals

The Yarrabee Solar Project footprint is not subject to any existing Development Applications (DA).

2.5 Surrounding Land Use

The Narrandera LGA covers an area of 4,116 km² that is predominately irrigated agricultural land. Other land uses within the Narrandera LGA include poultry production, forestry and renewable energy such as small scale solar farms.

The Project site is located approximately 23 km southwest of Narrandera. The Project will occupy a maximum of 2,600 ha footprint within the 3,000 ha project boundary as shown in **Figure 1-3**. The site is bounded on 3 sides (north, south and west) by flat, grassy landscapes that are rural in nature. The site boundary is offset on the eastern side relative to Washpen Creek, which meanders through the rural landscape. There are a number of small dams on-site as well as several sparse stands of existing vegetation



H:\Projects-SLR\620-BNE\610-SYD\610.17428\01 GIS\ArcGIS\SLR610.17428_EIS_Ownership_01.mxd

Scale:1:70,000
GDA 1994 MGA Zone 55

10-Aug-2018

SLR

Land Ownership

FIGURE 2.1

All land within and immediately surrounding the project boundary is zoned RU1 – Primary production, whilst further to the east of the project is zoned RU4 – Primary Production Small Lots (Narrandera LEP 2013).

2.6 Soil, Topography and Hydrology

2.6.1 Topography and Hydrology

The Project site is located immediately west of Washpen Creek, and the topography falls generally westwards away from the western bank of Washpen Creek at very flat grades. Elevations across the project site vary from approximately 133-134 m AHD along the top of the banks of Washpen Creek, to 131 -132 m AHD on the western boundary, indicating a fall of approximately 3 m over a distance of 9 km.

A shallow flat depression that meanders through the centre of the site drains surface water to an existing farm dam located within 2.64 km of the western boundary. From the farm dam the topography falls general towards the southwest, although the drainage pathways are very flat and not incised into the landform. Parts of the site adjacent to the southern boundary drain overland towards the south. The surface water drainage paths through the Project site are not marked on topographic maps as watercourses (SLR, 2018).

Downstream from the Project site the drainage depression continues towards the southwest in shallow braided channels at very flat grades, crosses Morundah Road, and eventually drains into a series of small rural dams upstream of the Coleambally Main Canal approximately 7 km southwest of the Project site. Coleambally Main Canal joins Yanco Creek south of Morundah.

2.6.2 Mainstream Flooding in Watercourses

The Murrumbidgee River flows westwards across the riverine plains of the southwest slopes of New South Wales, past Narrandera, and on to its confluence with the Murray River near Balranald.

The Yanco Creek system is a channel and floodplain system that commences from the Murrumbidgee River at the Yanco Weir located about 20 km west of Narrandera. This complex distributary system of paleochannels (Page at al. 2009), consists of a series of creeks including Yanco, Colombo, Billabong and Forest Creeks on the southern side of the Murrumbidgee. Yanco Creek flows for approximately 258 km in length in a southwesterly direction, discharging into the Edward River (part of the Murray River basin) at Moulamein.

Flows into Yanco Creek are regulated by the Yanco Weir. Flows are regulated for irrigation and to provide base flows to achieve environmental objectives. During major flood events along the Murrumbidgee, the flow regulating structures at the Yanco Weir cause backwater causing large flood flows to overtop the offtake channel upstream of the weir sending flows southwards into the Yanco Creek floodplain. The Yanco Weir structure has very limited control for flows exceeding 10,000 ML/d (Jacobs 2017).

Washpen Creek is a minor right bank anabranch located on the upper reaches of Yanco Creek. Back Creek joins Yanco Creek approximately 7.4 km south of the offtake from the Murrumbidgee River. Back Creek then splits into Washpen Creek and Pine Watercourse a further 7.5 km downstream. The divergence occurs approximately 2.9 km north of the project site, and then re-joins Yanco Creek further south-west via Woolshed Creek. Washpen Creek and Yanco Creek lie within the same broad floodplain. Adjacent to the Project site, this floodplain width extends approximately 5.3km from Washpen Creek east across to Yanco Creek.

Along Washpen Creek there are a series of wetlands covering around 90 ha, which are connected to Washpen Creek only during large, natural flood events (Webster 2007). These wetlands provide substantial flood storage.

The extent of the floodplains for the Murrumbidgee River and Yanco Creek System, and complexity of the creek systems can be seen in **Appendix H**, which shows the extent of flooding after the 1974 flood. This may not be a reflection of the flood behaviour today as regulation of flows on the Murrumbidgee has changed since 1974, and the plan was derived from satellite imagery days after the flood peak so there is no indication whether the flooding broke the banks of Back Creek or Washpen Creek and passed over the site or not.

The Project site is located immediately west of Washpen Creek.

The arrangement of the old Yanco Weir which is a fixed concrete weir spanning the southern branch and the new regulated twin gates which act as a sluice during low flows and weir during large flows. The offtake upstream requires a backwater level of 138.55 m AHD to enable Murrumbidgee River water to flow into the Yanco system.

2.6.3 Soils

The dominant soil types within the Project site were ground-truthed by SLR at the scale of approximately 1:170,000 and determined using the *Australian Soil Classification (ASC) System* (Isbell, 2002). This assessment was informed by a soil survey which consisted of 18 detailed soil profiles.

Two major soil orders are present within the Project site: a Vertosol, which is consistent with OEH eSpade mapping of the area, a Dermosol and a Vertosol-Dermosol Complex.

The Vertosol comprises the suborders Epipedal Red and Epipedal Grey, while the Dermosol comprises suborders Eutrophic Brown and Eutrophic Red.

Following SLR's field survey, it is believed that cultivation has altered some of the vertic properties of the Red Vertosols in the A1 horizon and as such the Red Dermosols have been combined with the Red Vertosols as a Red Vertosol-Dermosol Soil Complex for mapping purposes. Potential impacts from the Project and management of these two soil types within the Red Dermosol-Vertosol complex are similar. Areas for each mapped Soil Unit are show in **Table 4**.

Table 4 Dominant Soil Types and Inherent Fertility

Australian Soil Classification	Soil Unit	Inherent Fertility	Hectares	%
Brown Dermosol	1	Moderately High	1,261	42
Grey Vertosol	2	Moderately High	825	28
Red Vertosol-Dermosol Complex	3	Moderately High	914	30
		Total	**3,000**	**100**

The soil survey and assessment report is provided in **Appendix D**.

2.6.4 Acid Sulfate Soils

The risk of encountering acid sulfate soils is very low: there are no known occurrences of acid sulfate soils within the site boundary and the Project will not involve any significant excavation other than shallow trenching for electrical cables. The NSW Government SEED database does not indicate the presence of any known risk of acid sulfate soils on or in the vicinity of the Project site[3].

2.7 Biodiversity

The majority of the Project site has been cleared for agricultural cropping and, sheep and cattle grazing. Native woodland remnants comprise three Plant Community Types:

- River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion);
- Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina and Murray Darling Depression Bioregions); and
- White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone.

These woodland communities have been heavily grazed by herbivores, including resident populations of Western Red Kangaroos and Eastern Grey Kangaroos. Native plant diversity is relatively low in most areas and is comprised of native and exotic grasses and herbs. **Section 7.2.1** and **Appendix E** of this EIS provide further details on the biodiversity of the Project site.

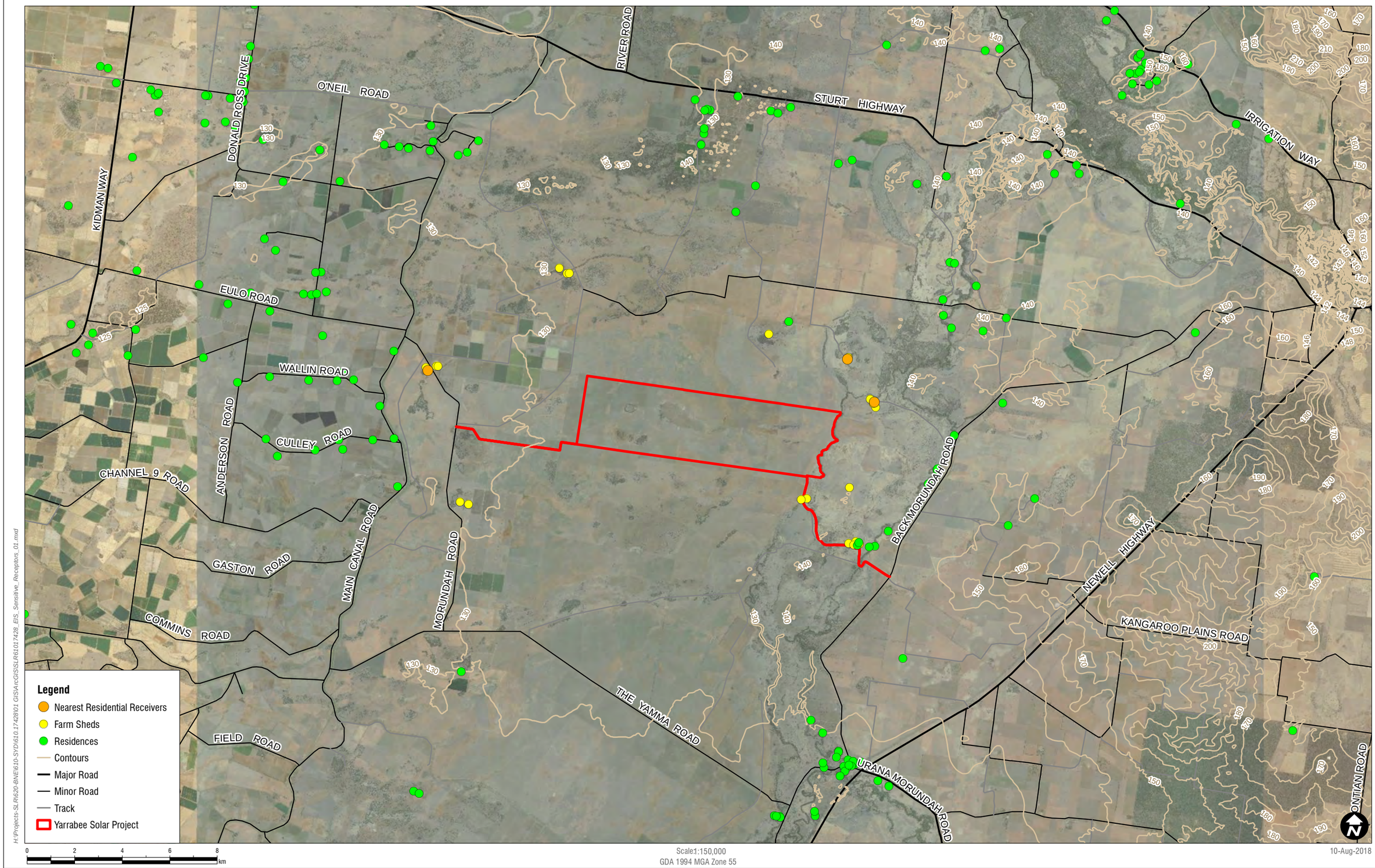
2.8 Socio-economic

The closest residences to the Project site are located 1.5 km from the nearest Project boundary and comprise widely-separated rural properties – refer **Figure 2-2**. There are no other sensitive receivers in the surrounding area. The nearest social infrastructure to the Project site, such as schools, medical centres and shops, are located in Narrandera about 23 km to the northeast.

Internal access tracks will be utilised throughout to facilitate vehicle movements between the external road network access points, site offices, inverter compounds and construction areas. The internal access tracks are shown in **Figure 2-3** along with the existing roads that would be used to access the wider regional road network.

The key roads located within proximity to the site include the Sturt Highway, Newell Highway, Reas Lane, Back Morundah Road, Browley Street, Main Canal Road, Old Morundah Road, Morundah Road and Yamma Road. The key roads are illustrated on **Figure 2-4**.

[3] Refer https://datasets.seed.nsw.gov.au/dataset/acid-sulfate-soils-risk0196c



SLR

Surrounding Residential Receivers

FIGURE 2.2

Figure 2-3 Proposed Access Routes

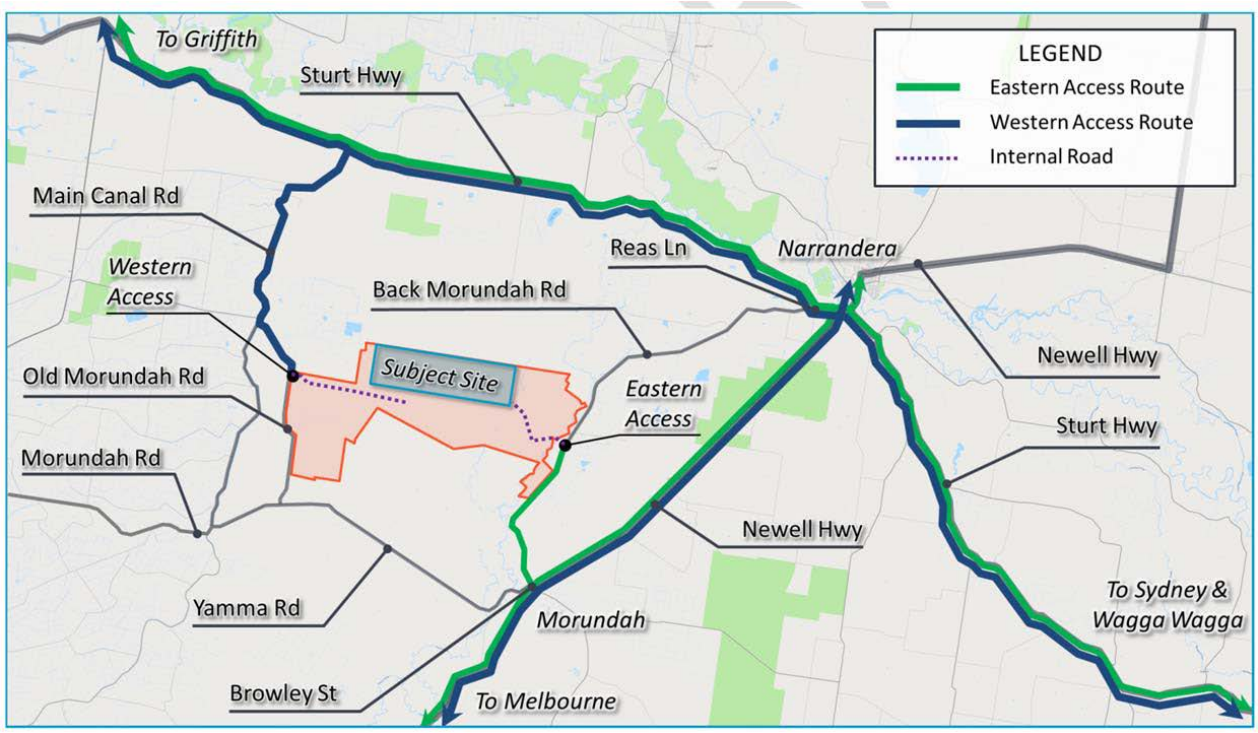
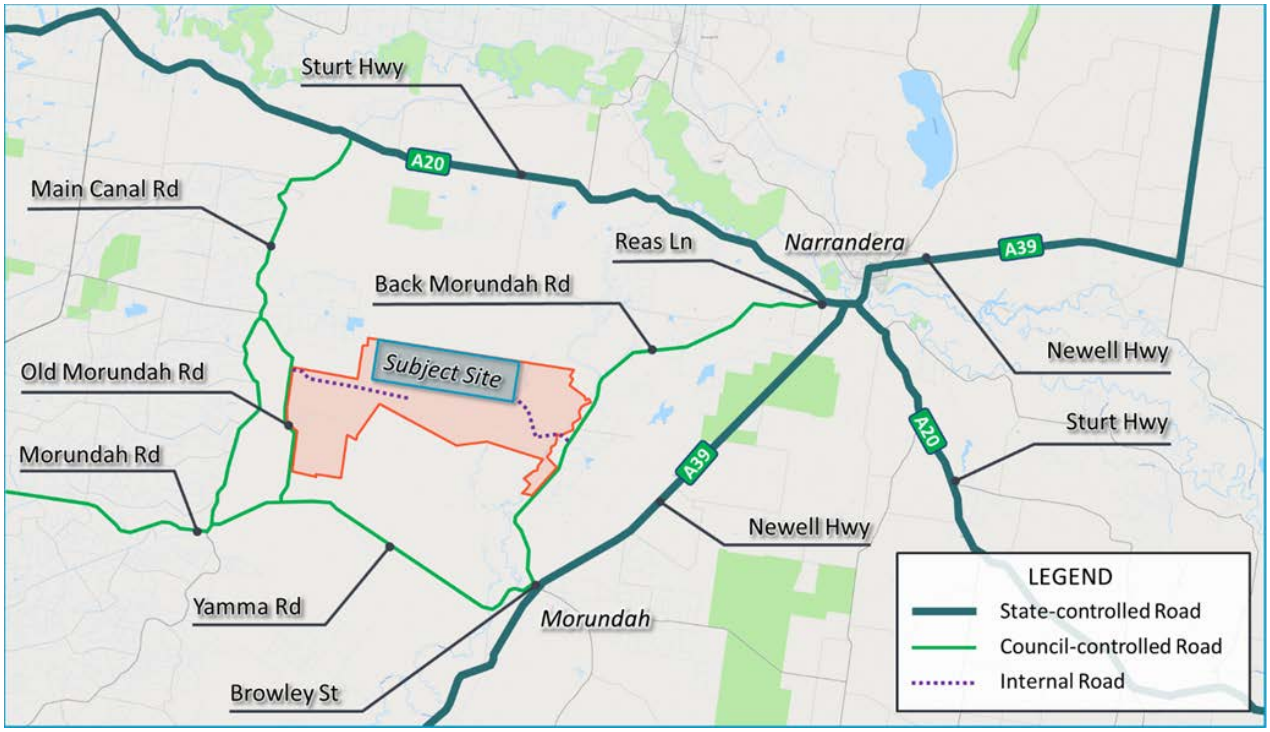


Figure 2-4 Surrounding Road Network



2.9 Climate

The Riverina Region of Western NSW, where the Project site is situated, is generally dominated by a dry semi-arid climate and characterised by hot summers and cool winters. Rainfall levels in the Riverina are generally low, with the highest levels typically occurring in May and September. Summer rainfall tends to occur mainly from localised thunderstorms, with more consistent rainfall occurring in the winter months.

Long-term average data for temperature, rainfall and relative humidity has been sourced from an automated weather station (AWS 074148, Lat 34.71°S Long 146.51°E, RL 145m) operated by the Bureau of Meteorology (BoM) at Narrandera Airport. The station is located approximately 22 km to the northeast of the Project site and has been operational since 1967.

Long-term average evaporation data has been sourced from a BoM weather station at the Griffith CSIRO (AWS 075028, Lat 34.32°S Long 146.07°E, RL 126m). While this station ceased operation in 1989, it appears to be the only BoM weather station within the area with evaporation data recorded and available. While the daily evaporation rates may have changed slightly since 1989, the data provided between 1962 and 1989 provides a reasonable indication of typical rates.

Data from the closest BoM weather station at Narrandera Airport indicates the following:

- The annual average maximum temperature is 23.8°C.
- The annual average minimum temperature is 9.9°C.
- January is the hottest month, with a mean maximum temperature of 33.4°C;
- July is the coldest month with a mean maximum temperature of 3.2°C.
- The mean annual rainfall is 437 mm, with the highest occurrence of rainfall in October (40 mm) and the lowest in March (31 mm).

2.10 Climate Change

The Intergovernmental Panel on Climate Change (IPCC) *Fifth Assessment Report* (2013) concluded that:

- Greenhouse gas (GHG) emissions have markedly increased in recent times as a result of human activities. This increase has influenced a warming of the atmosphere and the ocean (especially since the 1950s), changes in the global water cycle reduction in overall snow and ice, a global rise in mean sea level, and changes in some climate extremes.
  - Each of the three most recent decades has been successively warmer at the Earth's surface than any preceding decade since 1850. In the Northern Hemisphere, 1983-2012 was likely the warmest 30-year period of the last 1400 years (medium confidence).
  - It is now very likely that human influence has contributed to observed global scale changes in the frequency and intensity of daily temperature extremes since the mid-20th century, and likely that human influence has more than doubled the probability of occurrence of heat waves in some locations.
  - Over the last two decades, the Greenland and Antarctic ice sheets have been losing mass, glaciers have continued to shrink almost worldwide, and Arctic sea ice and Northern Hemisphere spring snow cover have continued to decrease in extent (high confidence)
  - The rate of sea level rise since the mid-19th century has been larger than the mean rate during the previous two millennia (high confidence).

- Continued warming and changes in all components of the global climate system are projected.
- It is likely that anthropogenic influence has affected the global water cycle since 1960, including:
  - observed increases in atmospheric moisture content in the atmosphere (medium confidence)
  - global-scale changes in precipitation patterns over land (medium confidence)
  - intensification of heavy precipitation over land regions (medium confidence), and
  - changes in surface and sub-surface ocean salinity (very likely).

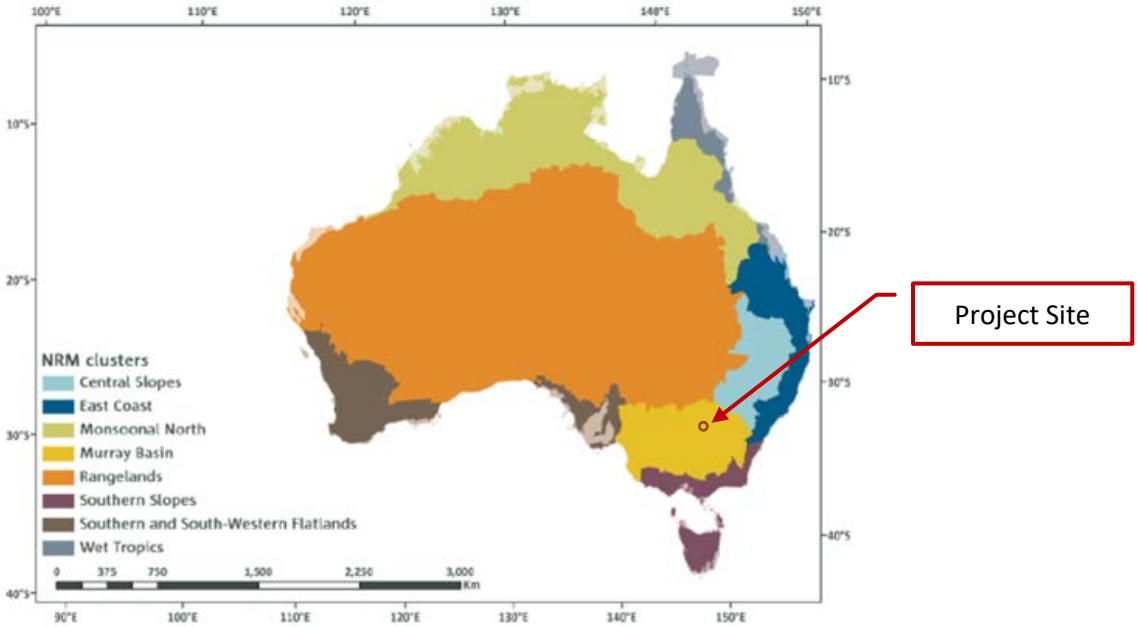
2.10.1 Climate Change Impacts in Australia – CSIRO-BOM NRMs

Australia has already experienced increasing temperatures, shifting rainfall patterns, surrounding ocean acidification and a rise in sea level associated with the impacts of a warming global climate. In recognition of the impact of climate change on the management of Australia's natural resources, the Australian Government developed the Regional Natural Resource Management (NRM) Planning for Climate Change Fund, to provide projections of the likely impact of climate change on Australia's natural resources. The Fund (which operates within the Commonwealth Department of Environment) has also been reviewing adaptation opportunities for protecting and managing our land, soil, water, plants and animals.

Australia has 54 NRM regions, defined by catchments and bioregions. Many aspects of the activities of both human activity and ecosystems within these regions are vulnerable to impacts of climate change.

- For the purposes of climate change impacts, NRM regions have been grouped into so-called **"clusters"**, which essentially correspond to the broad-scale climate and biophysical regions of Australia – refer **Figure 2.5**. Each cluster is broadly consistent in terms of its own history, population, resource base, geography and climate, and therefore has a unique set of priorities for responding to climate change
- The Project site is located in the Murray Basin NRM Cluster.

Figure 2-5 Australia's Natural Resources Management (NRM) Clusters



2.10.2 CMIP5 Modelling for Climate Change Predictions

Australia's CSIRO and Bureau of Meteorology (BOM) have prepared tailored climate change projections for each of Australia's eight NRM clusters to be considered in planning and adaptation option assessments. The future trajectory of anthropogenic greenhouse gas and aerosol emissions is highly uncertain, encompassing substantial unknowns in population and economic growth, technological developments and transfer, and in particular, political and social changes. Accordingly, the climate modelling community has developed "Representative Concentration Pathways" (RCPs) to explore credible future options, expressed in terms of future carbon emissions and associated radiative forcing.

- Each RCP prescribes internally self-consistent 'representative' concentrations of greenhouse gases and aerosols, as well as land use changes. RCPs were developed by a group of experts in areas spanning atmospheric modelling, chemistry and the carbon cycle and social scientists working in economics, policy and impacts [Moss et al. 2010].
- Four standard RCPs have since been commonly adopted in most global climate studies (and used in the Australian context). They represent the distillation of a much larger number of potential futures discussed in the literature [van Vuuren et al. 2011, Meinshausen et al. 2011].
- These RCPs were used in the *Fifth Climate Model Intercomparison Project* (CMIP5) and IPCC (2013). They span the range of plausible global warming scenarios and provide a range of options for planning purposes.

The RCP scenarios are shown in **Table 5**.

Table 5 RCP Scenarios Generally Used for Planning Purposes in the Australian Context

RCP Name	Description
RCP 8.5	This scenario represents a future with little curbing of emissions, with CO_2 concentrations continuing to rapidly rise, reaching 940 ppm by 2100 (we are currently just over 400 ppm).
RCP 6.0	This scenario represents lower emissions, achieved by application of some mitigation strategies and technologies. CO_2 concentrations rise less rapidly than RCP 8.5, but still reach 660 ppm by 2100 with total radiative forcing stabilising shortly after 2100.
RCP 4.5	In this scenario, concentrations are slightly above those of RCP 6.0 until after mid-century, but emissions peak earlier (around 2040). CO_2 concentrations reach 540 ppm by 2100.
RCP 2.6	This scenario represents the most ambitious mitigation scenario, with emissions peaking very soon (around 2020), then rapidly declining. Such a pathway would require early and aggressive carbon emission controls from all emitters, including developing countries, combined with advanced technologies for actively removing carbon dioxide from the atmosphere.

While no particular RCP scenario is deemed more likely than the others, it is generally acknowledged that the lowest radiative forcing scenario, RCP 2.6, would require major and rapid change in carbon emissions patterns on a global scale.

2.10.3 Murray Basin Cluster – Selected Climate Change Predictions

Table 6 shows the RCP scenario projections for some key climate variables for the Murray Basin NRM cluster. The projections for the year 2090 have been selected to indicate the longer-term trend suggested by the various RCP modelling scenarios.

- In terms of temperature, both the annual mean and annual maximum values are projected to increase: by just under +2˚C for the RCP 4.5 scenario mean temperature to just under +4˚C for the RCP 8.5 scenario mean temperature.
- In terms of rainfall, average rainfall is projected to experience a modest decline, ranging from -5% for the RCP 4.5 scenario to -6% for the RCP 8.5 scenario, albeit with significant variability in terms of the potential upper and lower bands.
- Peak rainfall events however are projected to increase, significantly in the case of the RCP 8.5 scenario. This is in line with expectation: in a warming climate, rainfall extremes are expected to increase in magnitude mainly due to a warmer atmosphere being able to hold more moisture (Sherwood et al., 2010).

Table 6 RCP 4.5 and RCP 8.5 Scenario Predictions for the Murray Basin Cluster (Year 2090)

Variable	Season	RCP 4.5	RCP 8.5
Temperature: MEAN	Annual	+1.8˚C (+1.3˚C to +2.4˚C)	+3.8˚C (+2.7˚C to +4.5˚C)
Temperature: MAXIMUM	Annual	+2.0 ˚C (+1.3 ˚C to +2.6 ˚C)	+4.1˚C (+2.9˚C to +5.0˚C)
Rainfall: Annual MEAN	Annual	-6% (-16% to +4%)	-5% (-27% to +9%)
Rainfall: 1-day MAXIMUM	Annual	+5% (-2% to +15%)	+18% (-4% to +29%)
Rainfall: 1-day MAXIMUM (20-year return period)	Annual	+8% (-6% to +25%)	+26% (+5% to +41%)

Note Values in Table 6 give median model projection and, in brackets, the 10-percentile and 90-percentile confidence limits.

Expanded detail on other climate variables (including frost days, drought, relative humidity, soil moisture and runoff, fire weather, etc) can be found in Timbal, B. *et al.* 2015, *Murray Basin Cluster Report*, Climate Change in Australia Projections for Australia's Natural Resource Management Regions: Cluster Reports, eds. Ekström, M. *et al.*, CSIRO and Bureau of Meteorology, Australia.

- The Murray Basin Cluster Report projects for example that number of *Severe Fire Danger Days* and the *Forest Fire Danger Index* will both increase in the RCP 4.5 and RCP 8.5 scenarios (by just under 50% and just over 100% respectively in the year 2090 projections).

The temperature and rainfall projections above have been used and discussed further in this EIS for the flood modelling risk calculations detailed in **EIS Appendix H**.

Reach SOLAR ENERGY

SECTION 3

PROJECT DESCRIPTION

3 PROJECT DESCRIPTION

3.1 Overview

The Project comprises the construction of a 900 MWac PV solar plant to be developed in stages. The number of stages to be constructed will be dependent on factors including:

- the contractual obligations entered into by the Project with one or more third parties for the purchase of electricity;
- the available capacity of the high voltage transmission network to which the Project will be connected for the export of generated electricity; and
- the future schedule for upgrading the high voltage transmission network.

This Project would occupy a 2,600 ha area within the 3,000 ha Project site, as illustrated in **Figure 1-2**. The Project is designed to minimise environmental impacts. Where possible, the Project design has been amended to avoid native vegetation, and areas of cultural or heritage significance, which have been identified during detailed on-site investigations undertaken for this EIS.

The Project includes the following elements:

- PV modules using solar panels and single axis tracking system;
- inverter stations and low-voltage and medium voltage reticulation systems;
- ancillary services equipment to assist the grid operations;
- synchronous condensers may be installed if required by the TransGrid;
- a permanent office and maintenance building;
- internal access roads to enable site maintenance;
- access to Project site from Yamma Road, Back Morundah Road, Main Canal Road and Old Morundah Road;
- a substation to be constructed within close proximity to the existing 330 kV Wagga to Darlington Point transmission line;
- grid connection from the new substation to the existing 330 kV Wagga to Darlington Point transmission line;
- potential energy storage located adjacent to the substation with a storage capacity of approximately 35 MW / 70 MWhr;
- designated buffer zones to areas of confirmed native vegetation and Washpen Creek riparian vegetation;
- designated buffer zones to areas of confirmed cultural and heritage significance;
- security perimeter fencing; and
- temporary construction laydown areas and ancillary facilities.

An indication of the possible solar array layout for a three-stage Project is illustrated in **Figure 1-3**.

The Project is expected to operate for between 30 and 50 years. Reach Solar would decommission the plant and rehabilitate the site at the end of its operational life if the lease with the land owner is not renewed and the Project is not extended. This would remove all above ground infrastructure and return the site to its existing agricultural land capacity.

3.2 Project Ownership

Reach Solar is the primary developer of the Yarrabee project. Due to the scale and monetary value of the assets, Reach Solar intends to structure the Project for sale and transfer to a long term owner, such as a large utility company or investment fund. Selection of the new owner will include the assessment of their technical and financial capabilities and ownership experience with similar assets.

Reach Solar is working with Price Waterhouse Coppers (PWC) to structure the project and key agreements to ensure that ongoing security of the Project is be maintained by the long term owner.

A key consideration will be the continued ability of the Project to meet the terms and conditions associated with: compliance with planning and environmental constraints, lender arrangements, provision of services under the offtake agreement and operations and maintenance.

It is currently intended that the initial 5 years of operation and maintenance of the project will be performed by the successful Engineering, Procurement and Construction (EPC) Contractor.

3.3 Infrastructure Design and Layout

Reach Solar has considered various design and layout configurations to ensure that the Project configuration represents current best practice for large scale, grid connected solar PV. Key considerations for the Project's design and layout included:

- equipment safety and operability;
- minimising impacts on the local environment;
- compliance with relevant Australian and international standards;
- minimising impacts to the Project from natural events, such as climate change and flooding;
- optimising of reliability and performance;
- ensuring compliance of grid connection infrastructure, particularly invertor systems; and
- maximising power generation and annual supply of energy to the grid through the life of the Project.

The final decisions for equipment supply and technology options will be determined during discussions with the EPC contractor equipment suppliers.

3.4 Key Project Components

The key components of the solar Project are PV modules, single-axis tracking systems, inverter stations, a high voltage sub-station and the potential energy storage system. These are discussed in more detail in the following sections.

3.4.1 Solar Modules and Trackers

The Project will require approximately 3 million PV solar panels to complete all stages. The panels would be similar to the flat solar panels seen on residential properties. The panels convert ultra violet energy from the sun into Direct Current (DC) electricity that is collected by a DC reticulation system. Solar modules come in different sizes and power (watt) ratings. It is expected the Project will use standard polycrystalline silicon modules approximately 1 m wide by 2 m long, with the final selection being made after technical and commercial evaluation during detailed design.

The solar modules would be mounted on approximately 36,000 single-axis tracking systems aligned north-south so that the panels track the sun from east to west through the day to maximise solar their exposure. The single-axis trackers will be mounted on steel piles that will be driven into the ground to approximately 3 m to 5 m depending on the specific location and the foundation conditions encountered.

Two different tracking systems are being considered for the Project, with the final selection to be made during detailed design.

1. **Portrait Orientation System** – This system is shown in **Photo 2** and typically supports 80 to 90 modules held in a portrait orientation and the tracker lengths are typically 95 m long. The trackers are driven by a centrally mounted-actuator which has its own solar panel and battery to generate the power it needs to track the sun throughout the day from 60˚ east of north to 60˚ west of north. Communications are typically wireless, greatly reducing cabling throughout the plant. They are also able to be operated independently enabling the solar yield to be optimised or tuned to match demand. The trackers are typically 5 m apart. The greatest height of the tracker is around 2 m from the ground. Similar systems have been installed on several projects in Australia including the Bungala 1 & 2 projects in Australia.
2. **Landscape Orientation System** – This system is shown in **Photos 3 and 4** and is taller than the portrait system, typically supporting around 80 to 90 modules held 4 modules deep. The trackers systems are typically only 45 m long which enables greater compatibility with variable terrain. The trackers are driven by a centrally mounted-actuator to track the sun throughout the day from 60˚ east of north to 60˚ west of north. Communications are typically wireless, greatly reducing cabling throughout the plant. They also operate independently enabling the solar yield to optimised or tuned to match demand. The trackers are typically 10 m to 12 m apart which enables greater utilisation of the areas between the trackers. The greatest height of the tracker is around 4 m from the ground. These systems have been used extensively in the USA.

Photo 2 Portrait Orientation System

Photo 3 Landscape Orientation System View 1

Photo 4 Landscape Orientation System View 2

3.4.2 Inverter Station

The Project will include approximately 222 inverter stations distributed throughout the solar panel array. Each inverter station would receive the DC electricity generated by the solar modules and collected by the DC reticulation system. This DC electricity would be converted to Alternating Current (AC) electricity via an inverter. Each inverter station would include two 2.5 Mega Volt Amps (MVA) inverters giving a total of 444 inverters.

The AC electricity converted by the inverter would be stepped up via a step-up transformer located at each inverter station to 33 kV. This 33 kV electricity would then feed into the 33 kV reticulation system via a Ring Main Unit (RMU) arrangement located at each inverter station.

The proposed inverter stations are containerised for easy installation mounted on shallow footings. Their height will be approximately 3.5 m. **Photo 5** shows a typical combined transformer and inverter station, similar to what is proposed for this Project.

Photo 5 Typical Combined Transformer and Inverter Station

3.4.3 AC Reticulation System

The AC reticulation system would comprise of 33 kV cabling that ties together the power from each inverter station. The use of 33 kV as the collector voltage is appropriate as this will keep line losses to a minimum and ensure the best possible voltage profile for the facility.

Surge arrestors would be fitted to the 33 kV cable-sealing end to provide protection to the Project from any external over-voltages, caused by lighting other system faults.

The use of extensive cabling on the collector feeders would also make this reticulation network effectively impervious to lightning discharges. There is also provision made in the design for surge protection device on the low voltage side of the kiosk transformers which supplies the inverters.

3.4.4 Transformer and Substation

The transformer and substation would be installed as close as possible to the current existing Wagga to Darlington Point transmission line within the northern Project boundary, as shown in **Figure 1-3**. The substation would be comprised of a 33 kV collector substation, step-up transformer and 330 kV switchyard. The 33 kV collector substation would combine electricity from the 33 kV cables onto a single bus. A 33 kV to 330 kV step-up transformer would receive this electricity via a single 33 kV feeder and transforms it up to the 330 kV transmission voltage. One or two step-up transformers would be implemented and this will be determined during detailed design.

Electricity would then be fed into the TransGrid transmission network via the 330 kV switchyard. A typical 350 MVA transformer is shown in **Photo 6**.

Photo 6 Typical 350MVA Transformer

3.4.5 Energy Storage

Provision has been made for a battery energy storage system to be installed adjacent to the 33 kV collector substation. It would comprise lithium-ion batteries and battery-paired inverters, as either stand-alone cubicles or pre-assembled containerised units. Their height would be approximately 3.5 m. The storage system is estimated to have a capacity of 35MW / 70MWhrs. Its implementation on-site will be confirmed during detailed design and is dependent on both Project-related design, staging requirements and authority requirements.

3.4.5.1 Likely Battery Energy Storage System Configuration

At the present time, the likely contender for the potential battery energy storage system is a Tesla PowerPack 2 based system, comprising either stand-alone battery cubicle modules or a containerised system mounted on concrete plinths – refer **Photo 7**. PowerPack 2 units have an internal cooling and heating system for accurate (internal) temperature control. Their dual coolant and refrigerant loop system was adapted from the Tesla Model S (vehicle) and ensures the unit can operate over a wide range of climatic extremes. The PowerPack 2 enclosure is similarly outdoor-rated for a wide range of climatic extremes, eliminating the need for additional structures, covers, etc.

Photo 7 Example Energy Storage Systems (Single Cubicle & Containerised Assembly)

Source: *TESLA (2018)*

3.4.5.2 Battery Energy Storage System Space Requirements

The area required for either of the above battery energy storage system configurations is likely to be of the order of 1 ha (100 m x 100 m, 50 m x 200 m, etc).

- The battery energy storage system would be located within its own secure enclosure, and in the vicinity of the Project sub-station, maintenance building and main office / control room building, with at least a 20 m separation from each of these for fire safety access, etc.
- The battery energy storage system will be positioned at least 100 m from the nearest site boundary (located to the north) and over 4 km from the nearest residence to the north.

3.4.6 Transmission Network

Reach Solar has commissioned a feasibility study (Study) from TransGrid (June 2018) to report on the scope, design and estimated annual connection fees associated with connecting the Project to the existing 330 kV transmission line, which runs adjacent to the Project site.

The Study details three substation designs which enable the connection of the three phases to the network (these being 300 MWac, 600 MWac and 900 MWac). The Study also reports on the level of network augmentation required to ensure that the various generation capacities from the Project can be accepted into the grid. In summary, little to no augmentation is required to the transmission system augmentation for 300 MWac, and a number of least-cost solutions are being considered by TransGrid above 300 MWac.

Modifications (if any) to the grid system outside of the Project site shall be the responsibility of TransGrid and/or an accredited TNSP including any relevant permits and approvals.

3.4.7 System Monitoring

A Supervisory Control and Data Acquisition (SCADA) system would be installed for the Project to provide real time monitoring and control of electricity generation and the functioning of the systems of the project.

The data provided by the SCADA system would be used to support the operations of the following:

- AEMO, the market operator;
- TransGrid, the network service provider (TSNP); and
- The generator owner/operator.

3.4.8 Internal Roads

The existing east-west access road which runs along the southern perimeter of the Project site is shown in **Photo 8**.

A limited number of internal roads will be constructed across the site to provide access for maintenance, operations and emergency services vehicles, and to minimise the occurrence of dust. Internal access roads will only be constructed where regular access to main equipment is needed, or emergency access may be required. Access to all other areas across the site will be via unsurfaced access tracks.

Internal access roads between the panels and inverter do not require sealing or surfacing. It is proposed that a covering of vegetation will be encouraged to grow between the panel rows. This vegetation will serve as a simple means for dust suppression.

Access to the power transformer, site office and amenities will be via a sealed access road and include appropriate directional signage and lighting as required.

The design and materials of the main access corridor(s) will comply with the Austroads *Guidelines for Sealed Pavements*. Geometric standards will comply with the TNSP transformer supplier transport guidelines which specify maximum grades, minimum curve radii and turning area requirements.

Photo 8 Existing Internal Access Road

3.4.9 Site Office and Staff Amenities

The site office and amenities building will be designed to house the staff required to manage the construction of the project during the construction period. The anticipated Project workforce is discussed further in **Section 3.6**. The total floor area for these combined buildings is anticipated to be approximately 1,500m^2.

3.4.10 Control and Maintenance Buildings

The control and maintenance building will be located adjacent to the 33 kV collector substation. The location of these buildings is shown in **Figure 1-3**. This building would be prefabricated construction approximately 20 m wide, 40 m long and 5.5 m high.

The control and maintenance building will contain:

- SCADA monitor and control work stations;
- Staff amenities including kitchen and bathrooms;
- First aid equipment;
- Water tanks and septic tank system;
- Carpark for 12 vehicles;
- Spare parts ; and
- Maintenance tools and equipment.

3.4.11 Site Access and Parking

The site would be accessed by two existing access routes as illustrated in **Figure 2-3**. These routes consist of existing unsealed roads that are currently used for farming operations. The roads are located on cleared pasture areas and would not be subject to any upgrade or construction works.

Reach has advised that it is proposed that vehicle access to the site will be separated between light vehicles and busses and heavy vehicles. Further site access requirements will form part of the construction Traffic Management Plan (TMP). The TMP will form one of the management plans required to be completed by the preferred EPC contractor. The EPC will be advised prior to their appointment of the intended site access protocol (i.e. splitting light and heavy vehicle traffic).

Reach has advised that preliminary traffic and site access requirements have been discussed with local council authorities and the local community during stakeholder communication meetings. The relevant council authorities will be engaged once more detail is available, to finalise the traffic plan and enter into any arrangements that may be required with respect to the initial condition of the road, proposed upgrades and ongoing maintenance.

Reach's preliminary plan is for heavy vehicles to enter and exit the site via the Western Access Route (via Main Canal Road) and for light vehicles and buses to access the site via the Eastern Access Route (via Back Morundah Road).

Reach expects that not more than 80% of total traffic would utilise either access route. In order to minimise potential rework of the traffic assessment upon finalisation of the material and workforce logistics strategy following award of the construction contract, SLR has however considered two potential demand scenarios whereby all project traffic has been assumed to utilise each of the access routes. This approach is highly conservative but provides road authorities confidence that irrespective of the ultimate proportionate use of the two proposed access routes that the road infrastructure will provide an appropriate level of safety and performance for the expected demands.

A permanent carpark would be built adjacent to the 33 kV collector substation and, Control and Maintenance Building.

Internal access tracks would be used within the site to facilitate vehicle movements between the external road network access points, site offices, inverter compounds and construction areas.

3.5 Site Service and Utilities

3.5.1 Site Power

The control and maintenance building will be supplied with low voltage electricity from the 33 kV collector substation and/or from the auxiliary power bus within the 330 kV substation.

3.5.2 Water and Sewerage Supply

Water supply to the control and maintenance building would be provided by up to two potable water tanks filled with rainwater or delivered by water truck. The Project would not use any other water supplies. A septic tank system would be installed to receive all sewage and building waste water. Storm and rain water run-off would be directed to the appropriate soak-aways.

3.5.3 Communications

The site would be connected to the internet and have telephone facilities provided via TNSP OPGW or dedicated fibre-optic line.

3.6 Construction

3.6.1 Construction Materials

The Project would predominately be constructed using the following materials.

- Solar Array:
  - Steel piles, racking and tracking system.
  - Glass Solar PV panels, which include the following elements; glass, encapsulate, frame, back-sheet and terminal box.
  - Various cabling systems where the conductors would be aluminium and copper based. Insulation of cables would be a modified plastic material which would provide electrical insulation and an element of fire protection.
- Substation:
  - HV transformer; copper based winding in a steel tank and oil filled for insulation and cooling.
  - Circuit breakers and isolators generally constructed of steel.
  - Busbars: aluminium and copper based.
  - Cement and aggregate based foundations and civil structures.
  - Steel fire water tank and fire-fighting equipment for the step-up transformer.
  - A bund would be installed around the substation in accordance with AS1940.
- Buildings:
  - Prefabricated buildings will include; timber, steel cladding, insulation and other finishing material.
- Roads:
  - Aggregate and bitumen.

3.6.2 Site Preparation

Site preparatory activities would include the following:

- Detailed site topographic survey;
- Geotechnical and soil testing;
- Pile driving testing;
- Roads upgrades as required;
- Site fencing and security; and
- Construction management offices and laydown areas.

3.6.3 Infrastructure Installation

The following ancillary infrastructure would be installed:

- A new 330 kV high voltage electrical substation (refer to Section 3.2.5) to be constructed adjacent to the existing 330 kV Wagga to Darlington Point transmission line.
- Potential energy storage located close to the new substation.
- Grid connection from the new substation to the existing 330 kV Wagga to Darlington Point transmission line.
- PV modules using PV solar panels and single axis tracking system.
- Inverter stations and low-voltage and medium voltage reticulation systems. Ancillary services equipment to assist the grid including energy storage and synchronous condenser.
- A permanent Project office and maintenance building.
- Security perimeter fencing.
- Temporary construction laydown areas and ancillary facilities.
- Construction of some internal site roads.

3.6.4 Construction Equipment

During construction the following equipment would typically be utilised:

- Graders of site preparation and levelling;
- Dump trucks (relocation and/or removal of excavation spoil);
- Compaction rollers (soil compaction);
- Piling machines (installation of tracking system piles);
- Excavators (cable trenching);
- Telehandlers (distribution of materials i.e. pilers, tracking system, solar panels, cables, inverter cabinets, etc); and
- Mobile crane (lifting equipment i.e. transformers, inverters, etc).

3.6.5 Construction Process

During construction the following equipment and activities will be implemented. This list is not exhaustive.

- Site preparation.
- Temporary and permanent security fencing.
- Formation of temporary and permanent road access points, and traffic management/calming as outlined in **Appendix M**.
- Piling for solar panel tracking system.
- Installation of single-axis tracking system to installed piles.
- Affixing solar panels to single-axis tracking system.

- Trenching for cable runs, laying of cables and backfilling of cable trenches to a depth of approximately 1 m.
- Foundation preparation for inverter and transformer cabinets.
- Installation of the inverter and transformer cabinets.
- Solar array cable connections, inverter connections, transformer connections.
- Installation of communications system.
- Construction of energy storage for the Project, including associated hardstands, etc.
- Construction of substation for, and connection to existing 330 kV transmission line.
- Construction of permanent operations & maintenance facilities.
- Road Dilapidation Survey.
- Prepare and implement Road-use Management Plan.

3.6.6 Construction Schedule

As described in **Section 3.1**, it is anticipated that the Project will be constructed in stages. The likely staging and construction of the Project is outlined below and in **Figure 1-3**:

- Stage 1 – Construction is anticipated to commence ~ 2019;
- Stage 2- Construction is anticipated to commence ~2020; and
- Stage 3 – construction is anticipated to commence ~2023.

It is expected that construction of a 300 MWac stage would take approximately 18 months. During this period, the activities on site will include:

- Mobilisation of construction site office and facilities;
- Provision of access to site and temporary internal roads for construction;
- Site preparation and grading;
- Equipment installation; and
- Commissioning and testing.

The trigger for commissioning and testing of the first phase would largely depend on the availability of the grid connection and the commercial arrangements with network operators.

Phases beyond about 300 MWac capacity would only commence once TransGrid has confirmed that adequate grid capacity is available. Regardless of grid availability, it is expected that a minimum stagger of between 6 to 9 months would be needed between the first and second stages of construction for the Project.

TransGrid has confirmed in their study that the final phase of construction would require upgrading of the grid system which will require the support of the TNSP.

3.7 Commissioning and Operations

3.7.1 Commissioning Activities

Commissioning initially involves performing checks and testing to ensure each component of the Project is mechanically complete. Subsequently, the generation system is divided into sub-sections and these are tested and energised in order to ensure the Project meets the technical requirements and complies with the specifications.

3.7.2 Operation Activities

Operation of the Project would involve monitoring plant performance, performing routine inspections on plant equipment and preventative maintenance activities, vegetation management and cleaning, testing and re-commissioning equipment. A suitable maintenance management system would be implemented to ensure the plant is maintained satisfactorily and in line with industry practice. Maintenance will be scheduled on a near-term and long-term basis typically with the use of skilled technicians on a contract basis.

3.8 Workforce

3.8.1 Construction

It is estimated that between 150 and 200 construction workers would be required on-site each day during typical construction periods for each phase. During peak activities this would increase to a maximum of 450 workers.

3.8.2 Operation

The operational workforce for the Project is expected to consist of 10-15 full-time staff attending the site on a daily basis. These staff will have a range of skills to address routine issues such as scheduled maintenance whilst more specialised technicians would be required on a contract basis.

3.9 Hours of Operation

3.9.1 Construction

Construction activities at the site would be restricted to standard daytime construction working hours, being:

- 7.00 am to 6.00 pm Monday to Friday
- 8.00 am to 1.00 pm on Saturdays.

No construction activities would occur on Sundays or Public Holidays. Approval would be applied for should any out of hours work be required during the construction period.

3.9.2 Operation

The normal work hours for the site during the Operational Period will be between 7.00am to 6.00pm, Monday to Friday. Whist the majority of staff will travel to and from the site during this period there will also be other visits outside of these hours to facilitate maintenance and other general activities.

3.10 Traffic Generation

3.10.1 Construction

As discussed in **Section 3.7.1**, during peak construction periods up to 450 contractors are expected to travel to site.

A local bus system has been discussed with Narrandera Shire Council as a means of reducing light vehicle traffic to and from the Project site and reduce the potential for traffic accidents. Further discussions are required with Narrandera Council as well as other key stakeholders in relation to a park and ride facility to be provided in the town of Narrandera.

Onsite parking would be limited during construction, with provision for up to 100 vehicles including bus parking bays to minimise on-site vehicular traffic.

3.10.2 Operation

During operations it is expected that between 10 and 15 permanent staff would operate the site with a further 10 staff expected to be required for specialist contract work, e.g. inverter maintenance, panel replacement, panel cleaning, vegetation management, fencing, etc.

Other operational and maintenance activities will be performed by contractors. Whilst maintenance activities will be irregular and seasonal in nature, it is assumed that additional traffic from contractor activities and deliveries to the site would be no more than five heavy goods vehicles per day and five light vehicles per day.

3.11 Fire Management

A search on the NSW Rural Fire Service (RFS) website in May 2018, using the RFS mapping tool, revealed that the Project site is not identified as being within bush fire prone land.

Only a small portion of the constituents of solar PV panels is flammable. These flammable components, which include the thin layers of polymer encapsulation surrounding the PV cells, polymer backsheets (framed panels only), plastic junction boxes found on the rear of a panel, and insulation on wiring, cannot self-support a significant fire. **EIS Appendix G** includes references covering the ignition potential of PV panels and arrays, which indicate that:

- Heat from a small flame will not ignite a PV panel, but heat from a very intense fire or energy from a serious electrical fault has the potential to ignite a PV panel.
- The possibility of a fire resulting from or intensified by solar PV panels is low risk.
- A real-world example occurred during July 2015 in an arid region of California. Three acres of grass under a thin film PV facility burned without igniting the panels mounted just above the grass.

Large-scale solar facilities do not pose the same physical challenges for firefighters when encountering extensive solar PV systems mounted on buildings, which can inhibit the standard methods of fighting fires (e.g. through roof ventilation) and access for the firefighters themselves to the building via roof entry points.

The Project has been designed to minimise fire risk. Specific features of the Project that mitigate fire include:

- The Project's solar panels will be mounted in rows, oriented north-south, which will have a separation distance of either 5 m or 10 m between tracking systems, depending on the tracking system selection.
- Adequate access tracks throughout the entire facility will be maintained for the lifetime of the Project. This will include perimeter set-backs allowing emergency vehicle access both around the site (but within the Project site boundary) and within the site, with low grade inclines (the site is essentially flat) and adequate passing bays and turning area widths.
- In accordance with NSW Rural Fire Service (RFS), *"Planning for Bush Fire Protection"* (2006) and the recent 2017 Draft Update of this policy, a firefighting water supply of 20,000 litres will be maintained on the site.
- The Project will comply with all National and State Fire Safety Codes, as well as NSW Rural Fire Service (RFS) and Fire and Rescue NSW requirements
- This includes the development of a comprehensive Project Emergency Response Plan (ERP) – refer sections which follow covering Bush Fire Risk.

Accordingly, "internal" fire risk, i.e. the potential for facility equipment to ignite and spread a major fire throughout the facility and beyond is considered low. A detailed fire and bush fire impact assessment in provide in **EIS Appendix G**.

3.12 External Lighting

Permanent external lighting will be limited to the main access roads, parking areas, offices and the substation. Other operational areas will not require permanent lighting. Temporary lighting may be required for out-of-hours maintenance work.

3.13 Site Security

During construction a security fence would be installed around the perimeter of construction areas. Security personal would also be tasked with implementing and managing any emergency procedures on the site. Security staff would be 24 hours a day / 7 days a week during the construction period. This might reduce to an automated security system during operational period.

Whilst the security fence would remain during operations, access to the site would be managed through a security and access system controlled and managed by the operational staff.

This would include a camera surveillance system to monitor the perimeter fence and operational areas. Site security and surveillance would be undertaken by security staff on a continuous basis.

Land which does not form part of the construction site or operational site would remain as farmed land and will not be fenced.

3.14 Surface Water Management

The existing drainage characteristics of the site would be maintained for the Project. This would be achieved by minimising ground disturbance, maintaining groundcover beneath and between the solar arrays, and by implementing design measures as necessary to mitigate runoff impacts.

3.15 Environmental Management

The Project would be constructed under a Construction Environmental Management Plan (CEMP) and operated under an Operation Environmental Management Plan (OEMP). The CEMP and OEMP would be prepared to meet the requirements of the Department of Infrastructure, Planning and Natural Resources (DIPNR's) (now DPE) *Guideline for the Preparation of Environmental Management Plans* (2004) and any approval requirements.

The CEMP and OEMP would be live documents that are updated as necessary to any/all operational changes. A decommissioning management plan (DMP) would be prepared three (3) years before the planned decommissioning of the Project. This is discussed further in **Section 3.16**.

3.16 Site Decommissioning

3.16.1 Decommissioning Management Plan (DMP)

Three years prior to the commencement of decommissioning activities, a DMP would be prepared in consultation with the landowner. This DMP would be submitted to the DPE for approval prior to the commencement of decommissioning activities in accordance with any approval requirements. The DMP would include incorporate the following elements:

- Rehabilitation strategies and objectives;
- Rehabilitation design criteria;
- Industry standards and best practices;
- Productivity targets to ensure that final land use after rehabilitation being the resumption of current agricultural practices at the site;
- Expected timeline for rehabilitation works; and
- Mitigation measures and monitoring.

3.16.2 Infrastructure Removal

As part of decommissioning and rehabilitating the site, all elements of the solar facility would be removed. This would include all equipment above the ground, plus all below grow structures such as cabling and piles. The key elements of decommissioning are expected to include but not be limited to:

- Removal of PV modules. Materials would be sorted and packaged for removal from the site and for recycling or reuse wherever possible. Many of the solar array panels are expected to be recyclable.
- Removal of inverter stations and low-voltage and medium voltage reticulation systems. Materials would be sorted and packaged for removal from the site and for recycling or reuse wherever possible.
- Removal of all equipment, with materials recycled or reused wherever possible.
- Removal of all buildings, with materials recycled or reused wherever possible.
- Removal of energy storage located close to the new substation
- Disconnection from the TransGrid connection point at the substation.
- Removal of security perimeter fencing (unless the landowner requests for this to be maintained).

The substation would remain under the ownership and control of the TNSP, therefore is expected to continue operations.

Due to the nature of the Project, the site can easily be returned back to the existing agricultural land use.

3.16.3 Site Rehabilitation

Following the decommissioning and removal of the main equipment, the site would be rehabilitated to return to existing agricultural land use. Rehabilitation activities would include:

- Removal of any concrete or foundation/footings;
- Ripping of any compacted areas to allow for agricultural activities such as cropping;
- Re-establishment of groundcover in areas where cropping or grazing activities are unlikely to occur. Any groundcover species planted in these areas would be compatible with the existing native species identified within the Project site; and
- Establishment of any suitable erosion and sediment control measures.

Due to the minimal use of any chemicals, lubricants of fuels for the Project, soil contamination is considered to be highly unlikely. However, if this were the case, then any contaminated soil would be removed or cleansed on site.

3.16.4 Final Land Use

The rehabilitation strategy for the Project is based on the final land use being the resumption of current agricultural practices at the site.

Reach SOLAR ENERGY

SECTION 4

PROJECT NEED AND ALTERNATIVES

SLR

4 PROJECT NEED AND ALTERNATIVES

4.1 Project Need

Reach Solar has proven expertise in the development of large scale PV solar electricity generation projects and has studied the development of the electricity industry and similar projects over an extended period.

The Australian electricity market is in a state of change driven by:

- Federal, State and Local government policy;
- Federal Government objectives, including the proposed National Energy Guarantee (the 'NEG');
- NSW Government objectives;
- Local Government renewable objectives;
- The Paris Accord;
- The ongoing retirement of ageing coal fired generation plant; and
- A continuing and substantial decrease in the Lowest Cost of Energy (the 'LCOE') for PV Solar.

These factors led Reach Solar to the conclusion that development of renewable energy generation continues to become substantially more commercially viable and competitive with gas, coal-fired and wind powered generation.

Energy generators are seeking the replacement of plant as it is retired from operation and energy retailers aim to reduce customer price volatility through long term energy supply contracts.

These factors all lead to the continuing development of multiple electricity generation sources with, in Reach Solar's opinion, PV solar creating the greatest opportunity to provide the best commercially viable outcome.

4.1.1.1 Electricity Supply and Demand

Electricity prices increased materially in the National Electricity Market (NEM) in recent years, impacted by the closure of base-load power plant (Northern 760 MW in South Australia, Hazelwood 1760 MW in Victoria), and the increase in cyclical global commodity prices for black thermal coal and LNG, i.e. the drivers are a market which is short on electricity and linked with global energy prices.

According to ecogeneration[4], the RET has been effective in encouraging competition between electricity generators and large-scale renewable energy projects are now starting to supply electricity into the NEM which is having the effect of reducing wholesale prices.

[4] Renewable energy employment hits new peak, and the best is yet to come, Ecogeneration. http://www.ecogeneration.com.au/renewable-energy-employment-hits-new-peak-and-the-best-is-yet-to-come/. 21 May 2018.

The Clean Energy Council has reported that with more than 20 large scale solar projects currently under construction nationally and a number of others scheduled to start soon, the solar industry is entering a period of unprecedented growth[5]. The falling cost of solar generation hardware has made it one of the cheapest kinds of energy generation which makes it attractive to developers.

The Clean Energy Australia report 2016 states that "the falling cost of energy storage and solar, along with trials of smart technology such as virtual power plants, are showing strong potential to change the way customers and retailers interact with the grid, reducing costs for consumers and increasing grid flexibility".

Average national residential electricity prices increased by 4.4 per cent from 2015/16 to 2016/17. The CEA 2016 report projected an increase of 2.7 per cent in 2017/18 and 2.3 per cent in 2018/19, which is equivalent to an average annual increase of 2.5 per cent over the two years to 2018/19.

4.1.2 Strategic

4.1.2.1 NSW Renewable Energy Action Plan

The NSW Government's Renewable Energy Action Plan was released in September 2013 and aims to support the former national target of sourcing 20% of the state's energy from renewable sources by 2020 and to secure its own vision for a secure, reliable, affordable and clean energy future for NSW. The strategy is to work closely with NSW communities and the renewable energy industry to increase renewable energy generation in NSW.

The plan will be implemented by working closely with NSW communities and the renewable energy industry to increase renewable energy generation in NSW.

The three key goals outlined in the Government's plan are:

1. To attract renewable energy investment;
2. Build community support; and
3. Attract and grow renewable energy expertise.

Table 7 outlines how the Project aligns with the goals and imperatives outlined in the Plan.

Table 7 NSW State Government Imperatives

NSW Government Renewable Energy Action Plan	Yarrabee Solar Project
The NSW Government is focused on removing barriers to investment in renewable energy, including:	
• *improving network connections*	The project will connect to the existing 330 kV high voltage transmission network to export its generated electricity.
• *streamlining the planning process*	The Project will satisfy all regulatory processes Reach Solar will work with government department to streamline approval processes.

[5] Large-scale solar the hottest ticket in town, Clean Energy Council, 27 February 2018. https://www.cleanenergycouncil.org.au/news/2018/February/large-scale-solar-hottest-ticket.html

• *creating a supportive regulatory environment*	The Project will continue the successful and proven track record of Reach Solar, along with its key advisor PwC, in structuring Projects and transactions of this nature. Reach Solar may seek support from the NSW Government to assist in expediting the planning and approval process.
• *promoting investment opportunities in NSW*	The Project will bring more than $1Bn of direct investment into the NSW economy depending on the MW capacity constructed.
• *maintaining a fair price for solar and a sustainable solar industry*	The Project is proposing to supply renewable energy at tariffs less than new coal or gas based generation assets.
By giving the community a say on decisions that affect them by:	
• *engaging with the community early and effectively on renewable energy projects*	Reach Solar has been in discussions with Narrandera Shire Council since mid-2017 regarding development of the Project. Reach Solar has also engaged with key stakeholders and community members since early 2018. Continued community consultation and stakeholder engagement will continue through the Project planning and approval process.
Attracting and growing expertise in renewable technologies by:	
• *creating renewable energy hubs* • *supporting the commercialisation of renewable technologies* • *Facilitating partnerships between industry, government and research organisations.*	The project, when fully developed will be one of the world's largest commercial solar projects and a showcase for the State of NSW.

4.1.2.2 Riverina Murray Regional Plan 2036

The Riverina Murray Regional Plan 2036 applies to the site and establishes a framework to grow the region's cities and local centres, supports the protection of high-value environmental assets and makes developing a strong, diverse and competitive economy central to building prosperity and resilience in the region[6].

Goal 1 of the Plan is to achieve "a growing and diverse economy". The strategic location of the region as well as its evolution as a centre of knowledge and innovation for agribusiness and value-added manufacturing, and green technologies and products, has seen the region recognised as an economic powerhouse. The Plan provided an outline of priority growth sectors that will further encourage growth within the region primarily through diversification of the economy.

The priority growth sectors identified in the Plan include:

- Agribusiness
- Advanced and value-added manufacturing
- Health and aged care
- Education and training
- Tourism
- Freight and logistics

[6] The Riverina Murray Regional Plan 2036, http://www.planning.nsw.gov.au/~/media/Files/DPE/Plans-and-policies/riverina-murray-regional-plan-2017.ashx, May 2018.

- Forestry
- Renewable energy and mining.

Of particular relevance to this Project is this first goal of the Plan – a growing and diverse economy, however; the Project is consistent with a number of other objectives outlined in the plan. When fully developed, the Project would provide the region with one of the world's largest commercial solar projects, strengthening the renewable energy sector in NSW and Australia, and providing construction as well as operational employment opportunities to the region.

4.1.2.3 Narrandera Shire Economic Development Strategy

The Project is aligned to the Narrandera Shire Economic Development Strategy 2017 – 2020. This plan outlines Narrandera Shire Council's vision to build the shire into a prosperous, diverse and sustainable community with a growing economy.

A review of how the Project aligns with relevant components of the strategy is provided in **Table 8.**

Table 8 Narrandera Shire Council Imperatives

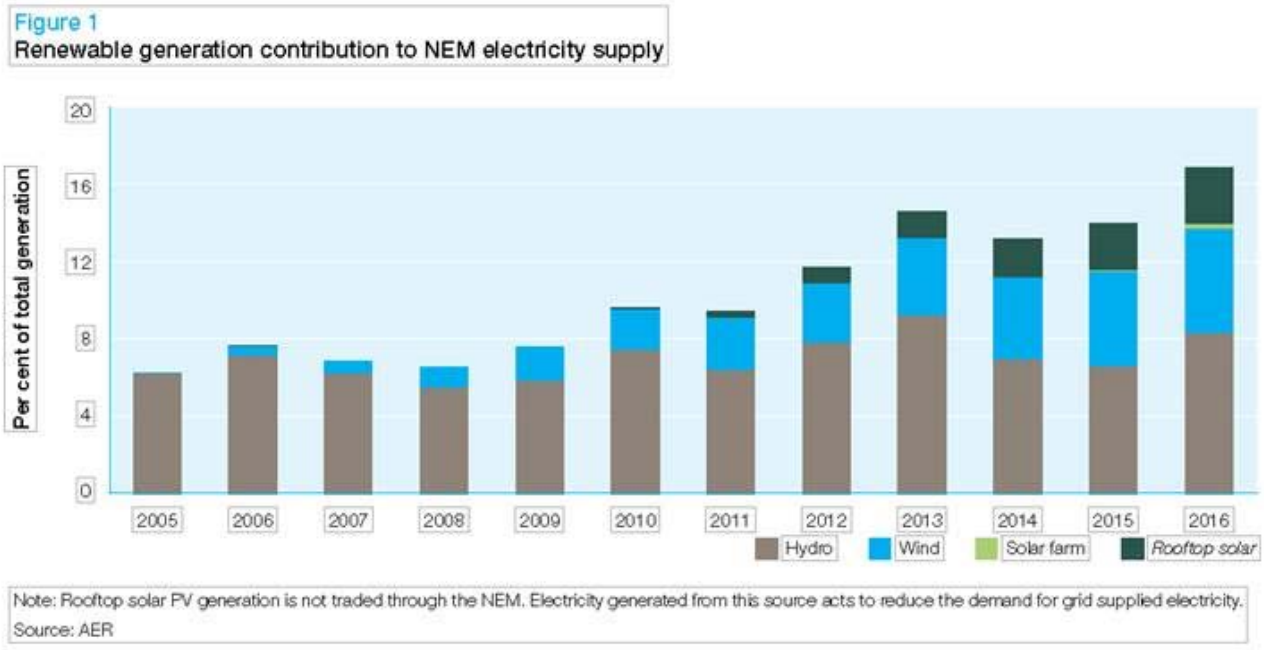
Narrandera Shire Economic Development Strategy 2017-2020	Yarrabee Solar Project
Collaborative approach between all tiers of government, business and community.	Reach Solar has opened discussions with both Narrandera Shire Council and relevant government departments to assist in a coordinated and streamlined development of the Project.
Supporting economic growth through strengthening communities and existing economic activities, diversification and innovation, and attracting new investment.	The Project will bring more than $1Bn of direct investment into regional, state and national economies if constructed.
Workforce development focusing on meeting industry needs, developing business and industry skills, enhanced educational outcomes, transition from school to work, attracting and retaining employees, community capacity building and social inclusion.	The Project would see the employment of up to 450 staff during peak construction periods and 10 – 15 permanent full time staff during operations.
Nominated priority growth sectors within the Riverina Region are:	
Technology – capitalising on new technologies and the installation and servicing of these technologies.	The Project will bring advanced technologies to the region and support the ongoing development of skills and resources in an emerging market.
Renewables - waste management, recycling, clean energy and low carbon initiatives.	The Project would be the largest renewable energy project currently built in Australia and one of the world's largest with a long term operational life of at least 30 years.

4.2 Electricity Reliability and Security

In a statement from TransGrid in its 2017 Annual Report, *"the electricity supply industry worldwide will increasingly be subjected to changing conditions with regard to the level of greenhouse gas emissions (GHG) from power generation. There is little doubt that the general community expectations will require reduced carbon emissions by all sectors of society. Accordingly the industry in NSW and Australia is expected to use a variety of measures to minimise future GHG emissions from energy usage. Abatement strategies that reduce energy consumption may also result in reduced demand on the transmission network."* The Project would provide a renewable energy source that would assist in reducing the level of greenhouse gas emissions from energy usage.

According to the Australian Energy Regulator's State of the Energy Market, May 2017, after limited growth for several years, peak electricity demand is again rising, particularly in Queensland (where new regional demand record was set in January 2017) and NSW. Tightened supply coincided with this growth in demand. An influx of wind and solar generation (refer to **Figure 4-1**, Renewable Generation Contribution to National Energy Market (NEM)) affected the viability of existing thermal generation, with several coal generators being retired, including South Australia's Northern power station in 2016 and Victoria's Hazelwood plant in 2017. These closures withdrew over 2000 megawatts (MW) from the market, equivalent to around 50 per cent of South Australia's generation capacity.

Figure 4-1 Renewable Generation Contribution to NEM Electricity[7]



[7] Source: State of Energy Report, May 2017. Australian Energy Regulator.

The Australian Energy Market Operator (AEMO) is responsible for monitoring the spot market and transmission network to 'keep the lights on'. The power system needs to be both reliable (having enough generation and network capacity to supply customers) and secure (being technically stable, even in the case of an incident such as the loss of a major transmission line or large generator.

The fully developed Yarrabee Solar Project of 900 MWac is expected to generate just over 2,000 GWhr per year, which represents the power consumption of approximately 335,000 homes.

The transition to renewable energy sources based on variable wind and solar PV generators has implications for reliability and security; these sources lack usable inertia to support power system security (Finkel *et al*. 2017). Geographic and technological diversity in the network can also provide improvements in security as well as smooth our impacts of variability (Finkel *et al* 2017).

The Yarrabee Solar Project would provide support to the electricity network, providing electricity generation close to local consumption centres, contributing to a more diverse mix of energy sources as well as improving the security of supply to the grid through the use of an energy/battery storage system.

The energy/battery storage system which may be constructed for the Project would be installed adjacent to the 330 kV grid. It would comprise of containerised battery-type inverters and containerised lithium-ion energy storage units. The output and storage is expected to be no more than 50 MW / 100 MWhr. The final sizing will be subject to authority requirements including AEMO, TransGrid and any Federal legislation. The facility would be capable of storing energy for release when the use or cost is beneficial.

4.3 Project Alternatives

Alternative forms of electricity generation such as wind, geothermal and gas-fired were not considered viable for the site due to prevailing wind patterns, topography, geology and proximity to fossil fuel resources. The only feasible alternative to the Project is the 'Do nothing option' which is considered in further detail below.

Options for the location, siting and design of the Project were also considered and are discussed further in **Section 4.3.2** and **4.3.3**.

4.3.1 *'Do Nothing'* Option

The 'do nothing' option would result in the following benefits being lost to the local and surrounding communities as well as the broader Australian community. Not proceeding with the Yarrabee Solar Project will result in the loss of:

- A renewable energy supply that would assist in reaching National, State and Local government energy targets;
- Additional electricity generation and supply in the Australia grid;
- Electricity network reliability and security benefits;
- Increased demand to drive the upgrade of capacity within the Australian electricity grid, further enabling the growth of the renewable market, in turn reducing the demand for coal fired power stations;
- Opportunity to reduce greenhouse gas emissions and move towards cleaner electricity generation; and
- Social and economic benefits generated through the direct and indirect employment opportunities during the construction and operational phases of the project.

The 'do nothing' option would avoid the potential environmental impacts associated with the construction and operation of the Project. The impacts include construction traffic and noise, minimal dust and visual impacts, as well as foregone agricultural production at the site for the life of the solar project. All of the impacts identified in this assessment are considered to be manageable and are unlikely to result in a negative impact to the environment or community in the medium to long term (refer **Section 7**).

The Project provides clear benefits and manageable environmental impacts. Reach Solar's constraints based approach to this project has enabled areas of environmental sensitivity such as areas of archaeological significance, native grasslands and riparian vegetation to be protected from any impacts. Based on this approach and Reach Solar's commitment to manage all environmental impacts, the 'do nothing' option is not the preferred option from an environmental, economic or social standpoint.

4.3.2 Preferred and Alternative Locations

The location for the Project was selected after an extensive review of land availability and access; land ownership and existing use; topography; geological formation; transmission grid access and capacity; and solar irradiation. The assessment of each of these factors across numerous sites resulted in the selection of the Yarrabee Park site.

The size of the Project is to ensure economies of scale can be achieved for equipment procurement, construction efficiencies, and to offset the significant cost of new grid connection infrastructure to accommodate large volumes of power.

Based on the above Reach Solar has determined that the Yarrabee site is the optimal location for this project. The project site allows for flexibility in design, enabling Reach Solar to avoid or effectively mitigate the archaeological, ecological and flooding constraints that have been identified during the EIS process.

4.3.3 Project Design and Site Configuration

The design of this project is the result of an iterative process. The design has been revised and modified progressively as the necessary field survey and assessment process has been completed. This process has identified site constraints, mainly archaeological sites of significance, ecological areas and flooding constraints. Constraints related to heritage and biodiversity values, drainage, road access, electricity network easement and biodiversity values in particular have been considered when preparing the proposed project design and layout below.

As a result of technical studies undertaken as part of this EIS, the proposed project design achieves Reach's objective of renewable energy generation and supply whilst avoiding and minimising environmental, social and economic impacts. The indicative project design layout is provided in **Figure 1-3** of this report.

Reach SOLAR ENERGY

SECTION 5

PLANNING AND STATUTORY REQUIREMENTS

5 PLANNING AND STATUTORY REQUIREMENTS

5.1 NSW Legislation

5.1.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) is the principal piece of legislation overseeing the assessment and determination of development proposals in NSW. The objects of the EP&A Act generally seek to promote management and conservation of natural and artificial resources, whilst also permitting appropriate development to occur.

Part 4.1 of the EP&A Act provides for the assessment of State Significant Development (SSD). *State Environmental Planning Policy (State and Regional Development) 2011* (the SRD SEPP) provides criteria for SSD and this is discussed further in **Section 5.1.2**. The Project meets the criteria for SSD and will therefore be assessed under Part 4.1 of the EP&A Act.

Section 4.12 of the EP&A Act requires a development application for SSD to be accompanied by an EIS prepared in accordance with the EP&A Regulation. This EIS has been prepared in accordance with Part 4 of EP&A Act and Schedule 2 of the EP&A Regulation.

An Environmental Impact Statement (EIS) has been prepared in accordance with the requirements of the SEARs provided by the Department of Planning and Environment on 20 April 2018.

Pursuant to Clause 4.42 of the EP&A Act, an authorisation of the following kind (as relevant to the Development) cannot be refused if it is necessary for carrying out an approved SSD proposal and must be granted "substantially consistent" with the SSD consent:

- An EPL under Chapter 3 of the *Protection of the Environment Operations Act 1997* (POEO Act) (refer to Section 5.19); and
- A consent under Section 138 of the *Roads Act 1993* (refer to Section 5.1.1).

Furthermore, pursuant to Section 4.41 of the EP&A Act, the following authorisations (as potentially relevant to the Development) are not required for approved SSD proposals:

- A permit under section 201, 205 or 219 of the *Fisheries Management Act 1994;*
- An approval under Part 4, or an excavation permit under section 139, of the *Heritage Act 1977;*
- An Aboriginal heritage impact permit under Section 90 of the *National Parks and Wildlife Act 1974*;
- A bush fire safety authority under Section 100B of the *Rural Fires Act 1997*; and
- A water use approval under Section 89, a water management work approval under Section 90 or an activity approval (other than an aquifer interference approval) under Section 91 of the *Water Management Act 2000*.

5.1.2 Biodiversity Conservation Act 2016 (BC Act)

The NSW *Biodiversity Conservation Act 2016* (BC Act), the NSW *Biodiversity Conservation Regulation 2017* (NSW BC Regulation) and amendments to the *Local Land Services Act 2013* (NSW LLS Act) commenced on 25 August 2017. The legislation aims to deliver "a strategic approach to conservation in NSW whilst supporting improved farm productivity and sustainable development" (OEH 2018b). The BC Act repeals several pre-existing Acts, most notably the *Threatened Species Conservation Act 1995* (NSW TSC Act), the *Nature Conservation Trust Act 2001* and the *Native Vegetation Act 2003*. Relevant provisions from each of the repealed Acts has been saved and incorporated into the new legislative framework. Transitional arrangements are in place to ensure a smooth transition from the repealed legislation to the BC Act.

In accordance with the BC Act, the Biodiversity Assessment Method (BAM) (OEH 2017c) and entry into the Biodiversity Offsets Scheme (BOS) is applicable to certain development activities based on specific criteria. Preparation of a Biodiversity Development Assessment Report (BDAR) is required for a development application that meets any of the following criteria:

- Part 4 development activities deemed to be 'State Significant' under the NSW *Environmental Planning and Assessment Act 1979* (NSW EP&A Act);
- Development activities that have the potential to impact Areas of Outstanding Biodiversity Value (AOBV) as listed under Part 3 of the BC Act;
- Development activities that have the potential to cause a significant impact on a threatened species, population or ecological community, listed under Schedules 1 and 2 of the BC Act, as determined by application of a five-part-test of significance in accordance with Section 7.3 of the BC Act;
- Development activities that have the potential to impact areas mapped as having 'high biodiversity value' as indicated by the NSW Biodiversity Values Map (BV Map); and
- Development activities that involve clearing of native vegetation that exceeds the Biodiversity Offset Scheme thresholds (BOS thresholds) as determined by the NSW BC regulation.

A BDAR has been prepared for the Project and is provided as **Appendix E** and discussed further in **Section 7.1.1**. The BDAR determined that construction of the Project would not require the removal of native vegetation or threatened species habitat within the Project Site, and all woodland areas will be retained. Potential impacts of the proposed development on biodiversity values are therefore considered to be minimal.

5.1.3 NSW Biosecurity Act 2015

The NSW *Biosecurity Act 2015* provides a streamlined statutory framework to protect the NSW economy, environment and community from the negative impact of pests, diseases and weeds. The primary object of the Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers. In NSW, all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

The Project is not expected to result in the increase of any biosecurity risks at the Project Site. The only relevant biosecurity issue to the Project is weed management. Measures to manage and control weeds would be implemented during construction and operation of the Project and this is discussed further in **Section 7.1.1.**

5.1.4 Crown Lands Act

The objects of this Act are to ensure that Crown land is managed for the benefit of the people of New South Wales. Under Part 3 of the Act, the Minister for Lands must be satisfied that the land has been assessed prior to any allocation action, i.e. reservation, dedication, sale, lease, licence or permit. The purpose of a land assessment is to ensure decisions made in relation to Crown land are in accordance with the principles of Crown land management by (amongst other matters) including an assessment of the capabilities of Crown land and the identification of suitable land uses.

Crown Land has not being identified within the proposed Project site during the EIS assessment process.

5.1.1 Electricity Supply Act 1995 and Electricity Network Assets (Authorised Transactions) Act 2015

Transmission and distribution lines are operated by an electricity transmission operator or distributor approved under the *Electricity Supply Act 1995*, or an 'authorised network operator' approved under the *Electricity Network Assets (Authorised Transactions) Act 2015*. The Project would connect to the electricity network operated by TransGrid, who are an authorised network operator. Reach are not required to hold an approval under these acts for the Project as it does not involve the transmission of electricity on a network.

Reach Solar commenced early discussions with TransGrid regarding the Project and an electricity reliability and security study was commissioned by Reach to confirm the ability for the project to connect to the existing 330 kV Wagga Wagga to Darlington Point transmission line. This study determined that TransGrid's transmission network has sufficient capacity to receive the load generated by Stage 1 of the Project but would require upgrades for Stages 2 and 3. This study is discussed in more detail in **Section 3.4**.

5.1.2 Heritage Act 1997

This Act aims to conserve heritage values within NSW. The Act defines 'environmental heritage' as those places, buildings, works, relics, moveable objects and precincts listed in the Local or State Heritage Significance. Heritage items are listed in the environmental heritage schedule of the local Council's Local Environmental Plan or listed on the State Heritage Register, a register of places and items of particular importance to the people of NSW. Under Section 89J of the EP&A Act, an approval under Part 4 or a permit under Section 139 of the Heritage Act 1977 would not be required for a SSD project.

A heritage study was undertaken for Project and determined that it is unlikely to result in any direct or indirect impacts to items of heritage significance (refer to **Section 7.2.4** of this report).

5.1.3 Local Lands Act 2013

The clearing of native vegetation in NSW is regulated under the *Local Lands Services Act 2013* (LLS Act), the *Local Land Services Regulation 2014* (LLS Regulation), the *Biodiversity Conservation Act* 2016 (BC Act) and the *Biodiversity Conservation Regulation 2017*. A Native Vegetation Regulatory Map (NVRM) is currently being developed by the Office of Environment and Heritage (OEH) to inform the application of the LLS Act. Land categories identified by the NVRM are as follows:

- Category 1 - Exempt land is land that allows native vegetation clearing without approval from Local Land Services; and
- Category 2 land comprises:

- Regulated land, which is any Category 2 land that is not Vulnerable or Sensitive regulated land. Authorisation for native vegetation clearing may be required from Local Land Services.
- Vulnerable regulated land is land where clearing of native vegetation may not be permitted under the Land Management (Native Vegetation) Code 2018, and a limited suite of allowable activities apply.
- Sensitive regulated land is where clearing is not permitted, and
- Excluded land refers to land outside of the land management framework (i.e. urban areas).

Under the LLS Act, clearing of native vegetation is permitted if it is authorised under other legislation, including development consent under Part 4 of the EP&A Act. The current project is being assessed under Part 4 (Section 4.7) of the EP&A act and therefore approval is not required by Local Land Services (i.e. NSW Minister for Primary Industries). Nevertheless, the NVRM was viewed on the 26 June 2018 to identify the land categories mapped within the project site. This mapping showed that no areas of the Project site are currently categorised by the NVRM, although the riparian vegetation associated with Washpen Creek near the eastern boundary of the project site is mapped as 'Category 2 vulnerable land'.

5.1.4 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act* 1974 (NPW Act) aims to conserve nature, objects, places or features (including biological diversity) of cultural value within the landscape. The Act also aims to foster public appreciation, understanding and enjoyment of nature and cultural heritage, and provides for the preservation and management of national parks, historic sites and certain other areas identified under the Act. The Act is administered by the NSW Office of Environment and Heritage (OEH).

No areas of National Park estate occur within or adjacent to the Project site. An assessment of the proposal in relation to impacts on native flora and fauna; with an emphasis on threatened species and habitat, is provided in **Appendix E** and is discussed in **Section 7.1.1** .

Amended during 2010, the NPW Act provides for the protection of Aboriginal objects (sites, objects and cultural material) and Aboriginal places. Under the Act (Part 6), an Aboriginal object is defined as: any deposit, object or material evidence (not being handcraft for sale) relating to indigenous and non-European habitation of the areas that comprises NSW, being habitation both prior to and concurrent with the occupation of that area by persons of European extraction, and includes Aboriginal remains.

An Aboriginal place is defined under the NPW Act as an area which has been declared by the Minister administering the Act as a place of special significance for Aboriginal culture. It may or may not contain physical Aboriginal objects.

As of 1 October 2010, it is an offence under Section 86 of the NPW Act to 'harm or desecrate and object the person knows is an Aboriginal object'. It is also a strict liability office to 'harm an Aboriginal object' or to 'harm or desecrate an Aboriginal place', whether knowingly or unknowingly. Section 87 of the Act provides a series of defences against the offences listed in Section 86, such as:

- The harm was authorised by and conducted in accordance with the requirements of an *Aboriginal Heritage Impact Permit* (AHIP) under Section 90 of the Act.
- The defendant exercised 'due diligence' to determine whether the action would harm and Aboriginal object; or

- The harm to the Aboriginal object occurred during the undertaking of a 'low impact activity' (as defined in the regulations).

Under Section 89A of the Act, it is a requirement to notify the Office of Environment and Heritage (OEH) Director –General of the location of an Aboriginal object. Identified Aboriginal items and sites are registered on Aboriginal Heritage Information Management System (AHIMS).

An Aboriginal Cultural Heritage Assessment was prepared for the project and is discussed further in **Section 7.1.2**. The assessed found that the Project has the potential to impact on six Aboriginal heritage sites which are located on or adjacent to existing access tracks. These sites have been determined to have low scientific/archaeological significance, low aesthetic value and low historical value. As outlined in **Section 5.1.1**, an Aboriginal Heritage Impact Permit is not required for an approved SSD project.

5.1.5 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) provides an integrated system of licensing for certain polluting activities within the objective of protecting the environment:

- Section 148 of this Act requires notification of pollution incidents;
- Section 120 of this Act provides that it an offence to pollute waters; and
- Schedule 1 of the POEO Act describes activities for which an Environment Protection Licence is required.

Under section 48 of the POEO Act, premises-based scheduled activities (as defined in Schedule 1 of the POEO Act) require an Environment Protection Licence (EPL). Clause 17 of Schedule 1 of the POEO Act concerns electricity generation works, however does not include solar power. The proposal would not be a scheduled activity under the Act and an EPL is not required.

The Project would be managed to ensure pollution risks are minimised during the construction and operation phases. Measures have been incorporated into the EIS to ensure risks to soils, waterways and air quality are avoided or minimised. The Environment Protection Authority would be notified if a 'pollution incident' occurs that causes or threatens 'material harm' to the environment.

Legal requirements for the management of waste are also established under the POEO Act and the *Protection of the Environment Operations (Waste) Regulation 2005*. Unlawful transportation and deposition of waste is an offence under Section 143 of the POEO Act. Waste minimisation and management is address in **Section 7.2.10** of this EIS.

5.1.6 Roads Act 1993

The *Roads Act 1993* (Roads Act) establishes a system of 'classified roads', comprising the following categories: main road, highway, freeway, controlled access road, secondary road, tourist road, tollway, transit way and a State network. Roads and Maritime Services (RMS) groups these roads classes into a three tier administrative system of State, Regional and Local Roads.

The Roads Act provides for the declaration of RMS and other public authorities as roads authorities for both classified and unclassified roads. Freeways, State Highways and Main Roads ("State Roads") are generally the responsibility of RMS. For State Roads other than Freeways, the local council generally had responsibility for footpaths and road reserves. Council are road authorities for less important classified roads and for roads not classified under the Act. The Lands Minister is the authority for Crown Roads, including paper roads.

The Roads Act regulates the carrying out of various activities in, on and over public roads. Under Section 138, the consent of the appropriate roads authority is required to:

(a) erect a structure or carry out a work in, on or over a public road

(b) dig up or disturb the surface of a public road

(c) remove or interfere with a structure, work or tree on a public road

(d) pump water into a public road from any land adjoining the road

(e) connect a road (whether public or private) to a classified road.

Consent in relation to a classified road requires the concurrence of RMS. Section 138 also applies to works undertaken by road authorities.

A Traffic Impact Assessment has been prepared for the Project and is discussed further is **Section 7.2.9**. This assessment outlines the requirements for use of roads to service the Project. If required, approval from the RMS or Narrandera Council will be sought under Section 138 of the Roads Act.

5.1.7 Water Management Act 2000

The *Water Management Act 2000* (the WM Act) is intended to ensure that water resources are conserved and properly managed for sustainable use benefitting both present and future generations. Water sharing plans prepared in accordance with the WM Act include rules for protecting the environment and administrating water licencing and trading.

By the operation of Section 89J of the EP&A Act, the Project would not require a water use approval under Section 89 of the WM Act, a water management approval under Section 90 or a controlled activity approval under Section 91.

An assessment of impacts to water resources from the Project has been undertaken and is outlined in **Section 7.1.4.** The assessment determined that the Project is unlikely to result in any direct impacts to water resources. The Project would have a risk of causing indirect impacts to surface water resources and measures would be implemented to mitigate these risks.

5.2 NSW Planning Instruments

5.2.1 State Environmental Planning Policy (State and Regional Development) 2011

State Environmental Planning Policy (State and Regional Development) 2011 aims to identify development that is of State significance and confers functions on joint regional planning panels to determine significant development applications.

Clause 20 of Schedule 1 of the policy includes the following definition of SSD:

Development for the purpose of electricity generating works or heat or their co-generation (using any energy source, including, gas, coal, biofuel, distillate, waste, hydro, wave, solar or wind power that:

a. has a capital investment value of more than $30 million, or

b. has a capital investment value of more than $10 million and is located in an environmentally sensitive area of State Significance.

c. The Project development is not located in an environmentally sensitive area but has an estimated capital investment value greater than $30 million, and therefore will be classified as a State Significant Development (SSD) under Part 4 of the EP&A Act.

d. An Environmental Impact Statement (EIS) will be prepared in accordance with the requirements of the SEARs provided by the DPE. In determining the SEARs, the Secretary is required to consult with relevant public authorities and would need to address key issues raise by those public authorities.

The Project has an estimated capital investment value greater than $30 million and therefore meets the definition of SSD.

5.2.2 State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State by providing a consistent planning regime for infrastructure development.

Clause 34 (1) of ISEPP provides that the development of electricity generating works (including solar energy systems) may be carried out by any person with consent on any land. Large-scale solar developments such as the Project are still required to be compatible with the local land use objectives as outlined in any application Local Environmental Plan and this is considered further for the Project in **Section 5.2**.

5.2.3 State Environment Planning Policy (Rural Lands) 2008 (Rural SEPP)

The aims of the State Environment Planning Policy (Rural Lands) 2008 (Rural Lands SEPP) are:

1. *to facilitate the orderly and economic use and development of rural lands for rural purposes,*

2. *to identify the Rural Planning Principles and the Rural Subdivision Principles to assist in the proper management, development and protection of rural lands for the purpose of promoting the social, economic and environmental welfare of the State,*

3. *to identify the Rural Planning Principles and the Rural Subdivision Principles to assist in the proper management, development and protection of rural lands for the purpose of promoting the social, economic and environmental welfare of the State,*

4. *to implement measures designed to reduce land use conflicts,*

5. *to identify State significant agricultural land for ensuring the ongoing viability of agriculture on that land, having regard to social, economic and environmental considerations,*

6. *to amend provisions of other environmental planning instruments relating to concessional lots in rural subdivisions.*

The Rural Lands SEPP rural planning principles, listed under clause 7, are:

a. *the promotion and protection of opportunities for current and potential productive and sustainable economic activities in rural areas,*

b. recognition of the importance of rural lands and agriculture and the changing nature of agriculture and of trends, demands and issues in agriculture in the area, region or State,

c. recognition of the significance of rural land uses to the State and rural communities, including the social and economic benefits of rural land use and development,

d. in planning for rural lands, to balance the social, economic and environmental interests of the community,

e. the identification and protection of natural resources, having regard to maintaining biodiversity, the protection of native vegetation, the importance of water resources and avoiding constrained land,

f. the provision of opportunities for rural lifestyle, settlement and housing that contribute to the social and economic welfare of rural communities,

g. the consideration of impacts on services and infrastructure and appropriate location when providing for rural housing,

h. ensuring consistency with any applicable regional strategy of the Department of Planning or any applicable local strategy endorsed by the Director-General.

The Project proposal is consistent with the aims and planning principles of the Rural Lands SEPP. Part 4 of the Rural Lands SEPP relates to state significant agricultural land. The Project area is not identified in Schedule 2, it is not identified as state significant agricultural land. Part 4 of the Rural Lands SEPP does not apply to the Project area.

5.2.4 State Environmental Planning Policy No.44 – Koala Habitat Protection

State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) aims to encourage the 'proper conservation and management of areas of natural vegetation that provide habitat for Koalas (*Phascolarctos cinereus*) to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline'. A new version of SEPP 44 is currently being amended by DPE and consultation has now closed on the draft. Key changes to the amended SEPP relate to the following:

- Definitions of koala habitat;
- List of Koala feed tree species;
- List of councils to which the SEPP applies; and
- Various changes to the development assessment process.

SEPP 44 does not apply to SSD Projects. Notwithstanding this, a brief discussion of the main requirements of the policy has been included here to describe the Koala habitat (if present) on the site and the relevance of the site to the occurrence of the Koala.

Narrandera LGA is identified in Schedule 1 of the SEPP as being an area to which the SEPP applies. Preferred Koala feed tree species include those identified in Schedule 2 of the SEPP. This list was reviewed to determine if any Koala feed trees were present within the Project Site prior to the biodiversity assessment. The biodiversity assessment identified *Eucalyptus camaldulensis* (River Redgum) as a listed Koala feed tree species that is abundant within some woodland patches within the Project Site. Accordingly, the patches of vegetation within the site where River Red Gum makes up more than 15 % of the tree canopy (including the riparian zone of Washpen Creek) would qualify as 'potential Koala habitat' in accordance with Clause 7 of SEPP 44. However, due to a lack of recent Koala sightings, low numbers of Koala records within the locality and the fragmented nature of potential Koala habitat within and surrounding the site, the Project Site is not considered to constitute 'core Koala habitat', as defined under Clause 8 of the policy. Further consideration of this policy is therefore not required.

5.2.5 State Environmental Planning Policy No. 33 – Hazardous and Offensive Development

SEPP No. 33 – Hazardous and Offensive Development (SEPP 33) defines and regulates the assessment and approval of potentially hazardous or offensive development.

A potentially hazardous industry is defined within SEPP 33 as "*a development for the purposes of any industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would pose a significant risk to in relation to the locality:*

(a) to human health , life or property,

(b) or to the biophysical environment,

and includes a hazardous storage establishment."

A potentially offensive development is defined within SEPP 33 as a "*a development for the purpose of an industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would emit a polluting discharge (including for example, noise) in a manner which would have a significant adverse impact in the locality or on the existing or likely future development on other land, and includes an offensive industry and an offensive storage establishment.*"

SEPP 33 provides for systematic assessment of potentially hazardous and offensive development for the purpose of industry or storage. For development proposals classified as 'potentially hazardous industry' the policy requires a preliminary hazard analysis (PHA) to determine risks to people, property and the environment.

A checklist and risk screening procedure developed by DPE is used to help determine whether a development is considered a potentially hazardous industry. Appendix 3 of the Applying SEPP33 guidelines list industries that may fall within SEPP 33. The list does not include for solar farms and energy storage facilities. A review of the Applying SEPP 33 guidelines found that the Project is not potentially hazardous, as it would not exceed the screening threshold for any of the hazardous materials identified in the guideline.

The potential hazards and risks of the Project are discussed further in **Section 7.2.1**. It is determined that the Project would not pose a significant risk to, or have a significant adverse impact on human health, life, property or the biophysical environment.

5.2.6 State Environmental Planning Policy No. 55 – Remediation of Land

SEPP No. 55 – Remediation of Land (SEPP 55) aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment.

Under Clause 7 of SEPP 55, a consent authority must not consent to the carrying out of any development on land unless it has considered whether the land is contaminated.

The Project site has been historically and is currently used for agricultural purposes. A soil survey was undertaken within the Project boundary and no evidence was found of any contamination as a result of historic or current practices. This is discussed in further detail in **Section 7.1.3** of this EIS.

5.3 Local Government

5.3.1 Zoning and Permissibility

All land within and adjoining the Project site is within Narrandera LGA and is zoned "RU1 – Primary Production" under the provisions of the Narrandera Shire Council Local Environment Plan 2013 (Narrandera LEP). The objectives of the RU1 zoning are listed in **Table 9**.

Table 9 RU1 – Primary Production Zoning Objectives

Objective	Yarrabee Solar Project
• To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.	The Project would not substantially reduce the availability of agricultural land within the LGA. Given the nature of the Project it would also be possible to utilise the land in and around the solar arrays for grazing in order to control vegetation growth. Following decommissioning, solar PV infrastructure would be removed and the site would be restored to its existing agricultural land use capacity.
• To encourage diversity in primary industry enterprises and systems appropriate for the area.	The Project will support the growth in the renewable energy market in Australia, as well as diversification within of the employment and economic opportunities with the regional economy of the LGA.
• To minimise the fragmentation and alienation of resource lands.	The Project site is located in the northeast corner of the Yarrabee Park property and will not result in the fragmentation of the cropping land and activities that will continue on the property.
• To minimise conflict between land uses within this zone and land uses within adjoining zones.	As the Project is located on one property, with one owner, it is not expected to result in any land use conflicts.

Electricity generation is not permitted with or without consent under the RU1 zone. However, under Clause 43 of the *State Environment Protection Policy (Infrastructure) 2007* (ISEPP) development for the purposes of solar energy system is permissible on any land with consent (refer Section 5).

5.4 Commonwealth Legislation

5.4.1 Environment Protection & Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) is the Australian Government's central piece of environmental legislation. The Act aims to, inter alia:

- provide for the protection of the environment, especially matters of national environmental significance;
- conserve Australia's biodiversity;
- provide a streamlined environmental assessment and approvals process where matters of national environmental significance are involved; and
- promote ecologically sustainable development.

The Act applies to the following matters of national environmental significance (MNES):

- world heritage properties;
- national heritage places;
- wetlands of international importance (listed under the Ramsar Convention of 1971);
- nationally threatened species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- nuclear actions (including uranium mining); and
- a water resource, in relation to coal seam gas development and large coal mining development.

The EPBC Act requires consideration of the potential for a "significant impact" to be imposed by an activity on any MNES. If it is considered that a development has potential to impact a MNES, the proposed activity must be referred to the Commonwealth Department of the Environment and Energy (DoEE) for determination as to whether it constitutes a "controlled action".

MNES listed under the EPBC Act include the National Heritage List and the Commonwealth Heritage List, both administered by the DoEE. Ministerial approval is required under the EPBC Act for proposals involving significant impacts to National/Commonwealth heritage places.

Where a development activity is determined to be a "controlled action", approval under the EPBC Act is required. There is a bilateral agreement between the Commonwealth of Australia and the State of New South Wales (NSW) relating to environmental assessment (the 'assessment bilateral agreement'), which allows the Commonwealth Minister for the Environment to rely on specified NSW environmental impact assessment processes in assessing actions under the EPBC Act.

Matters of national environmental significance of potential relevance to the Project site include:

- nationally threatened species and ecological communities
- wetlands of international importance ('Ramsar' wetlands); and
- migratory species.

A search of the Commonwealth Protected Matters Search Tool indicates that there are no World Heritage Properties or National Heritage Places within the vicinity of the Project Site. The Commonwealth Protected Matters Search Tool and biodiversity investigations undertaken as part of this EIS indicate that there is limited potential for threatened species or migratory species to occur within the Project site and therefore a referral under the EPBC Act is not considered relevant to the Project.

5.4.2 Aboriginal Heritage and Torres Strait Islander Heritage Protection Act 1984

The Aboriginal and Torres Strait Islander Heritage Protection Act 1984 enables the Australian Government to respond to requests to protect areas and objects of particular significance to Aboriginal people if it appears that state and territory laws have not provided effective protection.

The Australian Government can make a declaration to protect an area, object or class of objects from a threat of injury or desecration. However, the government cannot make a declaration unless an Aboriginal person or group of persons have requested it. A declaration is only made if the relevant processes of the state or territory have been exhausted.

The proposed layout of the Project has been specifically designed to avoid areas of Aboriginal significance.

5.4.3 Native Title Act 1993

The Native Title Act 1993 provides a legislative framework for the recognition and protection of common law native title rights. Native title is the recognition by Australian law that Indigenous people had a system of law and ownership of their lands before European settlement. Where that traditional connection to land and waters has been maintained and where government acts have not removed it, the law recognises this as native title.

A search of the Native Title Tribunals register was undertaken on 19 June 2018 has not identified any Native Title Claims or active applications over the proposed Project boundary. Should any concerns over potential Native Title issues arise, Reach Solar will need to obtain legal advice as to whether current land tenure will require Native Title consultation.

5.4.4 Renewable Energy Act (Electricity) Act 2000

The *Renewable Energy (Electricity) Act* 2000 (RE Act) aims to:

- encourage the additional generation of electricity from renewable sources;
- reduce emissions of greenhouse gases in the electricity sector; and
- ensure that renewable energy sources are ecologically sustainable.

Section 17 of the RE Act defines renewable energy sources eligible under the Commonwealth Government's Renewable Energy Target; includes solar energy. Certificates for the generation of electricity are issued using eligible renewable energy sources. This requires purchasers (called liable entities) to surrender a specified number of certificates for the electricity that they acquire. In January 2011, renewable energy certificates were reclassified as either large-scale generation certificates or a small-scale technology certificates following changes to the RET scheme. The Yarrabee Solar Project would need to be accredited as a Renewable Energy Generator to create Renewable Energy Certificates.

Reach SOLAR ENERGY

SECTION 6

CONSULTATION AND STAKEHOLDER ENGAGEMENT

SLR

6 CONSULTATION AND STAKEHOLDER ENGAGEMENT

6.1 Agency Consultation

During the preparation of the Preliminary Environmental Assessment (PEA) and this EIS, SLR and Reach Solar have consulted the Department of Planning and Environment (DPE). This consultation has covered a range of issues which is summarised below:

- Clarifying expectations around planning policies and guidelines;
- Clarification of key elements in the PEA document (scope);
- Issue of SEARs for the project; and
- Invitation to the Public Meeting on the 15th March, 2018.

From 21 February through to 24 February 2018 Reach representatives completed consultation with a number of key stakeholders including a preliminary briefing to the Narrandera Council as well as meetings with four of the immediate neighbours to the project site. The key issues discussed included reviewing possible alternative access routes for light and heavy vehicles; and identify and develop preliminary strategies to mitigate potential transport access issues.

The discussions held with all parties were in the main supportive of the project with many of its benefits (i.e. employment, renewable energy) seen as positive for the region. The Council Members were pleased to see early engagement and Reach's intent to develop an extensive communications plan was welcomed.

On the 16 May 2018, Reach Solar representatives attended a meeting with Narrandera Shire Council. This meeting had been arranged through the Narrandera Economic Development and was intended to provide an update to the Council.

Attendees at the meeting from Council were:

- Mayor;
- Economic Development Manager;
- General Manager;
- Deputy General Manager, Infrastructure;

The presentation focused on progress that had been made from the previous meeting with Council (23 February 2018) and also the Public meeting (15 March 2018).

The key issues raised by Council at the meeting include:

- Community support in the form of a financial contribution from Reach Solar to various local activities in the future;
- Workers accommodation including the worker numbers during construction and the specific duration of construction and the phased development;
- Waste Management; and
- Traffic related issues including the transport routes for construction and operation of the solar farm.

The SEARs for this Project were issued by DPE after consultation with Narrandera Shire Council and all relevant State Government Agencies. Records of the correspondence from these agencies in response to the draft SEARs proposed by DPE is provided in **Appendix A** of this report.

In preparation of the EIS, relevant Local, State and Commonwealth Government authorities as well as infrastructure and service providers were consulted with. A number of telephone conversations and emails have been exchanged between the proponent and DPE in order to clarify SEARs requirements or to update the authority on the Project details.

The proponent has also had direct discussions with other agencies including the Narrandera Shire Council, Murrumbidgee Shire Council, NSW Fire and Rescue, Office of Environment and Heritage and Transgrid. A complete record of consultations with agencies and organisations in provided in **Appendix O**.

6.2 Aboriginal Consultation

Aboriginal community consultation for the Project has been undertaken by OzArk as part of the Aboriginal and Cultural heritage impact assessment (refer to **Section 7.1.2**). This consultation has followed the Aboriginal Cultural Heritage Consultation Requirements (ACHCRs)(NPWS 2010) as part of this assessment. The main stages of the ACHCRs for this Project are provided below.

6.2.1 Stage 1 Notification of the Development and Registration of Interest

- Advertisement placed in the Narrandera Argus, 17 January 2018.
- Letter seeking information from agencies sent on 15 January 2018. Letters sent to Office of Environment and Heritage, Office of Registrar ALRA, NTSCORP, National Native Title Tribunal, Narrandera Local Aboriginal Land Council (LALC).
- Letter seeking information from agencies sent on 17 January 2018. Letter sent to Leeton and District LALC.
- By closing date for registration concerning this Project, seven groups or individuals registered to be consulted as Registered Aboriginal Parties (RAPs). They are as follows:
  - Leeton and District LALC;
  - Narrandera LALC;
  - Will Carter;
  - Lee Reavley;
  - Lesley Houston;
  - Bevan Bright; and
  - Bundyi Aboriginal Cultural Knowledge.

6.2.2 Stage 2/3 Presentation of Information about the Proposed Development and Gathering Information about Cultural Significance

On 16 February 2018 all RAPs were sent the following information:

- Development overview; and
- Survey methodology.

Will Carter provided feedback on the survey methodology proposing that at the beginning of the report the the Wiradjuri people, are acknowledged as the Traditional Owners of the area.

No further feedback regarding Stage 2/3 development overview or survey methodology was provided to OzArk by any RAPs.

6.2.3 Field Survey Participation

Fieldwork was undertaken 22-29 March 2018. The following RAPs or representatives of RAPs participated in the fieldwork program:

- 22 March and 24-28 March 2018 – Mark Sadler (Bundyi Aboriginal Cultural Knowledge);
- 22-23 March – Roland Williams (Leeton and District LALC); and
- 22-23 March – Warrick Williams (Leeton and District LALC).

6.2.4 Stage 4 Review of Draft Aboriginal and Cultural Heritage Assessment Report

The draft Aboriginal and Cultural Heritage Assessment Report (ACHAR) was sent to all registered RAPs on 29 May 2018. A 28 day review period was provided, closing on 27 June 2018.

No comments were received from RAPs by the close of the 28 day review period.

A log and copies of all Aboriginal consultation is provided within the ACHAR which is provided in **Appendix C** of this EIS.

6.3 Community and Stakeholder Engagement Strategy

The purpose of the Community and Stakeholder Engagement Strategy was to:

- identify the relevant stakeholders relating to the Project;
- to engage with the identified stakeholders to present them with up to date details of the Project ;
- provide the stakeholders with an opportunity to provide feedback any identify and issues or concerns that they may have; and
- document any outcomes from the consultation that are to be included in the EIS.

6.3.1 Identification of Key Stakeholders

6.3.1.1 Stakeholder Identification

An initial high level assessment was undertaken by SLR to identify all relevant stakeholders, their potential impact from the project as well as their contact details. As the stakeholder engagement process progressed, this initial list of Stakeholders was refined. This initial assessment identified 145 stakeholders that could be engaged during the stakeholder engagement process.

The stakeholders were classified into different groups based on their interests.

The classifications used included:

- RAPs;
- Community Groups;
- Transport;
- Federal Government;
- State Government;
- Landowner(s);
- Internal Consultant;
- Community Member;
- Environmental Group(s);
- Business/Industry Stakeholder group(s);
- Infrastructure Owner(s);
- Government Department(s);
- Media;
- Local Members (State and Federal); and
- Other.

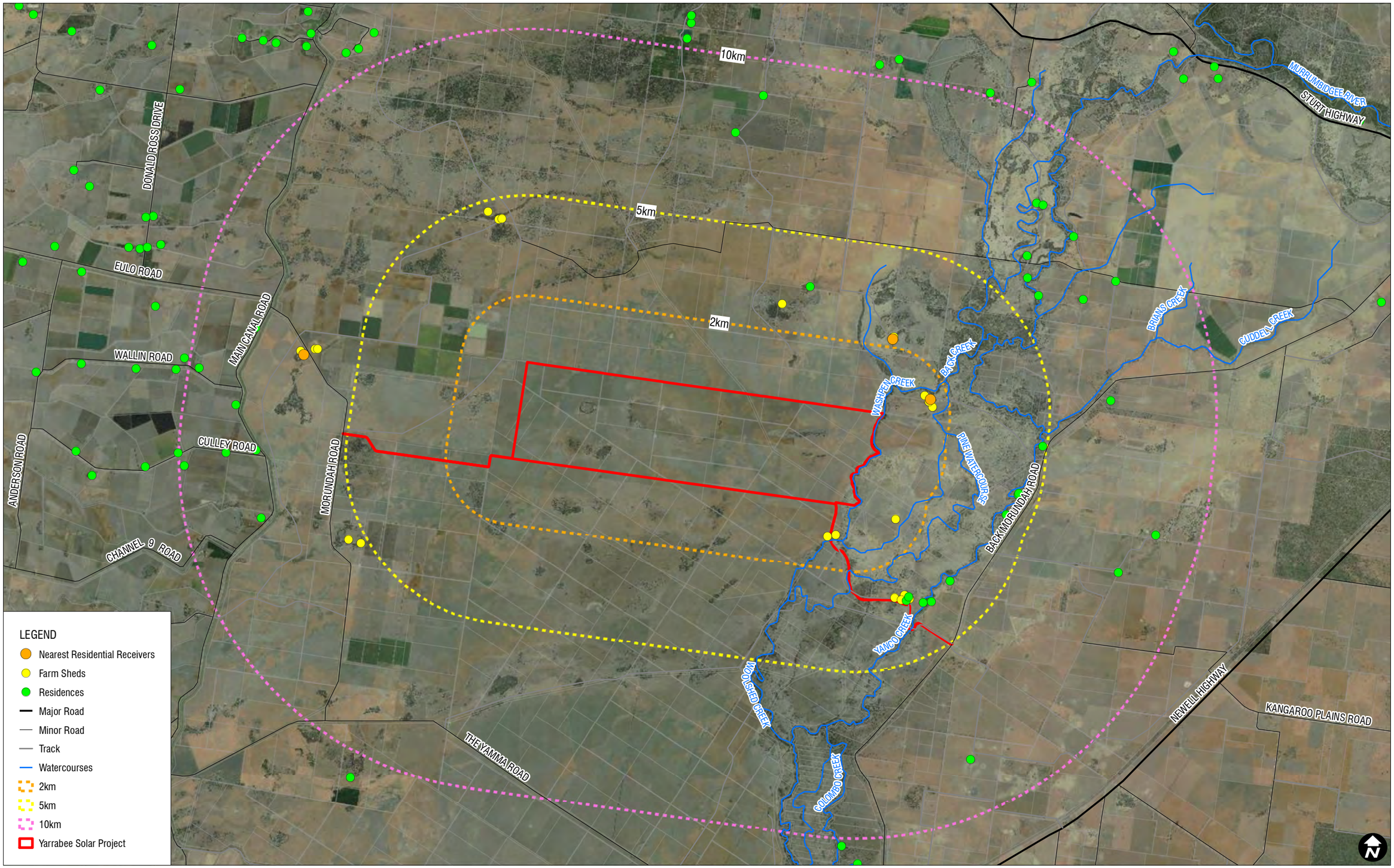
Landowners directly adjacent to the Project area are included in the Plan and are shown on **Figure 6-1**.

- Seven (7) adjacent landowners have been identified.

As part of the Aboriginal and Cultural Heritage Assessment, an advertisement was posted in the local paper to seek expressions of interest from Aboriginal groups or individuals of the Narrandera area, who wish to be consulted over an Aboriginal cultural heritage assessment for the proposed Project.

During this stage the Narrandera Council Shire (Council), Murrumbidgee Shire Council and Department of Planning and Environment (DPE) were also consulted regarding the Project.

In order to better understand the potential impacts and matters that may be of important to the Stakeholders a list of key issues was prepared by the Project team for the Project.



SLR

Land Owners

FIGURE 6.1

This included the following:

- Impacts to native grasslands;
- Glare from the solar panels;
- Construction impacts;
  - Noise
  - Dust
  - Access
  - Source of water for ablutions, wash-down bay, site office etc;
  - Accommodating the construction workforce;
  - Strain on community resources/public facilities;
  - Traffic impacts (particularly during shift changeover);
  - Transient nature of the construction
  - Competing with local business for staff resources;
- Operational impacts;
  - Source of water for hosing down solar panels, site office.
- Access;
- Loss of cropping land;
- Cumulative impacts from other proposed solar farms and poultry projects;
- Stimulation of the local economy;
- Employment opportunities; and
- Implications of a large construction on a small, rural community.

Whilst not specifically a requirement for this project, the NSW Department of Planning & Environment's (DPE) recently published Social Impact Assessment Guidelines (September 2017) have been used to guide the approach taken to identify and engage with the key stakeholders. To this end, the following principals from the Guideline were adopted:

- Early engagement;
- Providing details regarding the Project in a manner that can be easily understood by the community and other stakeholders;
- Communicating the aspects of the Project which may be altered as a result of community and stakeholder feedback;
- Having appropriate protocols in place to manage any culturally sensitive information;
- Paying particular attention to impacted and interested people when they are part of a vulnerable group, such as Aboriginal people;
- Encouraging involvement of all relevant stakeholders; and
- Indicating how community and stakeholder feedback will be used in decision-making and Project change.

Department of Planning and Environment's expectations for engaging with the community and other stakeholders during scoping are also acknowledged. These expectations are listed in **Table 10** and have been used to guide the ongoing community consultation and stakeholder engagement process during scoping and future phases of the Project.

Table 10 Department of Planning and Environment's Engagement Requirements

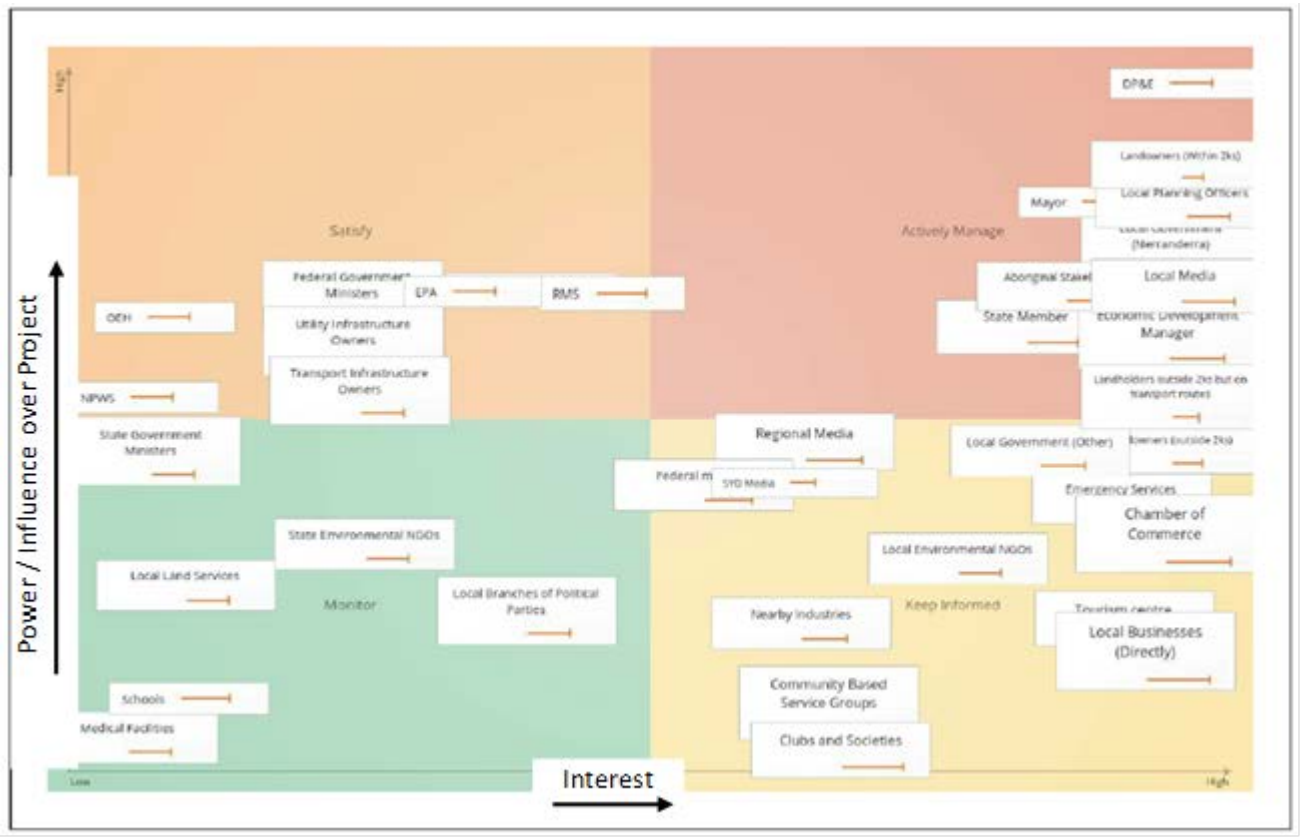
Activity	Requirements	Response
Information to be provided to the community and other stakeholders	Proponents are to provide the community and other stakeholders with:	Information has been provided in the following Sections of the EIS.
	• A description of the project;	Section 3.1
	• A map showing the project's location in both its local and regional context, and at a scale that locates properties likely to be impacted;	Section 2
	• The rationale or reason for the project;	Section 4
	• The project's strategic planning context;	Section 5
	• Alternatives considered in advance of the decision to pursue the project;	Section 4.3
	• The relevant matters for consideration in the EIA as identified through the Scoping Worksheet;	Section 9.2
	• The point of contact for the community and other stakeholders to obtain more information if needed;	Section 1.6
	• Information about how feedback from the community and other stakeholders during the scoping phase will be considered in the Scoping Report and used to inform the SEARs;	Section 6.3
	• Explanation of where scoping fits within EIA, the purpose of participation during the scoping phase, and the opportunities for participation of the community and other stakeholders during the remainder of the EIA.	Section 6.3
Feedback to be obtained from the community and other stakeholders on defined issues	Proponents are to obtain feedback on:	Information has been addressed in this section the EIS (Section 6).
	• Any community and other stakeholder concerns about the environmental, economic and social matters identified in the draft Scoping Worksheet and the nature of those concerns;	
	• Any other relevant matters or local knowledge that the community and other stakeholders believe should be considered in the EIS;	
	• Community and other stakeholder preference for how they want to participate during the EIS preparation and exhibition phases; and	
	• Benefits of the project identified by the community and other stakeholders.	

DPE *Approach to Engagement Worksheet* (as set out in Guidance Note 6, Community Stakeholder Engagement – Draft Environmental Impact Assessment Guidance Series June 2017), was also used to guide the consultation and stakeholder engagement process, as shown in **Table 10**.

6.3.1.2 Stakeholder Mapping

Following the completion of the initial Phase, SLR prepared a Stakeholder Map which assessed each of the Stakeholders. It was prepared in consultation with Reach and was used to prioritise those stakeholders based on their interest in the project and their ability to influence the project. **Figure 6.2** is the completed map.

Figure 6-2 Output from the Stakeholder Mapping



6.3.2 Stakeholder Engagement Strategy

A Stakeholder Engagement (SE) Strategy was prepared using the information determined from the Stakeholder identification stages of the project. The SE Strategy included grouping each stakeholder into groups, identifying the names and details of the key contacts. In addition, the SE Strategy specified how consultation would be undertaken, using methods such as: face to face meetings, letters, emails, letterbox drops and the project website. An engagement log has also been maintained as part of the Project which includes key dates, who was involved and a list of any issues raised during the consultation.

6.3.3 Consultation Undertaken to Date

The following sections provide a summary of the community and stakeholder consultation undertaken on the Project. Reach Solar would maintain on-going consultation with the community and other project stakeholders during and following the EIS exhibition period.

6.3.3.1 Meetings

Meetings with four near neighbours were held to inform them of the project. Transport access for both heavy and light vehicles, and potential routes for oversized transport requirements (i.e. transformers) along with potential mitigation strategies for moving the anticipated large number of workers were discussed at these meetings.

A public meeting was held at the Narrandera Ex-Services Club on the 15 March 2018. The meeting was attended by Reach Solar and its planning consultant SLR's . The purpose of the meeting was to brief the community on the Project and to encourage feedback that could be considered further in the technical work that was ongoing. A total of 25 community members attended the meeting. A copy of the presentation given at the meeting is included as **Appendix O**.

The key issues raised by community members at the meeting and where this has been addressed in the EIS are provided in **Table 11** below.

Table 11 Key issues raised by community members

Key Issues Raised	Response
General question regarding the plant and layout.	An indicative layout of the Project was presented at the meeting. This presentation was also provided to key stakeholders at meetings, via email or letterbox drop as outlined in following sections. No feedback on the indicative layout to date.
Would the project increase the level of EMF generated from the 330kV transmission lines.	This has been addressed as part of the Hazard and Risk Assessment. Refer Section 7.3.3 and Appendix G.
General questions regarding transport and routes, including the possibility to use rail.	A detailed Traffic Impact Assessment has been undertaken which provides details on the Project transport and routes. This assessment also addresses the possibility of using rail. Refer Section 7.3.9 and Appendix M.
The possibility for low cost energy for Narrandera and the surrounding area	The possibility for low cost energy for Narrandera and the surrounding area is discussed in **Sections 4.1 and 4.2.**
The feasibility of other solar projects in the region and how this might affect the Yarrabee project.	Reach Solar is not in a position to comment on the feasibility of other solar projects in the region. The cumulative impacts of other projects including the Euroley Poultry Production Complex and the proposed Avonlie and Sandigo solar projects is discussed in Section 7.4.
Ability to have sheep grazing within the facility after the plant is operational.	Additional employment opportunities are likely to be available to the landowner through opportunities that may arise in terms of managing sheep during the solar project's operation. Activities such as sheep grazing during the operational phase of the Project would be subject to agreement with the landholder. Refer Section 7.3.8.

On the 16 May 2018, Reach Solar representatives attended a meeting with Narrandera Shire Council. This meeting had been arranged through the Narrandera Economic Development and was intended to provide an update to the Council.

Attendees at the meeting from Council were:

- Mayor;
- Economic Development Manager;
- General Manager;
- Deputy General Manager, Infrastructure;

The presentation on the project focused on progress that had been made from the previous meeting with Council (23 February 2018) and also the Public meeting (15 March 2018).

The key issues raised at the meeting include:

- Community support in the form of a financial contribution to various local activities in the future;
- Workers accommodation including the worker numbers during construction and the specific duration of construction and the phased development;
- Waste types and volumes, and how waste will be managed; and
- Traffic related issues include the transport routes for construction and operation of the solar farm.

During the week commencing 28 May 2018, representatives from SLR and Reach Solar planned to be in the region to undertake further face to face meetings with key stakeholders. In preparation for this visit a number of phone calls were made to the near neighbours and the surrounding Councils.

Despite this offer to meet, all stakeholders contacted indicated that they were happy to receive information emailed to them rather than meet in person, so face to face meetings were not held on this occasion (see **Section 6.5.2** below).

General feedback from the community about the Project has been positive and provided a sense of broad acceptance regarding how the issues raised in consultation have been addressed.

Printed information about the project including updated project information has been made available at all meeting with Council and the broader community members.

6.3.3.2 Letterbox Drops

On 2 June 2018, a number of Project leaflets were dropped in all mailboxes along Main Canal Road and the Back Morundah Road. These roads had been identified as the likely transport routes during construction and operation so it was important that any stakeholders living along these roads provided with information on the project. No feedback has been received in response to this letterbox drop. A copy of the leaflet is provided in **Appendix O**.

6.3.3.3 Mail Outs

On 5 June 2018, information packs were emailed to all stakeholders who indicated an interest in the Project. A copy of the information pack and the cover email is provided in **Appendix O**.

6.3.3.4 Project Website

Project information has been provided on the Yarrabee Solar Project website at www.yarrabeesolar.com.

The website includes an overview of the Project and offers stakeholders the opportunity to provide further feedback and comments.

6.3.3.5 Consultation database

A consultation database has been created and maintained to record community stakeholder contact details, and issues concerns or feedback received on the Project.

A copy of the register is included in **Appendix O**.

6.3.4 EIS Exhibition and Response to Submissions

Once the EIS is submitted it will be put on public exhibition for a minimum of 28 days. During this public exhibition period all stakeholders will have the opportunity to provide further feedback on the Project directly to the DPE including the opportunity to review the EIS and attached technical studies. Reach Solar will respond to any issues raised through the EIS exhibition process in a response to submissions report. Reach Solar would also undertake ongoing community consultation and stakeholder engagement activities as part of further developing the Project.

Reach SOLAR ENERGY

SECTION 7

ENVIRONMENTAL IMPACT ASSESSMENT

SLR

7 ENVIRONMENTAL IMPACT ASSESSMENT

7.1 Impact Assessment of Key Environmental Issues

This section contains a description of the existing environment and a comprehensive and focussed assessment of the potential environmental issues/impacts for key issues identified for the Project.

7.1.1 Biodiversity (Fauna and Flora)

7.1.1.1 Approach

A Biodiversity Development Assessment Report (BDAR) has been prepared for the Project and is included as **Appendix E**. The BDAR has been prepared in accordance with the NSW Biodiversity Assessment Method (BAM) (OEH 2017c) and aims to:

- Outline the methods used to identify the biodiversity values within the Project site;
- Describe the biodiversity values within the Project site, including:
  - The presence of native vegetation and its integrity;
  - The presence and extent of each identified Plant Community Type (PCT);
  - The presence of flora and fauna species, and the extent of their respective habitats;
  - The presence of threatened species, populations and ecological communities listed under the NSW *Biodiversity Conservation Act 2016* (BC Act); and
  - The presence of matters of national environmental significance, particularly threatened ecological communities (TECs), threatened species and migratory species listed under the Commonwealth EPBC Act.
- To assess potential impacts of the proposal on biodiversity values, including prescribed impacts and serious and irreversible impacts (SAIIs), in terms of biodiversity credits (i.e. ecosystem credits and species credits) as per the BAM (OEH 2017b);
- Recommend mitigation and environmental management measures to avoid and/or minimise adverse impacts on biodiversity values; and
- Determine whether a biodiversity offset is required for project approval, as per the requirements of the BAM.

7.1.1.2 Existing Environment

Vegetation Communities

Regional vegetation mapping (OEH 2018j) indicates that the following vegetation communities occur within the Project site:

- Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina and Murray Darling Depression Bioregions);
- Native grassland complex;

- River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina and Murray Darling Depression Bioregions);
- River Red Gum - Warrego Grass - herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion;
- Shallow Swamp;
- White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone;
- Yellow Box - River Red Gum tall grassy riverine woodland of NSW South West Slopes and Riverina Bioregions; and
- Yellow Box - White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina and western NSW South Western Slopes Bioregion.

A field assessment determined that the regional vegetation mapping was relatively inaccurate in terms of vegetation community identification and extent. Following the site assessment, it was determined that native grasslands were not as extensive as indicated by the mapping and only three PCTs were confirmed to be present. A vegetation map based on the site survey is presented in **Figure 7-1**.

Threatened flora

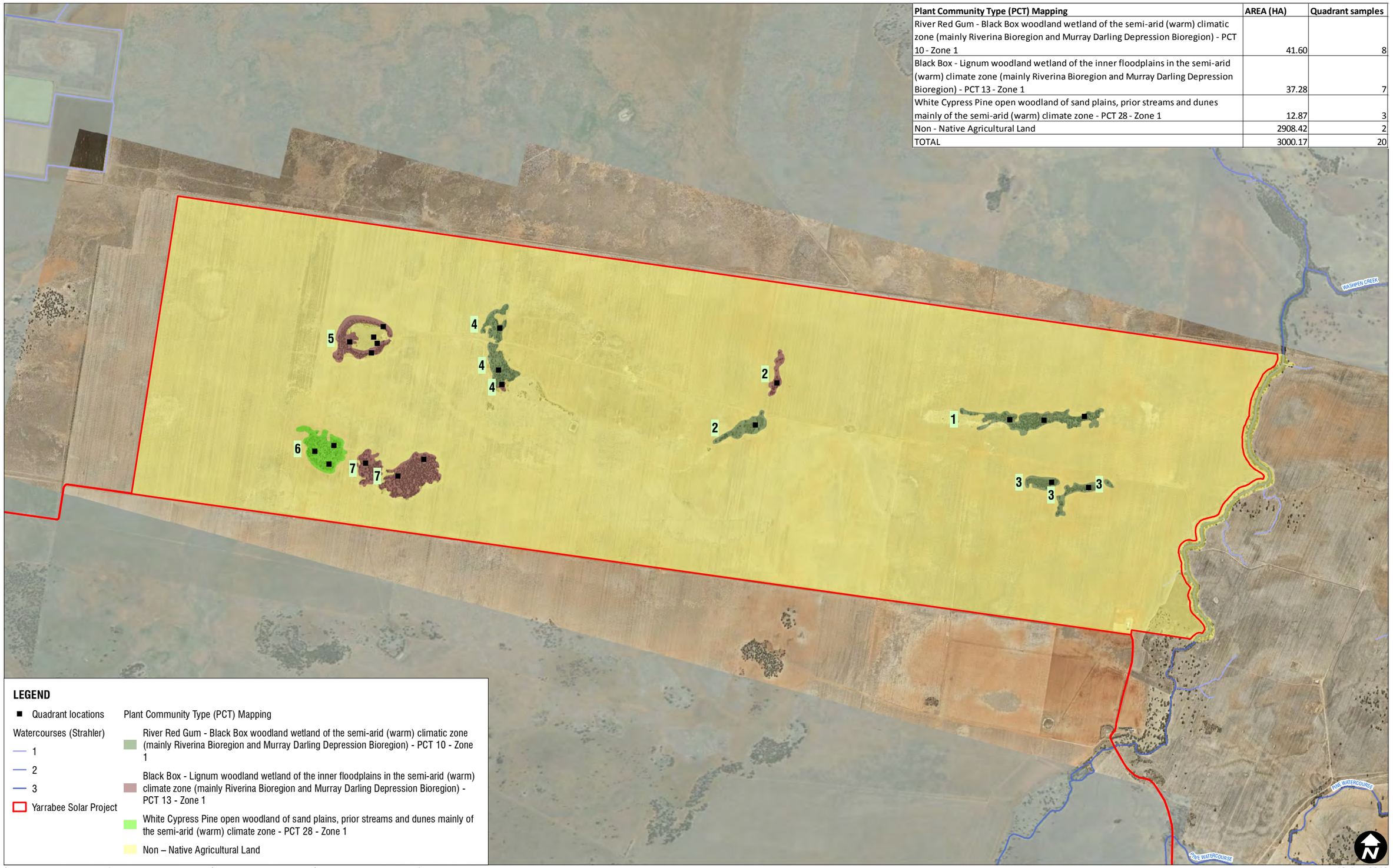
Records of threatened species retrieved from the NSW Bionet Atlas database (10 km search area) (OEH 2018a) found that a total of 58 threatened fauna species 24 threatened flora species and 5 threatened ecological communities have been identified within the Project site and surrounding areas. These are discussed further in the sections below.

Threatened fauna habitat

A search of the NSW Bionet Atlas detected 24 threatened plant species within a 10 km radius from the centre of the Project site (**Appendix E**). No threatened flora species were identified within the Project site, although the species listed below were identified as having a moderate 'likelihood of occurrence' based on habitat availability in woodland habitat. Although the flora surveys did not coincide with the detectability of all of these species, no habitat for these species was found to be present within the development footprint

- Bindweed (*Convolvulus tedmoorei*);
- Chariot Wheels (*Maireana cheelii*);
- Claypan Daisy (*Brachyscome muelleroides*);
- Hoary Sunray (*Leucochrysum albicans var. tricolor*);
- Lanky Buttons (*Leptorhynchos orientalis*);
- Menindee Nightshade (*Solanum karsense*);
- Oaklands Diuris (*Diuris sp. - Oaklands, D.L. Jones 5380*);
- Red Darling Pea (*Swainsona plagiotropis*);
- Sand-hill Spider Orchid (*Caladenia arenaria*);
- Silky Swainson-pea (*Swainsona sericea*);
- Slender Darling Pea (*Swainsona murrayana*);
- Small Scurf-pea (*Cullen parvum*); and
- Winged Peppercress (*Lepidium monoplocoides*).

Plant Community Type (PCT) Mapping	AREA (HA)	Quadrant samples
River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) - PCT 10 - Zone 1	41.60	8
Black Box - Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) - PCT 13 - Zone 1	37.28	7
White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone - PCT 28 - Zone 1	12.87	3
Non - Native Agricultural Land	2908.42	2
TOTAL	3000.17	20



LEGEND

- Quadrant locations
- Watercourses (Strahler)
  - 1
  - 2
  - 3
- Yarrabee Solar Project

Plant Community Type (PCT) Mapping

- River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) - PCT 10 - Zone 1
- Black Box - Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) - PCT 13 - Zone 1
- White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone - PCT 28 - Zone 1
- Non – Native Agricultural Land

0 1 2 3 4 km

Scale: 1:35,000
GDA 1994 MGA Zone 55

10-Aug-2018

H:\Projects-SLR\620-BNE\610-SYD\610.17428\01 GIS\ArcGIS\SLR610.17428_EIS_Survey_Vegetation_Mapping_001.mxd

SLR

Plant Community Type (PCT) Mapping

FIGURE 7.1

Threatened Fauna and Habitat

Of the threatened biota identified as potentially occurring within the Project site, two species were recorded during the field surveys:

- Brown Treecreeper (*Climacteris picumnus victoriae*) which was observed foraging in riparian woodland vegetation during the field survey; and
- Inland Forest Bat (*Vespadelus baverstocki*), which is likely to be utilising hollow-bearing trees in woodland areas as roosting habitat.

Additionally, the following threatened fauna species were identified as having a moderate 'likelihood of occurrence' based on habitat availability in woodland habitat:

- Spotted Harrier (*Circus assimilis*);
- Major Mitchell's Cockatoo (*Lophochroa leadbeateri*);
- Black Falcon (*Falco subniger*);
  - Little Eagle (*Hieraaetus morphnoides*);
  - White-bellied Sea-Eagle (*Haliaeetus leucogaster*);
  - Black-breasted Buzzard (*Hamirostra melanosternon*);
  - Dusky Woodswallow (*Artamus cyanopterus*);
  - Diamond Firetail (*Stagonopleura guttata*);
  - Varied Sittella (*Daphoenositta chrysoptera*);
  - Bush Stone-curlew (*Burhinus grallarius*);
  - Turquoise Parrot (*Neophema pulchella*);
  - Superb Parrot (*Polytelis swainsonii*);
  - Regent Honeyeater (*Anthochaera Phrygia*);
  - Painted Honeyeater (*Grantiella picta*);
  - Black-chinned Honeyeater - Eastern Subspecies (*Melithreptus gularis gularis*);
  - Grey-crowned Babbler (*Pomatostomus temporalis temporalis*);
  - Scarlet Robin (*Petroica boodang*);
  - Barking Owl (*Ninox connivens*);
  - Grey-headed Flying-fox (*Pteropus poliocephalus*);
  - Little Pied Bat (*Chalinolobus picatus*);
  - Southern Myotis (*Myotis macropus*); and
  - Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*).

Although the fauna surveys did not coincide with the detectability of all of these species, no suitable habitat for these species would be directly impacted by the Project. Additionally, the majority of these species are likely to use habitats in the local area as part of a wider network of habitat within the wider area. Therefore, the habitat is not considered to be critical to the survival of these species.

Figure 7-2 shows the locations where each threatened fauna species was recorded within the Project site.

Field surveys confirmed that the following main fauna habitat types occur within or adjacent to the Project site:

- Woodland;
- Native Grassland;
- Dams (Aquatic Habitat);
- Riparian Vegetation (adjacent to the Project site); and
- Agricultural Areas.

Justification for the identification of this TEC is provided below:

The vegetation is a native plant community within the Riverina Bioregion, and;

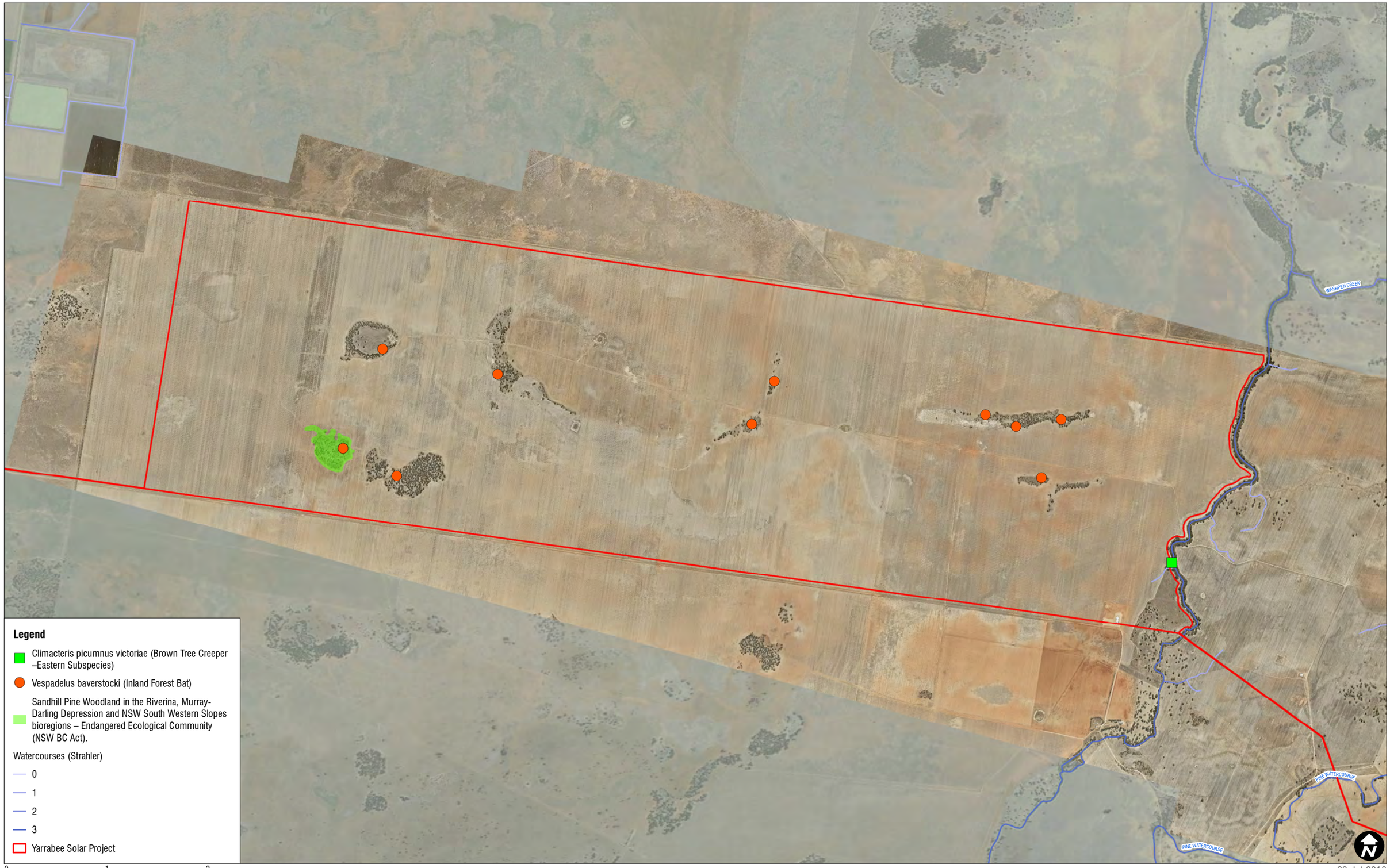
- The vegetation is commensurate with a Riverine Sandhill Woodlands as indicated by its position on an elevated sand hill area within the Project site;
- The canopy of the community contains indicator species including Callitris glaucophylla (White Cypress); and
- The groundcover of the community is comprised of native grasses and herbs.

Threatened Ecological Communities

A search of the NSW Bionet Atlas detected four threatened ecological communities (TECs) within a 10 km radius from the centre of the Project site. Of these, one was identified within the Project site: Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions ('Sandhill Pine Woodland'). The occurrence of Sandhill Pine Woodland TEC within the Project site is restricted to a single 12.87 ha patch in the southwest portion. The vegetation integrity score for this community is 17.2 (refer to **Section 3.2.5 of Appendix E**). This indicates that the condition of the community is low, as evidenced by the lack of native understory and shrub species identified during the field assessment.

7.1.1.3 Site Surveys

Vegetation assessment and threatened flora surveys were conducted on the 19/02/2018 and 23/02/2018. Fauna surveys and habitat assessments were conducted between the 19/02/2018 and the 19/04/2018. Methods used during the field surveys are described in **EIS Appendix E**. The assessment was undertaken in accordance with the BAM (OEH 2017c) and with reference to the *NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft)* (DEC 2004).



H:\Projects-SLR\620-BNE\610-SYD\610.17428\01 GIS\ArcGIS\SLR610.17428_EIS_Threatened_Biota_001.mxd

Scale: 1:35,000
GDA 1994 MGA Zone 55

23-Jul-2018

SLR

Threatened biota

FIGURE 7.2

The vegetation assessment revealed that the Project site contains the following features and biodiversity values:

- The Project site is relatively flat and lies within an alluvial floodplain to the west of Washpen Creek;
- The Project site contains three constructed dams, all of which lack aquatic and emergent vegetation;
- The soils within the Project site are derived from quaternary alluviums which consist of grey, brown and red cracking clays;
- A total of 74 plant species were recorded on the Project site. These comprised 41 native species and 33 exotic species.
- No threatened plant species listed under the NSW BC Act or the Commonwealth EPBC Act were recorded.
- Three native vegetation communities were identified:
  - River Red Gum - Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion);
  - Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina and Murray Darling Depression Bioregions); and
  - White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone.
- One vegetation community is commensurate with an EEC listed under the BC Act: Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions.
- A total 68 fauna species were recorded on the Project site, comprising 43 birds, 18 mammals, six reptiles and one amphibian.
- Two threatened fauna species listed under the BC Act were identified:
  - Brown Treecreeper (*Climacteris picumnus victoriae*) – Vulnerable; and
  - Inland Forest Bat (*Vespadelus baverstocki*) – Vulnerable.

7.1.1.4 Potential Impacts

Construction of the Project will not require the removal of native vegetation or threatened species habitat within the Project site, and all woodland areas will be retained. No mature trees or hollow-bearing trees are located within the development footprint and therefore none will be removed to allow for construction of the Project.

Impacts on fauna habitat are therefore restricted to the removal of aquatic habitat at each of the dam sites and removal of agricultural land that provides low quality foraging habitat for a narrow selection of common fauna species. Given that resident fauna populations are likely to utilise these areas as part of a wider network of habitats, the Project is likely to have minimal adverse impacts on these species.

Potential impacts of the Project on biodiversity values are therefore considered minimal given that no native vegetation or threatened fauna habitat will be removed or directly impacted.

The Project has the potential for indirect impacts to fauna that may occur incidentally in the Project site during both the construction and operational phase of the Project.

Such impacts may include the following:

- The construction of solar panels and security perimeter fencing within the Project site may obstruct the movement of fauna species through the landscape and may trap fauna within the Project site;
- Light spill from artificial lighting within the Project site may adversely affect the natural behaviour of nocturnal fauna species such as arboreal mammals, large forest owls and foraging microbats;
- Increased traffic within the Project site may facilitate the encroachment of plant weeds that could further degrade the retained areas of native woodland; and
- Increased visitation of the Project site may disturb resident fauna and disrupt their natural behaviour.

Avoidance measures and mitigation measures have been developed to reduce the potential for impacts to biodiversity values within the Project site. These measures are relevant to both the construction and operational phases of the Project.

Given that the Project is generally located on cleared agricultural land and would not directly affect native vegetation or habitat for threatened species, in accordance with the BAM, no biodiversity offsets are required.

7.1.1.5 Avoidance Measures

Consideration has been given to avoiding and minimising impacts to biodiversity through design of the Project. Site selection options have been assessed against key environmental, social and economic criteria, with several alignment and interchange options being eliminated due to their impact on environmental values; notably on native vegetation, EECs, and threatened species habitat. The option selection process has succeeded in avoiding any direct impacts on these biodiversity values will result from the Project.

7.1.1.6 Mitigation and Management Measures – Construction Phase

Construction activities within the Project site have the potential to impact on habitats outside the subject site (i.e. Washpen Creek) indirectly through sedimentation, chemical spills that spread off-site and spread of weeds. The following mitigation measures would be implemented to minimise such impacts.

Erosion Control

Mitigation measures to reduce soil erosion and pollutant run-off during construction activities should include:

- Installation of erosion and sediment control measures prior to any works;
- Regular inspection of erosion and sediment control measures, particularly following rainfall events, to ensure their ongoing functionality;
- Management of excavated materials to prevent sediment transfer;
- Avoiding stockpiling of materials adjacent to native vegetation, but instead use areas that are already cleared/ disturbed; and
- Maintenance of silt fences and other mitigation measures to isolate runoff.

Chemical Spills

Specific measures to minimise the potential for chemical spills and associated impacts on adjacent natural environments should include the following:

- All chemicals must be kept in clearly marked bunded areas.
- Regularly inspect vehicles and mechanical plant for leakage of fuel or oil.
- No re-fuelling of vehicles, washing of vehicles or maintenance of vehicles and plant to be undertaken within 20 m of natural drainage lines.

Weed Management

Priority weeds, environmental weeds and HTE species were identified within the subject site (see Section 3.2). Measures to prevent the spread of weeds should include the following weed hygiene procedures:

- All vehicles, equipment, footwear and clothing should be clean and free of weed propagules prior to entering the subject site.
- Any weeds that are removed during the construction phase should be disposed of via an appropriate waste facility.

7.1.1.7 Mitigation Measures – Operational Phase

Security Perimeter Fencing

The fencing of large land parcels can have a negative impact on terrestrial fauna species within the locality such as Kangaroos and Emus. It is important to allow for natural movements of fauna throughout the landscape thus maintaining high connectivity. Degradation of habitat by high Kangaroo numbers in fenced sites has occurred on numerous Defence sites throughout NSW and the ACT and has caused widespread public concern after culls have been required to control animal numbers (Peachey *et al*. 2007). Additionally, high numbers of Kangaroos can cause severe degradation of grassland and woodland habitats (Leigh 1989; ESA 2016) if trapped within fenced areas.

Monitoring should be conducted annually for a three to five year period following project construction to assess the abundance and welfare of Kangaroos and Emus within the Project site. A quantitative survey approach should be employed by a suitably trained project ecologist. This method should involve walking transects to estimate Kangaroo and Emu numbers. Statistical analysis may involve using distance analysis to estimate population size and density (Thomas et al. 2010). Each monitoring event should also assess the impacts of grazing pressure on native vegetation via permanent monitoring plots. At least one monitoring plot should be placed in each vegetation type to assess grazing impacts. Vegetation integrity should be assessed using the Biodiversity Assessment Method (OEH 2017c).

Offset Requirements

The BAM (OEH 2017c) establishes a framework to offset impacts on biodiversity from development through the Biodiversity Offsets Scheme. Given that the Project would not directly impact any areas native vegetation or habitat for threatened species, no biodiversity offsets are required.

7.1.2 Aboriginal Heritage

7.1.2.1 Background

An Aboriginal Cultural Heritage Assessment has been carried out by OzArk Environmental and Heritage Management Pty Ltd (OzArk) for the Project and is provided in **EIS Appendix C.**

The objectives of the Aboriginal Cultural Heritage Assessment were to:

- Undertake background research on the study area to formulate a predicative model for location of Aboriginal sites within the Project site;
- Identify and record objects or sites of Aboriginal heritage significance within the study area, as well as any landforms likely to contain further archaeological deposits; and
- Assess the likely impacts of the proposed work to Aboriginal cultural heritage and provide management recommendations.

7.1.2.2 Site Survey

A site survey was carried out for the Project to identify and assess Aboriginal potential heritage constraints. The assessment was undertaken in accordance with the following guidelines:

- *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (Code of Practice; DECCW 2010);
- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011); and
- *Aboriginal Cultural Heritage Consultation Requirements for proponents* (DECCW 2010b) (ACHCRs).

The site survey was completed by OzArk between 22-29 March 2018. Surveys of the eastern and western access roads were carried out separately on 7 August 2018. Consultation with the Aboriginal community was carried out in accordance with the ACHCRs and involved the following activities:

- Stage 1 – notification of the development and registration of interest;
- Stage 2/3 – presentation of information about the proposed development and gathering information about cultural significance. This stage also included the participation of Registered Aboriginals Parties (RAPs) in the fieldwork program; and
- Stage 4 – review of draft Aboriginal Cultural Heritage Assessment report.

Further details of each stage identified above are provided in **EIS Appendix C**.

As discussed above, the archaeological methods utilised in the Aboriginal archaeological assessment followed the Code of Practice and the proposed methodology, which is provided in Attachment 1 of **EIS Appendix C**. Standard archaeological field survey and recording methods were employed in this study (Burke & Smith 2004). The study area was assessed by pedestrian transects, covering specific landforms and sampling the main landform type of flat ploughed plain. Surveys were undertaken by suitably qualified archaeologists who were spaced approximately 100 m apart in non-sensitive areas, and 50 m apart in identified potentially sensitive areas.

The field assessment included:

- Full pedestrian survey of landforms within the study area identified to be potentially sensitive regarding Aboriginal archaeological potential. This included areas of remnant trees, within 200 m of watercourses, and higher ground including dunes. This equated to 19.1% of the study area;
- Targeted pedestrian survey in areas where the landform was flat ploughed plain (with low archaeological potential). This includes areas more than 200 m from watercourses, areas with poor GSV, and areas with significant prior disturbance (18.2% of the study area). The survey methodology established that 18 survey areas, each measuring 600 m by 500 m, were randomly selected across the low potential landforms to ensure a robust sample was obtained;
- Overall, 37.3% of the study area was subject to visual inspection; and
- All mature, native trees within the study area and with the potential to contain Aboriginal scarring were inspected.

7.1.2.3 Existing Environment

The existing environment of the study area consists mostly of flat plains and is characterised by quaternary alluvial sands, which includes clays and sands with bordering dunes and lakes. The majority of the study area has been cleared for agricultural cropping and, sheep and cattle grazing. Native woodland remnants comprise three Plant Community Types (refer to **EIS Appendix C**). Native plant diversity is relatively low in most areas and is comprised of native and exotic grasses and herbs.

The main soils in the subregion are red brown earths, grey and brown clays and deep siliceous sands on dunes. There is a large dune formation in the centre of the study area characterised by richer red-brown loamy soils. There is also a similar dune formation, on a smaller scale, in the southwest of the study area where an area of remnant trees remains. In the northwest of the study area there is a natural swamp surrounded by remnant vegetation and with native grasses inside the area (refer to **EIS Appendix C**). There are no rock outcrops within the study area, typical of the Riverina bioregion, and almost no gravels were observed.

The study area stretches from 40 m west of Washpen Creek to 8 km east of Coleambally Main Canal. Both Washpen Creek and the Coleambally Main Canal connect with the Murrumbidgee River north of the study area. There are also several man-made dams within the study area, and are characterised by man-made banks, windmills and old fencing (see **Plate 4** of **EIS Appendix C**). Though the study area has been extensively ploughed over the last decade, there still remain indications of earlier water sources. Specifically, there are two natural areas which likely still gather water during rainfall. The main one is a circular shallow basin of swamp surrounded by remnant vegetation in the northwest section of the study area (see **Plate 5** of **EIS Appendix C**). The second area is a shallow channel within a remnant treeline in the northeast section of the study area (see **Plate 6** of **EIS Appendix C**).

Overall, the study area has moderate to high levels of disturbance mostly consisting of impacts related to the area's agricultural use and vegetation clearing.

Desktop searches undertaken for the Project, including a search of the OEH administered AHIMS register identified two Aboriginal heritage sites in proximity to the study area. The two sites recorded were both earth mounds for ovens or hearths. These sites were located in close proximity to each other and GPS co-ordinates place them on the eastern side of Washpen Creek, outside the study area. A further 22 Aboriginal heritage sites were recorded within a 10 km radius of the site, but were also located outside the boundary of the study area.

During site surveys, a total of 25 Aboriginal heritage sites were recorded within the study area. Recorded Aboriginal sites include nine isolated finds (Yarrabee IF-1 to IF-9), 13 artefact scatters (Yarrabee OS-3 to OS-15), one earthen mound (Yarrabee EM-1), and two scarred trees (Yarrabee ST-1 and ST-2). Twelve Aboriginal sites were located on a large dune formation in the centre of the study area, while seven were located within remnant tree lines, five on the flat plains and one within a drainage area. The sites recorded during surveys are summarised in **Table 12** and described in detail in **Section 5.4** of **EIS Appendix C**.

Table 12 Site Survey Results

Site number	Feature(s)	Survey unit	Landform
Yarrabee IF-1	1 silcrete flake	1	Flat plains
Yarrabee IF-2	1 silcrete flake	3	Remnant tree line
Yarrabee IF-3	1 silcrete flake	3	Remnant tree line
Yarrabee IF-4	1 quartz flake	3	Remnant tree line
Yarrabee IF-5	1 silcrete flake	2	Dune
Yarrabee IF-6	1 silcrete flake	2	Dune
Yarrabee IF-7	1 silcrete flake	2	Dune
Yarrabee IF-8	1 quartzite flake	2	Dune
Yarrabee IF-9	1 quartz flake	1	Flat plains
Yarrabee OS-3	4 stone artefacts	3	Remnant tree line
Yarrabee OS-4	2 stone artefacts	3	Remnant tree line
Yarrabee OS-5	2 stone artefacts	1	Flat plains
Yarrabee OS-6	16 stone artefacts	2	Dune
Yarrabee OS-7	2 stone artefacts	2	Dune
Yarrabee OS-8	14 stone artefacts	2	Dune
Yarrabee OS-9	2 stone artefacts	2	Dune
Yarrabee OS-10	7 stone artefacts	1	Flat plains
Yarrabee OS-11	8 stone artefacts	2	Dune
Yarrabee OS-12	2 stone artefacts	2	Dune
Yarrabee OS-13	4 stone artefacts	2	Dune
Yarrabee OS-14	4 stone artefacts	3	Remnant tree line
Yarrabee OS-15	4 stone artefacts	1	Flat plains
Yarrabee EM-1	Earth mound with PAD	2	Dune
Yarrabee ST-1	Scarred tree	3	Remnant tree line
Yarrabee ST-2	Scarred tree	3	Remnant tree line

7.1.2.4 Potential Impacts

The Project has the potential to impact on six Aboriginal heritage sites within the study area. These sites are located on or next to existing access tracks are already potentially impacted by ongoing farm activities and may be further impact be impacted if these existing tracks are used by heavy machinery. The sites consist of two isolated finds and four low density artefact scatters (refer to **Table 13**).

There is also a possibility for subsurface archaeological deposits at three of the artefact scatters: Yarrabee OS-8; Yarrabee OS-11; and Yarrabee OS-15, which have the potential to be impacted by the Project. Harm arising from the Project at these sites is assessed as 'partial' because while it will be recommended that the surface manifestation at these sites is salvaged to remove surface artefacts from potential harm by vehicle movements, the subsurface manifestation at these sites will not be impacted by the Project and will remain in situ. As Yarrabee OS-5 is a surface manifestation only, it is expected that the site will be totally harmed by the Project (refer to **Table 13**).

In addition, none of the RAP sites recorded were within the impact footprint (refer to Table 5-8 of **EIS Appendix C**) and will therefore not be impacted by the Project.

Table 13 Impact Assessment of Recorded Sites

Site Name	Type of Harm	Degree of Harm	Consequence of Harm
Yarrabee IF-5	Direct	Total	Total
Yarrabee IF-6	Direct	Total	Total
Yarrabee OS-5	Direct	Total	Total
Yarrabee OS-8	Direct	Partial	Partial
Yarrabee OS-11	Direct	Partial	Partial
Yarrabee OS-15	Direct	Partial	Partial

All six sites have been assessed as having low scientific/archaeological significance, low aesthetic value and low historical value based on the following values:

- Low density of artefacts;
- Few formal tool types; and
- Widespread past and current disturbance through ploughing practices and creation of existing access tracks.

None of the sites recorded have an apparent direct relationship to known historical Aboriginal sites (such as missions or massacre sites).

7.1.2.5 Mitigation and Management Measures

Appropriate management of cultural heritage items is primarily determined on the basis of their assessed significance as well as the likely impacts of the proposed development. The following management options are general principles, in terms of best practice and desired outcomes, rather than mitigation measures against individual site disturbance.

- Avoid impact by altering the Project or in this case by avoiding impact to a recorded Aboriginal site. If this can be done, then a suitable curtilage around the site must be provided to ensure its protection both during the short-term construction phase of development and in the long-term use of the area. If plans are altered, care must be taken to ensure that impacts do not occur to areas not previously assessed. Avoidance of impact to sites/objects is the preferred archaeological and cultural outcome. It is noted that the proponent intends to avoid of the majority of the Aboriginal sites within the study area.

- If impact is unavoidable then appropriate management of the site/object will be determined through policies set out in an Aboriginal Cultural Heritage Management Plan (ACHMP). The ACHMP should include measures for site conservation, as well as detailing methods for the management of sites to be impacted. The management will depend on many factors including the assessed significance of the sites (Section 5.8.2). In certain instances, a site may have low archaeological, aesthetic, and historic values but moderate or high cultural value. In these cases, management is aimed to mitigate the loss of the cultural heritage values, rather than the loss of the scientific values. Sites of low scientific significance, such as an isolated find, could, from an archaeological perspective, be removed/destroyed with no further archaeological management being required. However, given the site's cultural value, further management in respect to these sites will be recommended here. For example, due to a site's cultural values, the local Aboriginal community may wish to collect or relocate artefacts, whether temporarily or permanently, and such management will form part of the ACHMP. The ACHMP will be developed in consultation between the proponent, RAPs and DPE.

Table 14 outlines the management recommendation for each site within or adjacent to the impact footprint, including those needing surface salvage. For the six sites located on existing access tracks there will be surface impacts only. As such, it is not necessary to impact subsurface artefacts or deposits unless ground disturbing activities are planned for the existing access tracks.

Table 14 Management recommendations for sites within or adjacent to the impact footprint of the Project

Site Name or ID	Management strategy
Yarrabee IF-1	The site is located within 50m of the proposed impact footprint. A 10m buffer around the site extent should be erected using high visibility ground markers (i.e. staking and flagging or fencing), prior and during construction works. The removal of the site buffer following construction will be left to the discretion of the proponent.
Yarrabee IF-2	No management required. The site is located in a 400m wide corridor not being impacted and is further than 50m away from the closest edge of the impact footprint.
Yarrabee IF-3	No management required. The site is located in a 400m wide corridor not being impacted and is further than 50m away from the closest edge of the impact footprint.
Yarrabee IF-4	No management required. The site is located 500m south from the closest impact footprint edge.
Yarrabee IF-5	Description and collection of surface artefact.
Yarrabee IF-6	Description and collection of surface artefact.
Yarrabee IF-7	No management required. The site is located 290m northeast from the closest impact footprint edge.
Yarrabee IF-8	No management required. The site is located 330m northeast from the closest impact footprint edge.
Yarrabee IF-9	No management required. The site is located 70m east from the closest impact footprint edge.
Yarrabee OS-3	No management required. The site is located 110m north from the closest impact footprint edge.
Yarrabee OS-4	The site is located within 50m of the proposed impact footprint. A 10m buffer around the site extent should be erected using high visibility ground markers (i.e. staking and flagging or fencing), prior and during construction works. The removal of the site buffer following construction will be left to the discretion of the proponent.
Yarrabee OS-5	Description and collection of surface artefacts.
Yarrabee OS-6	No management required. The site is located 170m north from the closest impact footprint edge.

Site Name or ID	Management strategy
Yarrabee OS-7	No management required. The site is located 250m south from the closest impact footprint edge.
Yarrabee OS-8	Description and collection of surface artefacts. Potential subsurface deposits to remain *in situ*.
Yarrabee OS-9	No management required. The site is located 260m west from the closest impact footprint edge.
Yarrabee OS-10	No management required. The site is located 116m west from the closest impact footprint edge.
Yarrabee OS-11	Description and collection of surface artefacts. Potential subsurface deposits to remain *in situ*.
Yarrabee OS-12	No management required. The site is located 340m south from the closest impact footprint edge.
Yarrabee OS-13	No management required. The site is located 380m west from the closest impact footprint edge.
Yarrabee OS-14	No management required. The site is located 160m northeast from the closest impact footprint edge.
Yarrabee OS-15	Description and collection of surface artefacts. Potential subsurface deposits to remain *in situ*.
Yarrabee EM-1	No management required. The site is located 260m south from the closest impact footprint edge.
Yarrabee ST-1	No management required. The site is located 150m south from the closest impact footprint edge.
Yarrabee ST-2	No management required. The site is located 290m west from the closest impact footprint edge.

The following measures would be implemented to mitigate the potential for Aboriginal heritage impacts associated with the Project.

1. All sites within the impact footprint for the Project or on existing access tracks would be salvaged by a surface collection of all visible artefacts.
2. The salvage works would include the mapping, analysis and collection of all surface artefacts at the affected sites. Results would be included in a report to preserve the data in a useable form.
3. All land-disturbing activities would be confined to within the assessed study area, in particular the impact footprint. Should the parameters of the proposed work extend beyond this, then further archaeological assessment would be required. This includes existing access tracks outside the impact footprint.
4. Following approval of the Project, an AHIP would not be required for impacts to cultural heritage, so long as the impact accords with the terms and conditions of the approval. Instead, impacts on Aboriginal heritage would be managed through an ACHMP which is to be agreed to by the proponent, RAPs and DPE. The archaeological management recommendations within this report would normally be incorporated into the ACHMP.

7.1.3 Agricultural Land Use

An Agricultural Land Assessment has been carried out for the Project, and is included in **EIS Appendix D**, which included an assessment of the soil type profiles, land capability, potential erosion issues and potential impacts of the development on agricultural land.

7.1.3.1 Existing Environment

The Project site is a relatively flat plain with slopes ranging between 1% to 3%, draining westwards away from Washpen Creek. Drainage channels within the site are considered intermittent watercourses with zero flow during low rainfall periods.

Assessment of recent aerial images, along with field inspection, shows that the majority of the site is cleared of native vegetation. Prior to 2016, the Project site was operated as a traditional "mixed farming" enterprise with approximately two thirds of the land area dedicated to sheep grazing and the remaining one third for growing winter cereal crops. In the past two years over 70 km of fencing has been removed and the entire arable area has been sown to winter cereal crops.

The Project site is not covered by Office of Environment and Heritage (OEH) soil landscape mapping. As such there are no soil landscape descriptions available for the Project site. However, two major soil orders are present within the Project site: a Vertosol, which is consistent with OEH eSpade mapping of the area, a Dermosol and a Vertosol-Dermosol Complex. The Vertosol comprises the suborders Red Vertosol, Grey Vertosol and Brown Vertosol which are described in detail in EIS **Appendix D**. Vertosols are clay soils with shrink-swell properties that exhibit strong cracking when dry and at depth have slickensides and/or lenticular structural aggregates. Vertosols are considered productive agricultural soils.

7.1.3.2 Methodology

Soil Survey and Assessment

A field survey and a desktop study were undertaken to assess the distribution of soil resources within the Project site. This process consisted of initial soil mapping using satellite imagery and topographic maps, review of reference information such as cadastral data, geological, vegetation and water resource studies, and previous soil information.

The field survey undertaken was an integrated and qualitative survey, and complied with the 1:250,000 scale survey criteria prescribed in the Guidelines for Surveying Soil and Land Resources (NCST, 2008). The dominant soil types within the Project site were ground-truthed by SLR at the scale of approximately 1:170,000 and determined using the Australian Soil Classification (ASC) System (Isbell, 1996). This assessment consists of 18 detailed soil profiles. The detailed soil profiles were then assessed in accordance with the Australian Soil and Land Survey Field Handbook (NCST 2009), with soil samples taken from thirteen profiles for laboratory analysis. Samples were analysed in order to:

- Classify soil taxonomic classes;
- Determine Land and Soil Capability and Agricultural Suitability classes; and
- Determine erosive potential of the soil.

Soil was collected from each major soil horizon (soil layer) and sent to the EAL Laboratories for analysis.

Soil layers at each profile site were also assessed according to a procedure devised by Elliot and Reynolds (2007) for the recognition of suitable topdressing material in the event surface disturbance occurs in the future. This procedure assesses soils based on grading, texture, structure, consistence, mottling and root presence.

Land and Soil Capability

The land and soil capability (LSC) classification applied to the Project site study area was in accordance with the OEH guideline *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH, 2013) (referred to as the LSC Guideline). This scheme uses the biophysical features of the land and soil to derive detailed rating tables for a range of land and soil hazards. The scheme consists of eight classes, which classify the land based on the severity of long-term limitations.

The LSC classes are described in **EIS Appendix D** Table 14 and their definition has been based on two considerations:

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

The biophysical features of the land that are associated with various hazards are broadly soil, climate and landform and more specifically: slope, landform position, acidity, salinity, drainage, rockiness; and climate.

The eight hazards associated with these biophysical features that are assessed by the scheme are:

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

Each hazard is assessed against set criteria tables, as described in the LSC Guideline; each hazard for the land is ranked from one through to eight with the overall ranking of the land determined by its most significant limitation (refer to **EIS Appendix D**).

Soil Erosion Potential

Emerson Aggregate Testing (EAT) was undertaken to determine the soils erosive potential. EAT ratings are provided in **EIS Appendix D** Table 16.

7.1.3.3 Potential Impacts

Land and Soil Capability

Land within the Project site has been classified as LSC Class 4, which is consistent with the OEH eSpade mapping of the area[8]. The main hazard for the Vertosols present is soil structure decline, with surface soil being mildly sodic, having a low calcium to magnesium ratio and being coarsely structured with little evidence of self-mulching.

LSC Class 4 is land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation). LSC Class 4 land is:

1. Considered moderate capability land which has moderate to high limitations for high-impact land uses;
2. This restricts land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture; and

[8] Office of Environment and Heritage (OEH) sSpade mapping, http://www.environment.nsw.gov.au/eSpade2Webapp

3. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.

Agricultural Compatibility

The Project site is adjacent to other cropping and mixed farming operations, including areas of irrigated agriculture. There are also a number of other major projects, including solar farms and poultry operations, either proposed or approved within the Murrumbidgee Local Government Area (LGA) and the Narrandera LGA.

Whilst construction and operation of the Project would limit the cropping potential within the Project site during the 30 to 50 year life of the project, agricultural production through sheep grazing may be undertaken within the area of the solar array.

It is not anticipated there will be any impacts to the continuing operation of surrounding agricultural enterprises as a result of the Project.

Biophysical Strategic Agricultural Land

There is no Biophysical Strategic Agricultural Land (BSAL) within or adjacent to the Project site. The nearest mapped BSAL is approximately 63 km to the east of the Project site, as shown on **Figure 6 of EIS Appendix D**.

Soil Erosion Potential

In general topsoils within the Project site are slightly dispersive, indicating that remoulded soil peds at field water-holding capacity will disperse in distilled water. The majority of subsoils are moderately dispersive, indicating that air dried soil peds will slake and undergo some dispersion in distilled water. However, given the minimal slope within the Project site, low run-off potential and lack of exposure of subsoils during the construction and operation phases of the Project, the potential for soil erosion to occur is minimal.

7.1.3.4 Mitigation and Management Measures

Mitigation measures provided below would be implemented to minimise potential impacts on agricultural land as a result of the Project:

- Measures for effective erosion and sediment control will be undertaken where soil surface disturbance occurs. These will include:
  - Integration of project design with any site constraints;
  - Preservation and stabilisation of drainageways and minimisation of the extent and duration of any surface disturbance;
  - Control of stormwater flows onto, through and from the Project site in suitably designed and stable drainage structures, including diversion of stormwater through perimeter controls; and
  - Protection of inlets and storm drain outlets, and regular inspection and maintenance of erosion and sediment control structures.
- Where potential impacts have been identified due to the exposure of sodic topsoil or subsoil, gypsum will be applied for any remediation earthworks where sodic soils (with exchangeable sodium percentage is greater than 5). The application of gypsum will minimise the potential for sheet, rill and tunnel erosion to occur on areas of disturbed soil.

7.1.4 Hydrology and Flooding

A Hydrological and Flood Modelling Study has been carried out for the Project, reported in detail in **EIS Appendix H**, addressing the relevant requirements of the Project SEARs. The study has considered the current site land use, existing environmental conditions and the likely impact of all phases of the Project on surrounding surface water and groundwater resources. This has included a detailed analysis of flooding behaviour in the adjacent Washpen Creek / Yanco Creek floodplain extending from the Yanco Weir in the Murrumbidgee River to Yamma Road, 3 km south of Morundah.

The Hydrological and Flood Modelling Study has examined Project impacts on site infrastructure, adjacent licensed water users and basic landholder rights, and developed measures to monitor, reduce and mitigate any potential impacts.

Details of water requirements and supply arrangements for the construction and operational phases of the Project have been estimated as well as the Erosion and Sediment Control (ESC) measures that would be implemented to mitigate any related Project impacts.

In addition to the Project SEARs, the requirements of other government agencies, including OEH (NSW Office of Environment & Heritage), DPI (NSW Department of Primary Industries) and the NSW EPA have also been addressed in **EIS Appendix H**. These requirements include flood modelling for both internal and external impacts, an assessment of the potential for impacts on erosion, siltation, destruction of riparian vegetation, river bank stability and any potential impacts on existing community emergency management arrangements for flooding. NSW DPI interest is directed towards the potential for impacts on listed aquatic threatened species, populations or ecological communities scheduled under the Fisheries Management Act 1994.

The following NSW legislation has been considered:

- *Protection of Environment Operations Act 1997*
- *Environmental Planning and Assessment Act 1979*
- *Fisheries Management Act 1994*
- *Water Management Act 2000*

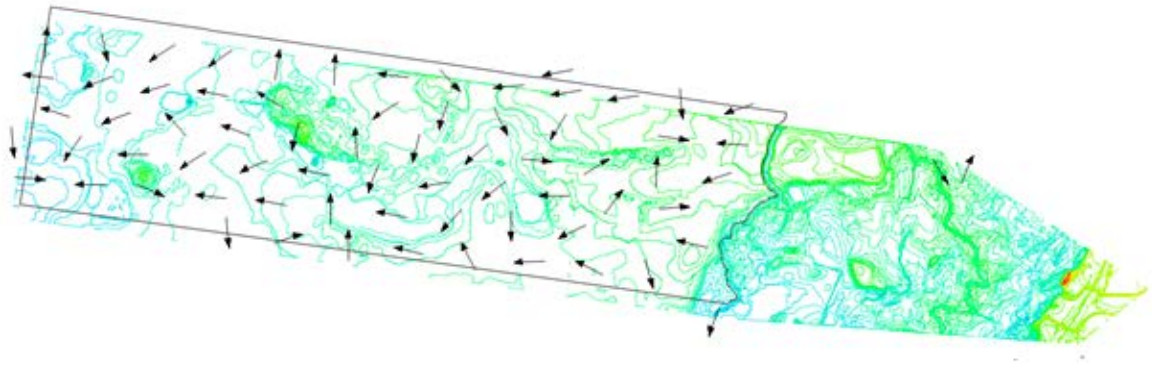
Site Visit

A site visit was conducted in April 2018 to obtain information on site soils, catchment wide vegetation, creek water levels and anecdotal information relevant to the study from the current occupier and long standing residents.

Topographical Survey

Topographical survey and imagery of the Project site using LiDAR methods was carried out by Fyfe Consultants in 2017, with supplementary survey of the adjacent floodplain in April 2018. The extent of survey includes the Project site, its immediate downstream environment, and the adjacent floodplain of Washpen and Yanco Creeks. The extent of LiDAR survey, the Project site boundary and the localised flow directions are shown in **Figure 7-3**.

Figure 7-3 Extent of LiDAR Survey, Site Contours and Localised Flow Directions



Additional topographic data beyond the extents of the Fyfe survey was obtained from the Shuttle Radar Topography Mission (SRTM) data, for the purpose of identifying catchment watersheds beyond the LiDAR data extent.

Previous Studies

A desktop assessment of the site was undertaken to identify relevant publicly available information about the site. The following previous flood studies in the region have been identified:

- A previous flood study of the Murrumbidgee River at Narrandera: *Narrandera Flood Study Review and Levee Options Assessment,* Lyall & Associates, October 2015, and
- A recent flood frequency analysis performed for the Colombo and Yanco Creeks at Morundah: *Flood Studies for the Towns of Urana, Morundah, Boree Creek, Oaklands and Rand,* Jacobs, November 2017.

Hydrology and Flooding Analysis Methodology

Hydrology and flood behaviour of the adjacent watercourses and flow of surface water across the project site have been carried out in accordance with Chapter 6, Book 1 of the online version of the *Australian Rainfall and Runoff 2016* (ARR 2016) guideline, using the XP-SWMM2D software.

Refer: (http://book.arr.org.au.s3-website-ap-southeast-2.amazonaws.com/#b1_ch6_e_fismf)

Water Quality

There are no available water quality measurements for the site. Water quality targets have been established based on the NSW Water Quality Objectives, consideration to published environmental objectives for the Yanco Creek, and the ANZECC 2000 water quality trigger values.

7.1.4.1 Existing Site Conditions - Climate Data for Rainfall and Evaporation

The closest Bureau of Meteorology (BoM) station to the Project site recording daily rainfall is Narrandera Airport AWS (Station 74148), approximately 23 km to the northeast of the Project site, with 51 years of rainfall record. Rainfall for the Project site has been based on this BoM dataset. The nearest station with evaporation data is at the Wagga Wagga Agricultural Institute. The average yearly rainfall at Narrandera Airport AWS is 437mm. Average monthly rainfall varies only moderately between the driest months of February-April (30-35 mm) and the wettest months of May-October (38-40 mm).

Although monthly average rainfall shows only modest variations, there are very considerable fluctuations in the rainfall from year to year. The lowest recorded annual rainfall at Narrandera Airport AWS was 172 mm, and the highest annual rainfall was 776 mm. In particular there are very large differences in summer rainfall between very dry and very wet years. For example, the 10-percentile rainfall in February is 0.8 mm, while the 90-percentile rainfall is 90 mm.

Daily Class 'A' Pan Evaporation has been recorded since 1898 at the Wagga Wagga Agricultural Institute monitoring station (annual average 1,715 mm, ranging from around 40 mm in June-July to around 280 mm in December-January). The data shows that the amount of evaporation always exceeds rainfall with the exception of July where evaporation is similar to average rainfall.

Project Site Rainfall IFD Data

EIS Appendix H Table 7 provides a listing of Intensity Frequency Duration (IFD) information for the site for durations ranging from 30 min to 168 hours (one week) and for AEP (Annual Exceedance Probability) levels ranging from 20% down to 1%. For example, the (1 in 20) 5% AEP rainfall event for a 24-hour period is 77.3 mm.

Climate Change and Effect on Rainfall

The issue of climate change as it applies to the Project site is addressed in **Section 2.10** of this EIS.

Of specific interest to the flood modelling carried out for the present assessment is the expected increase in rainfall associated with extreme events, arising from the increased moisture held in a warmer atmosphere (Sherwood et al., 2010). Given the long design life of the Project, climate change would likely be significant in relation to temperature, evaporation and rainfall extremes.

Australian Rainfall and Runoff (ARR 2016) identifies two alternative methods to estimate the impact of climate change on rainfall depth: the *"Simplified Method"* and *"Detailed Method"*.

The Simplified Method incorporates the effects of climate change in design rainfall and flood estimation by modelling of the 0.5% (1 in 200) AEP and 0.2% (1 in 500) AEP events in lieu of the 1% AEP event. For a 24-hour rainfall event this would represent an increase in rainfall of 12% and 28% respectively.

The Detailed Method involves an assessment of increased rainfall intensity based on predictive modelling of temperature increases sourced from the *Climate Change in Australia* website and applying a 5% change in design rainfall per degree of global warming (Equation 1.6.1 of ARR 2016).

Climate change temperature-related projections for the Project site are summarised in **Table 15**. The "RCP" scenarios listed in **Table 15** are described in **Section 2.10** of the EIS.

The numerical values shown in **Table 15** indicate the number of climate models which predict various temperature range increases for the different RCP scenarios. The projection year is 2070, in line with a potential 50-year lifespan for the Project.

Table 15 Murray Basin Climate Change Future Projections – Summary of Data for Year 2070

RCP Scenario	Total No of Input Climate Models	No of Climate Models Projecting Temperature Increase			
		Slightly Warmer > 0.5˚C	Warmer 0.5˚C to 1.5˚C	Hotter 1.5˚C to 3.0˚C	Much Hotter > 3.0˚C
RCP 2.6	29	2	**25**	2	0
RCP 4.5	46	1	15	**30**	0
RCP 6.0	22	0	4	**18**	0
RCP 8.5	48	0	0	**32**	16

- For the 46 climate models run for the RCP 4.5 scenarios, 32% predicted temperature increases in the Warmer interval (0.5°C to 1.5°C), 65% in the Hotter interval (1.5°C to 3°C), and 15% in the Much Hotter interval (greater than 3°C).
- For the 48 climate models run for the RCP 8.5 scenarios, 67% predicted temperature increases in the Hotter interval (1.5°C to 3°C) while 33% predicted temperature increases in the Much Hotter interval (greater than 3°C).

Considering the range of outcomes from the climate change models, it is apparent that there is a high level of confidence that temperatures will increase, and for the more conservative higher GHG emission RCP scenarios (RCP 4.5, RCP 6.0 and RCP 8.5) it appears likely that the temperature increase will be in the 1.5°C to 3.0°C range.

Based on this information, a conservative temperature increase for the Project site of 2.5°C is considered suitable for estimating rainfall intensity increases attributed to climate change.

This corresponds to a 12.5% increase in peak rainfall intensity, using Equation 1.6.1 of ARR 2016.

Adopted Climate Change Rainfall

On the basis of the above climate change considerations, the (1 in 200) 0.5% AEP rainfall event was adopted to examine the effect of climate change on the Project.

7.1.4.2 Design Rainfall - Rare and Extreme Events

The size of Murrumbidgee River catchment dwarfs the size of the local catchment of the Yanco Creek system, and therefore the distribution of flow from the Murrumbidgee dominates the flow in Yanco Creek and its anabranches including Back and Washpen Creeks.

Furthermore, the lag time between the flood peak at Morundah to the south of the Project site and the flood peak from the Murrumbidgee River for the flood event of March 2012 was more than one week (Jacobs 2017).

Rainfall events in the broader Murrumbidgee catchment and localised rainfall coincident with arrival of the flood peak are therefore almost completely independent. For this reason an X% AEP (e.g. 5% AEP) in the Murrumbidgee River and an X% AEP in the Yanco Creek catchment can be modelled separately.

Accordingly, flood modelling for the Project was carried out for two independent scenarios:

- an X% AEP flood event in the Murrumbidgee River with an overtopping of the Yanco offtake and flooding of the Yanco Creek system (X is the 5%, 1% and 0.5% AEP or PMP events); and
- an X% AEP rainfall event centred at the Project site coincident with a 20% AEP event in the Murrumbidgee River (X is the 5%, 1% and 0.5% AEP or PMP events).

EIS Appendix H Table 10 lists the estimated AEP local rainfall depths for a range of storm durations between 24 and 168 hours.

The PMP Event

The theoretical definition of the Probable Maximum Precipitation (PMP) is *"the greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographical location at a certain time of year"* (ARR 2016).

A methodology for generation PMP rainfall scenarios for modelling purposes has been developed by the Bureau of Meteorology (BoM) using two generalised methods which are reviewed in detail in **EIS Appendix H**: the Generalised Short Duration (GSDM) Method (used for durations up to six hours and areas less than 1000 km^2) and the Generalised Southeast Australia (GSAM) Method (used for durations up to 96 hours and areas up to 100,000 km^2 for Australian regions where tropical storms are not the source of the greatest rainfall depths). This led to the modelling scenarios described below.

Case 1 – GDSM (local PMP event)

BoM in association with the Hydrometeorological Advisory Service has developed a methodology to estimate PMP events for catchments less than 1000 km^2 and durations less than 6 hours. It is a culmination of a series of publications over 30 years. The annual exceedance probability of the probable maximum precipitate is a function of the size of the receiving catchment. The theory is that an intense rainfall cell is more likely to strike a larger catchment purely because of its size so it will have a lower or more frequent AEP.

To determine the rainfall estimates for this event it was necessary to perform CRC-FORGE curve fitting between the 2% and 1% AEP events and the Probable Maximum Precipitation (PMP) in addition to assigning site-specific factors relative to the location, terrain, elevation and moisture.

The Project site is located within the lower GDSM duration limit zone in Australia with a maximum duration of 3 hours. The terrain of a catchment has an effect on storm durations greater than 1 hour; steeper terrains for example induce heavier rainfall. The terrain of the Project site is considered *'smooth'*. The moisture adjustment factor used in the modelling is 0.65. The resulting PMP estimates for the Project site are shown in **Table 16**.

Table 16 PMP Rainfall Depths for the Project

Duration (hours)	Rainfall Depth (mm)	Duration (hours)	Rainfall Depth (mm)
0.25	110	1.5	280
0.5	160	2	320
0.75	200	2.5	330
1	240	3	360

Design Spatial Distribution of the PMP

The design spatial distribution for convective storms is a series of concentric ellipses. This assumes a virtually stationary storm which can be oriented in any direction with respect to the catchment. The PMP has a constant value at all points in the interval between consecutive ellipses. This constant value between ellipses is the mean rainfall depth for that interval.

Case 2 – GSAM (Regional PMP event)

The GSAM model was developed for estimating PMP in Australian regions where tropical storms are not the source of the greatest depths of rainfall, and where topographic influences vary markedly. The GSAM region is further divided into two zones, coastal and inland separated by the Great Dividing Range. The GSAM is appropriate for durations of 12 hours to a maximum of 120 hours depending on the location and catchment area. The Murrumbidgee catchment is located in the inland zone. A GSAM PMP was simulated by Lyall and Associates in 2015. The analysis is described in EIS **Appendix H.**

The Extreme Flood - Adopting a Worst Case Scenario

The worst case extreme flood between a regional PMF originating from the Murrumbidgee River and flooding derived from a local extreme event has been adopted as the extreme case.

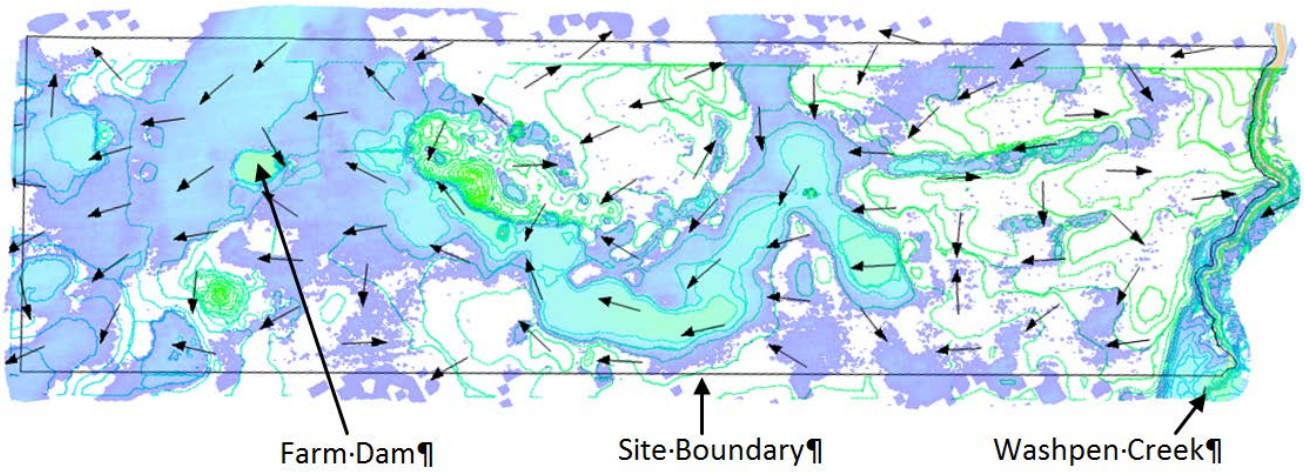
7.1.4.3 Site Topography and Drainage Patterns

The Project site is located immediately west of Washpen Creek, and the topography falls generally westwards away from the western bank of Washpen Creek at very flat grades. Elevations across the project site vary from approximately 133 m to 134 m AHD along the top of the banks of Washpen Creek, to 131 m to 132 m AHD on the western boundary, indicating a fall of around 3 m over a distance of 9 km.

A shallow flat depression that meanders through the centre of the site drains surface water to an existing farm dam located within 2,640 m of the western boundary. From the farm dam the topography falls general towards the southwest, although the drainage pathways are very flat and not incised into the landform. Parts of the site adjacent to the southern boundary drain overland towards the south. The surface water drainage paths through the site are not marked on topographic maps as watercourses (no OEH-water 'blue lines').

Downstream from the site the drainage depression continues towards the southwest in shallow braided channels at very flat grades, crosses Morundah Road, and eventually drains into a series of small rural dams upstream of the Coleambally Main Canal approximately 7 km southwest of the project site. Coleambally Main Canal joins Yanco Creek south of Morundah. The topography of the project site, alignment of overland flow paths, and locations of the existing farm dam and depression are shown in **Figure 7-4**.

Figure 7-4 Topography and Overland Flow Paths



The Murrumbidgee River flows westwards across the riverine plains of the southwest slopes of New South Wales, past Narrandera, and on to its confluence with the River Murray near Balranald. The Yanco Creek system is a channel and floodplain system that commences from the Murrumbidgee River at the Yanco Weir located about 20 km west of Narrandera.

This complex distributary system of paleochannels (Page at al. 2009), consists of a series of creeks including Yanco, Colombo, Billabong and Forest Creeks on the southern side of the Murrumbidgee. Yanco Creek flows for approximately 258 km in length in a southwesterly direction, discharging into the Edward River (part of the Murray River basin) at Moulamein. The broad riverine context is shown in **Figure 7-5**.

Figure 7-5 Riverine Context – Yanco Creek System

Flows into Yanco Creek are regulated by the Yanco Weir. Flows are regulated for irrigation and to provide base flows to achieve environmental objectives. During major flood events along the Murrumbidgee, the flow regulating structures at the Yanco Weir cause backwater causing large flood flows to overtop the offtake channel upstream of the weir sending flows southwards into the Yanco Creek floodplain. The Yanco Weir structure has very limited control for flows exceeding 10,000 ML/d *(Jacobs 2017).*

Figure 7-6 shows the arrangement of the old Yanco Weir which is a fixed concrete weir spanning the southern branch and the new regulated twin gates which act as a sluice during low flows and weir during large flows. The offtake upstream requires a backwater level of 138.55 m AHD to enable Murrumbidgee River water to flow into the Yanco system.

Figure 7-6 Yanco Control System

Washpen Creek is a minor right bank anabranch located on the upper reaches of Yanco Creek. Back Creek joins Yanco Creek approximately 7.4 km south of the offtake from the Murrumbidgee River. Back Creek then splits into Washpen Creek and Pine Watercourse a further 7.5 km downstream. The divergence occurs approximately 2.9 km north of the project site, and then re-joins Yanco Creek further south-west via Woolshed Creek. Washpen Creek and Yanco Creek lie within the same broad floodplain. Adjacent to the Project site, this floodplain width extends approximately 5.3km from Washpen Creek east across to Yanco Creek.

Along Washpen Creek there are a series of wetlands covering around 90 ha, which are connected to the Washpen Creek only during large, natural flood events (Webster 2007). These wetlands provide substantial flood storage.

The extent of the floodplains for the Murrumbidgee River and Yanco Creek System, and complexity of the creek systems can be seen in **Figure 7-7** which shows the extent of flooding after the 1974 flood. This may not be a reflection of the flood behaviour today as regulation of flows on the Murrumbidgee has changed since 1974, and the plan was derived from satellite imagery days after the flood peak so there is no indication whether the flooding broke the banks of Back Creek or Washpen Creek and passed over the site or not.

The Project site is outside of the Murrumbidgee and Coleambally Irrigation Areas, but within the region for the Murrumbidgee Catchment Management Authority.

The statutory water management plan (under the Water Management Act 2000) encompassing the Yanco Creek system is the Murrumbidgee Regulated River Water Sharing Plan 2003 (Murrumbidgee WSP). The Yanco Creek and Tributaries Advisory Council (YACTAC) comprises over 150 landholders who voluntarily contribute a levy which commenced in 2006 and is used to maintain and improve the health of the Yanco Creek system.

7.1.4.4 Site Soils

Knowledge of the rate of infiltration and storage capacity of soils is an important factor in understanding the response of a catchment to rainfall.

Sampling of Project site soils was completed by SLR in May 2018, as part of the Agricultural Land & Soil Assessment (**EIS Appendix D**). This involved sampling at 18 locations, which identified red, brown and grey Vertosols. Vertosols are clay soils with shrink-swell properties that exhibit strong cracking when dry, and at depth have slickensides and/or lenticular structural aggregates. Most surface soils had slight dispersivity, with two samples exhibiting medium dispersivity. The surface soils were underlain by medium clays. Analysis of the soils within the Project site as sampled by SLR in **EIS Appendix D** indicates that they exhibit some variability but are broadly analogous to those noted to the north and south by OEH.

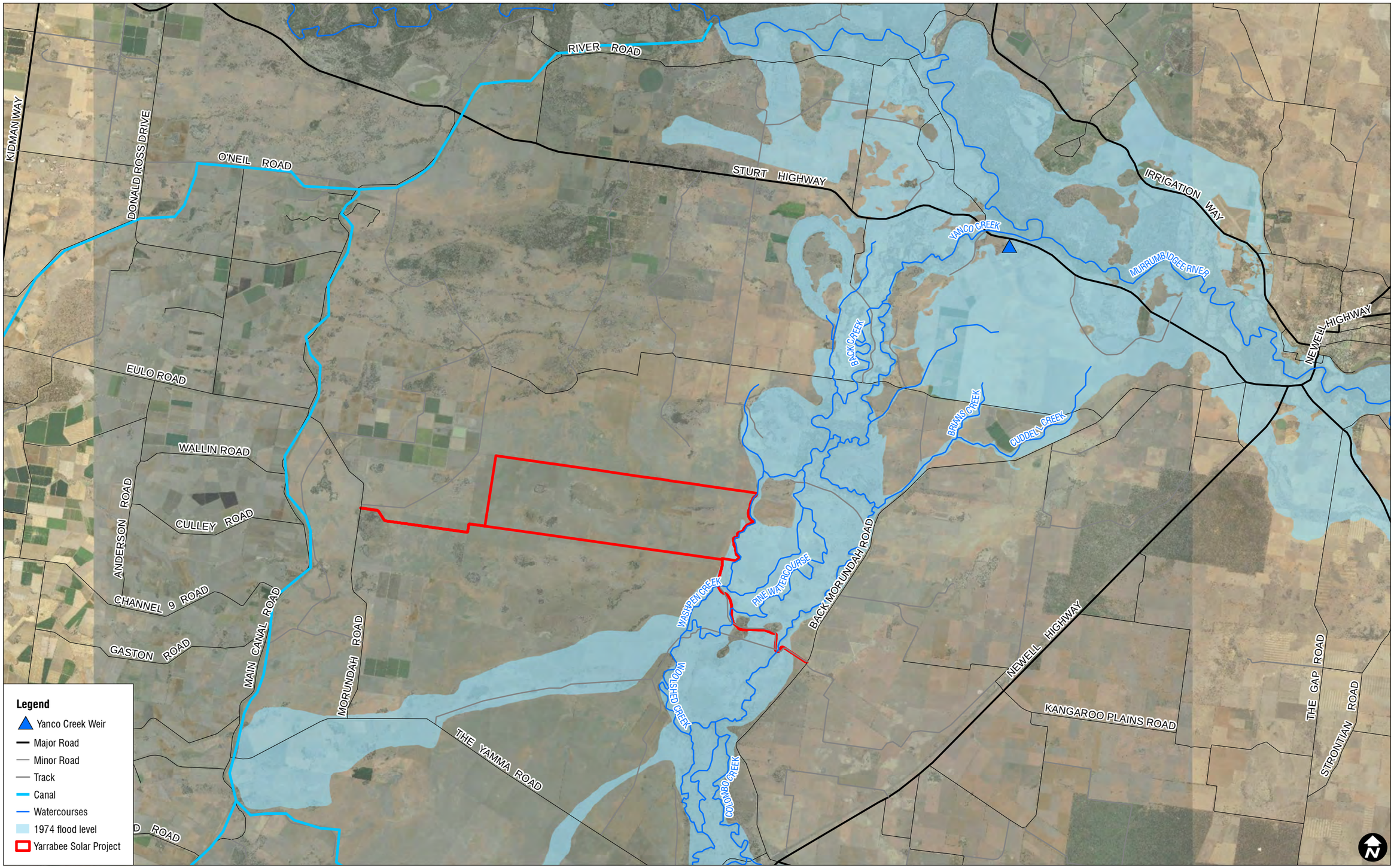
In summary, the low soil storage capacity, extremely low infiltration rate, extensive clay profile and flat topography implies the site would absorb the first 20 mm of rainfall through depression storage and surface cracking wetting clays which inhibit hydraulic conductivity. The site would be very responsive to subsequent rainfall causing extensive pooling in flat depressions. Site drainage would be very slow moving to the southwest with pools remaining for a considerable length of time after inundation.

The present occupiers of the site have indicated that the site surface is difficult to traffic following rain, and takes several days to dry out. Additional details relating to the soil behaviour can be seen in **Attachment C**

7.1.4.5 Acid Sulfate Soils

The risk of encountering acid sulfate soils is very low since there are no known occurrences of acid sulfate soils within the site boundary and the Project will not involve any significant excavation other than shallow trenching for electrical cables. The NSW Government SEED database does not indicate the presence of any known risk of acid sulfate soils on or in the vicinity of the Project site.

Refer: https://datasets.seed.nsw.gov.au/dataset/acid-sulfate-soils-risk0196c



H:\Projects-SLR\620-BNE\610-SYD\610.17428\01 GIS\ArcGIS\SLR610.17428_EIS_Flood_1974_01.mxd

Scale:1:150,000
GDA 1994 MGA Zone 55

10-Aug-2018

SLR

Flood Envelope (1974) and Project Site

FIGURE 7.7

7.1.4.6 Potential Impacts of the Project

EIS Appendix H examines the impact of the Project in relation to the following:

- Riverine flooding in Washpen Creek / Yanco Creek;
- Project site drainage and pattern of runoff to downstream properties;
- Runoff annual yield, and surface infiltration;
- Water quality of surface runoff during construction of the project, and then during operation; and
- Groundwater impacts.

EIS Appendix H also considers potential impacts of flooding on the Project's own infrastructure, as well as human safety during extreme flood events.

Flood Behaviour along Washpen Creek

Washpen Creek is an anabranch of Yanco Creek via Back Creek to the north which divides into both Pine Watercourse and Washpen Creek and then reunites via Woolshed Creek to Yanco Creek. Flow from Yanco Creek to Back Creek is regulated by means of a weir with a control gate at Spiller's Regulator. Pine Watercourse is ephemeral and only operates when the water level in Washpen Creek exceeds the left overbank.

The conveyance of Washpen Creek is supplemented by the hydraulic capacity in Pine Watercourse. The hydraulic capacity of Washpen Creek is further enhanced by a 'natural' longitudinal bund running along the top of the western bank. The crest of the bund is higher than the site ground level. With this hydraulic arrangement it is unlikely Washpen Creek would surcharge unless major overbank flooding occurs upstream.

Site Surface Hydrology

The site is essentially very flat with site grades typically less than 0.05%. Even so, there is still a defined drainage path which meanders from the northeastern boundary to the southwestern corner. Along this drainage path there are four surface depressions which have the capacity to hold water, and a constructed dam which is furthest west.

Water Yield and Environmental Flows

The Project's solar PV arrays will not result in an increase in runoff since the same area of soil is available for infiltration, and vegetative groundcover will be maintained to distribute runoff. Other than maintaining the existing farm dam, no additional harvesting of surface water is proposed. The existing farm dam has a capacity of 25 ML, which is less than the site harvestable rights of 134 ML. There will be no change to low flows or environmental flows as a result of the project, and the annual yield of runoff from the site catchments will be unchanged from the current rural activities.

7.1.4.7 Water Quality during Construction and Operation of the Project

Erosion and sediment controls will be implemented in accordance with Erosion and Sediment Control (ESC) Plans documented in the Construction and Operational Environmental Management Plans. Overall, due to the flatness of the Project site, there is a very low potential for erosion which should be readily managed using standard ESC practices. It is intended to retain the existing farm dam as a sediment basin, and to monitor site water quality.

Existing Water Quality

The NSW Water Quality Objectives are the agreed environmental values and long-term goals for NSW surface waters. Water Quality Objectives for most catchments in NSW are published on the Department of Environment Climate Change and Water website (http://www.environment.nsw.gov.au/ieo/).

River flow objectives suggest that the natural and existing regime of flows from the Project site should be retained as far as practically compatible with other requirements, mimicking natural river flow patterns as closely as possible. Harvesting of surface water on-site (including the addition of new dams) should be minimised, but some minor storages may be necessary to achieve water quality objectives.

ANZECC 2000 Default Water Quality Trigger Values

The ANZECC 2000 Guidelines advocate a risk based approach to water quality assessment and management. That is, the intensity of assessment of current water quality status or impacts on water quality should reflect the risk of impacts on the achievement/protection of the water quality objective.

For Protection of Aquatic Ecosystems in NSW, and for irrigation water used in primary production, the ANZECC 2000 Guidelines provide default trigger values for major physico-chemical stressors, which are used to assess whether the condition of an ambient water body supports the environmental values. These values, shown in **Table 17**, provide typical values which if exceeded warrant investigation, and could adversely impact downstream environments and/or water uses.

Table 17 ANZECC Trigger Values – Environment and Irrigation Water

Parameter	Default Trigger Value for NSW lowland rivers for aquatic ecosystems in slightly disturbed ecosystems
Total Phosphorous TP (mg/L)	0.05
Total Nitrogen TN (mg/L)	0.50
Ammonium NH_4^+ (mg/L)	0.02
Total Suspended Solids (mg/L)	50 - Professional judgement
Turbidity (NTU)	6 - 50
Salinity	125 – 2200 µS
pH	6.5 – 8.5
Pesticides	Concentrations in discharge water should not exceed the Crop injury threshold values in Table 4.2.12 of the ANZECC 2000 Guidelines
Heavy metals and metalloids	Concentrations in discharge water should not exceed the STV values in Table 4.2.10 of the ANZECC 2000 Guidelines
Thermotolerant coliforms (cfu/100mL)	<1000

7.1.4.8 Environmental Values – Yanco Creek System

Environmental objectives for the Yanco Creek System are as follows:

- Maintain a mosaic of wetlands;
- Support self-sustaining populations of macro-invertebrate taxa from the endangered Lower Murray Aquatic Ecological Community;
- Maintain and/or improve medium-bodied native fish community; and
- Maintain and/or improve small bodied native fish – floodplain specialists.

The Project site actually falls away from Washpen Creek and has been set-back via a dedicated buffer zone from ground areas which fall towards Washpen Creek. Specifically, the Project will maintain a riparian zone of 40 m to the top of bank of Washpen Creek, and will not alter the distribution of flows, or involve any works that would directly impact on mainstream hydrology or flood behaviours along Washpen Creek.

7.1.4.9 Erosion and Sediment Control – Construction Phase

Construction activities which disturb the land surface typically increase the potential for erosion of soils during rainfall events and increase the risk of sediment-laden stormwater runoff discharging to the receiving environment.

The construction of the Yarrabee Solar Project is expected to result in only minor ground disturbance, and a very low potential for erosion due to the following mitigating factors:

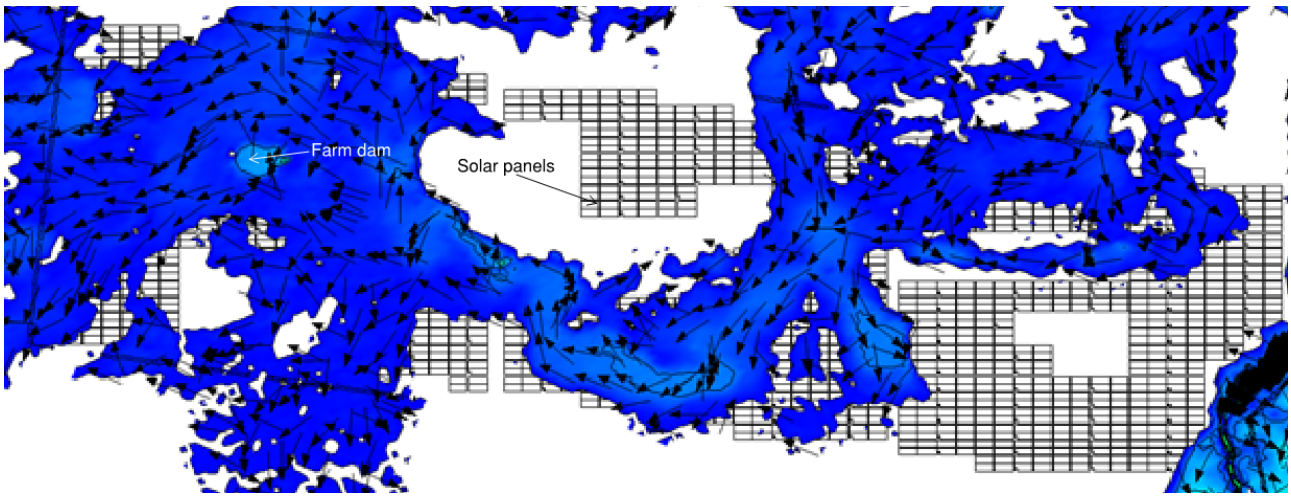
- Construction will proceed in stages, and within each stage the construction activities will be sequenced, such that the construction zone at any one time will only be a small proportion of the overall Project site area;
- The Project will utilise the existing landform and no broad-scale re-contouring of the existing ground levels is proposed. Hence the existing vegetative cover and soil structure will be maintained intact across much of the Project area;
- Solar arrays will be pole mounted, with the poles being supported on a driven or screw pile, so that there is no excavation required other than for electrical cabling;
- Construction areas will be progressively revegetated as installation of solar panels proceeds across the site;
- At locations where earthworks are necessary, such as for construction of access tracks, sub-station pads, or site facilities, localised erosion and sediment controls will be placed in accordance with the Landcom (2004) guidelines; and
- The flatness of the site is not conducive to erosion or sediment transport, given that surface runoff can only move at very low velocities.

It is also noted that the site presently has a rural land-use, and that the level of soil disturbance for installation of solar arrays will likely be less than that associated with broad-acre agriculture.

The project incorporates a 40 m riparian buffer zone to the top of bank along Washpen Creek. No ground disturbance will occur within this zone. Since the remainder of the site falls towards the west, there will be no adverse water quality impacts on Washpen Creek. Current rural activities may occur much closer to the top of Washpen Creek.

Hydraulic modelling indicates that a large portion of the Project site drains to an existing farm dam. This dam currently has a capacity of 25 ML. The catchment for the existing farm dam, and other areas which discharge off site are shown on **Figure 7-8** for a 1% AEP event. The arrows on **Figure 7-7** illustrate the complicated drainage pattern over the Project site. Flows shown across the northern boundary are flowing south from an overflow of Back Creek.

Figure 7-8 Site Drainage Paths and Location of the Yarrabee Farm Dam



With the implementation of standard erosion and sediment control measures in accordance with Landcom (2004) the potential environmental impact is considered very low and manageable.

A site-wide Erosion and Sediment Control Plan (ESCP) will be prepared as part of the Construction Environmental Management Plan (CEMP) for the Project. The ESCP will be prepared in accordance with *Managing Urban Stormwater: Soils and Construction, Volume 1, 4th Edition* (Landcom 2004), known as *"The Blue Book"*, and *Volume 2A Installation of Services* (DECC 2008a). Mitigation measures and site management practices will include:

- Staging of construction works and progressive revegetation to limit the disturbed area
- Early establishment of site access tracks to minimise disturbance of site soils by construction vehicles
- Progressive revegetation of disturbed areas
- Reseeding of soils beneath the lower edge of PV panels, to ensure the early establishment of vegetative ground cover, and limit the potential for soil erosion from panel runoff
- Stabilisation of table drains alongside access tracks using vegetation, and rock check dams
- Installation of sediment fences for any earthworks in proximity to site overland flow paths
- Installation of localised sediment controls such as sediment fencing, straw bales, and sediment sumps at any site areas involving earthworks greater than 1,000m^2 in area
- Install a shaker pad at the site exit to reduce mud or clay on vehicle wheels being tracked onto external roads
- Inspection of ESC measures following heavy rainfall
- Water quality monitoring and reporting requirements

- Providing an appropriate level of resourcing for environmental management and monitoring.
- Appropriate site storage of hydrocarbons within bunded areas, and documented spill response procedures

A separate ESCP will also be prepared prior to the decommissioning phase and for the construction of any future Project upgrades with the potential to disturb soils.

7.1.4.10 Erosion and Sediment Controls – Operational Phase

Soil disturbance during operation of the Project would be minimal and limited to maintenance activities, which will involve very small localised disturbance areas on an infrequent basis. Water quality impacts from these minor disturbances are likely to have an insignificant impact on overall site water quality. For sites in proximity (less than 200 m) to site overland flow paths or the site boundary, erosion and sediment control measures will be implemented to minimise the potential for sediment export.

These measures would be developed on a case by case basis in accordance with the Landcom (2004) guidelines, and are likely to include measures such as sediment fencing, localised sediment traps, and progressive stabilisation with vegetation.

Concentrated runoff from the surface of solar panels falling onto the ground has some potential to cause localised erosion below the solar array modules. Cook and McCuen's (2013) study of grid-scale solar projects indicates that the potential for localised erosion can be effectively mitigated by the establishment and maintenance of thick groundcover vegetation beneath the panels. The rates of erosion during the period when vegetation is being established will be closely monitored during the initial stages of the development, and if warranted, jute mesh will be used to cover and protect these small areas from erosion during the establishment of grass cover.

During operation the single-tracking system mounted panels would constantly change orientation during the day, with runoff being distributed in the area around each panel, and not drained permanently to a single place on the ground. Measures to manage any bare areas and erosion that develop beneath the solar arrays over time would be included in a groundcover management plan for implementation during ongoing operation of the proposal.

The existing farm dam will be retained and will provide a location for collection of samples for monitoring surface water quality from the project.

While the main east-west access road within the solar farm will be sealed, other access tracks across the broader site will be unsealed, and there is some potential for dust creation, mainly when tracks are traversed by site vehicles. Dusts deposited on the ground can be easily washed away during rainfall, increasing the turbidity and sediment loads in downstream waterbodies. The Project will have a strong interest in reducing dust, which can reduce the efficiency of PV arrays. Dust will be reduced by a range of mitigation measures including watering to suppress dust when required on dry windy days, the application of binders to road surfaces to reduce dust, limiting vehicle speeds, and reducing vehicle movements.

7.1.4.11 Rainfall Infiltration and Catchment Yield

Mean Annual Runoff (MAR) for the project site is 4,725 ML, based on a contributing catchment area of 9,570 ha, an assumed average annual rainfall of 437 mm and a volumetric runoff coefficient of 0.113.

The Project will not change the existing runoff characteristics of the site. While the Project involves constructing solar arrays with impervious surfaces, runoff volumes will not be increased, because rainwater will drain to the ground underneath the arrays, be dispersed by vegetation maintained below the panels, and infiltrate into the existing soils which will provide the same overall soil surface area available for rainfall infiltration.

This is supported by the study by Cook and McCuen (2013) into the impact of solar projects on hydrology, which found that such facilities using pole-mounted PV arrays do not have a significant impact on the surface water run-off rate, or volume. This study found that underlying groundcover was the primary determinant of runoff rate.

Overland flows will follow the same flow paths as those currently present on the site. No change to the runoff generated by the site is expected, because by retaining good grass cover across the proposal site, runoff water from PV arrays would be absorbed into the ground similar to current conditions.

No additional dams are proposed on site as part of this Project. The existing farm dam will be retained, which has a capacity of 25 ML, or about 0.5% of estimated mean annual runoff.

7.1.4.12 Groundwater Impacts

Groundwater is important in sustaining Groundwater Dependent Ecosystems (GDEs), including aquatic and terrestial ecosystems such as springs, wetlands, rivers and forests. GDEs can include aquatic ecosystems which rely on the surface expression of groundwater, and terrestial ecosytsems which rely on the subsurface presence of groundwater.

The *Groundwater Dependent Ecosystems Atlas* (BoM, 2017) indicates that there are two small High Priority Terrestrial GDEs within the proposal area plus the riparian edges along Washpen Creek. The remainder of the site is mapped as having a low potential for GDE's. Areas to the northeast of the Project site, and associated with riverine wetlands within the Yanco Creek System, are also identified as GDE's (terrestrial and aquatic).

The location of these GDE's and existing groundwater wells are shown on **Figure 7-9**.

Groundwater Vulnerability

The project site is located within an area mapped as having groundwater vulnerability under the Narrandera LEP, indicating areas in which the hydrological functions of groundwater systems should be maintained to protect vulnerable groundwater resources from depletion and contamination as a result of development. Narrandera LEP Clause 6.5 states that:

> '*Before determining a development application for development on land to which this clause applies, the consent authority must consider the following:*
> *(a) the likelihood of groundwater contamination from the development (including from any on-site storage or disposal of solid or liquid waste and chemicals),*
> *(b) any adverse impacts the development may have on groundwater dependent ecosystems,*
> *(c) the cumulative impact the development may have on groundwater (including impacts on nearby groundwater extraction for a potable water supply or stock water supply),*
> *(d) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development'*

COLEAMBALLY IRRIGATION AREA

YANCO CREEK

BRIANS CREEK

CUDDELL CREEK

BACK CREEK

PINE WATERCOURSE

WASHPEN CREEK

WOOLSHED CREEK

COLOMBO CREEK

Legend

Wells
- Irrigation
- Monitoring
- Stock
- Water supply

Watercourses

Irrigation area

Yarrabee Solar Project

Groundwater Dependent Ecosystems - Terrestrial
- High potential GDE - from regional studies
- Moderate potential GDE - from regional studies
- Low potential GDE - from regional studies

Groundwater Dependent Ecosystems - Aquatic
- High potential GDE - from national assessment
- Known GDE - from regional studies
- Low potential GDE - from national assessment
- Moderate potential GDE - from national assessment
- Unclassified potential GDE - from regional studies

0 1 2 km

Scale1:100,000
GDA 1994 MGA Zone 55

10-Aug-2018

H:\Projects-SLR\620.BNE\610.SYD\610.17428\01 GIS\ArcGIS\SLR610.17428_EIS_GDEBores_01.mxd

SLR

Groundwater Dependent Ecosystems and Wells

FIGURE 7.9

7.1.4.13 Existing Water Users

The site has a number of licenced groundwater bores. These bores are not intended to be utilised for water supply to the Project.

7.1.4.14 Impact Assessment

The Project is not likely to have any impact on groundwater resources or GDE's. Impacts to groundwater during construction and operation of the solar farm are unlikely to occur due to the following:

- The pattern of surface drainage and associated groundwater recharge will remain unchanged;
- Soil infiltration across the broader surface of the site will be unchanged, as discussed in Section **7.1.4.11** of this report, and therefore the rates of groundwater recharge will be unaffected;
- The project does not include any excavation with potential to interact with groundwater; and,
- No solar arrays or other infrastructure are proposed at or close to the locations of GDE's within the site

7.1.4.15 Riverine Flooding

Major flooding along the Yanco Creek floodplain, including Washpen and Back Creeks near the Project site, results from flows distributed from the Murrumbidgee River. The arrival of flood peaks at the Project site may not necessarily be accompanied by local rainfall.

7.1.4.16 Flooding – Existing Information

The project site is not within a flood planning area as designated under the Narrandera LEP. There are no flood studies which cover the site location.

Historical information on flood extents at the Project site is provided by mapping of the 1974 flood extent recorded by means of a satellite photograph taken following passage of the peak flood, provided by Narrandera Shire Council as reproduced in **Figure 7-7**.

This event caused major flooding within the Murrumbidgee Catchment. Lyall & Associates (2015) reported that the peak flow recorded at Narrandera during the 1974 flood had an equivalent ARI of 'about 100 years'. The image shows that at the time the aerial photograph was taken that the project site was not inundated beyond the banks of Washpen Creek.

The two previous flood studies which provide valuable flooding information upstream and downstream of the project site are:

- Lyall & Associates, Oct 2015, *Narrandera Flood Study Review and Levee Options Assessment*
- Jacobs, Nov 2017, *Flood Study Report for Morundah*

Information from these studies relevant to the present study is described below.

Narrandera Flood Study (Lyall & Assoc 2015)

The majority of flood flow along Washpen and Yanco Creeks comprises water that overflows from the Murrumbidgee flood plain south into the Yanco Creek floodplain. The study modelling did not extend south down the Yanco Creek system.

Two hydraulic models were developed for a 140 km reach of the Murrumbidgee River between Wagga Wagga and downstream of Narrandera using the TUFLOW hydraulic model, calibrated against the flood events of September 1974, December 2010 and March 2012. The study updated design flood estimates for the Murrumbidgee River at Narrandera gauge (GS 410005) for the full range of flood events between 20% AEP and extreme flood events. The study provides estimates of flood levels in the area where flows overflow into the Yanco Creek system. For a 1 in 100 year Annual Recurrence Interval (ARI) flood event (now referred to as the 1% Annual Exceedance Probability) along the Murrumbidgee River, these levels are approximately RL 140.7 AHD at the Yanco Weir offtake.

Flood Study Report for Morundah (Jacobs, Nov 2017)

This study was focussed on estimating flood behaviour at Morundah, which is approximately 15m south of the project site. As part of the flood study Jacobs prepared a flood frequency analysis using the available annual peak flows for Yanco Creek at Morundah gauge (GS 410015), and the available annual peak flows for the period 1913 to 2012. For Yanco Creek at Morundah (GS 410015), there was 96 years of available data. The largest flood recorded at the station was the 1974 flood, which had an estimated peak flow of 20,250 ML/day. Jacobs fitted a Log-Pearson Type III distribution to the annual maximum flow data using a Bayesian influence methodology, to derive peak flow estimates for a range of AEP's, as shown in **Table 18**.

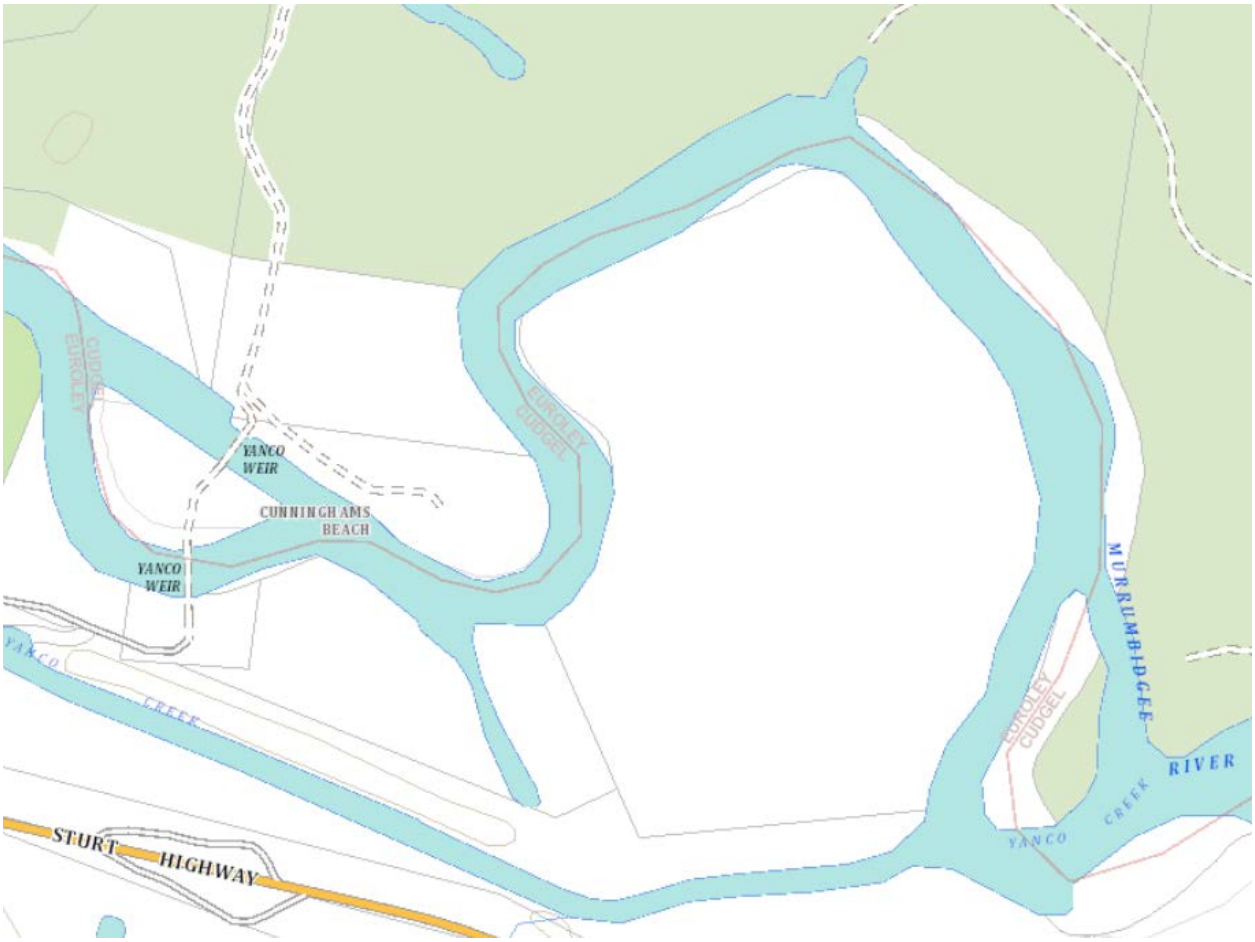
Table 18 Flood Frequency Analysis at Morundah (from Jacobs 2017)

Annual Exceedance Probability	Peak Flow (m^3/s) in Yanco Creek @ Morundah gauge (GS410015) (5% & 95% confidence limits)	Peak Flow (m3/s) Colombo Creek @ Morundah gauge (GS410014) (5% & 95% confidence limits)
20%	30 - 45	18 – 26
10%	50 - 80	27 - 42
5%	70 - 140	37 - 65
2%	100 - 250	50 - 110
1%	130 - 290	65 - 180

SLR's own flood modelling has been extended down to the Yanco Creek at Morundah gauge (GS 410015) and Colombo Creek at Morundah gauge (GS 410014), to allow calibration of modelling parameters. The 1% AEP peak flood level in the Murrumbidgee River at the Yanco Weir offtake was entered as the northern boundary condition and the peak flow rates simulated at the two flow gauges compared to the flood frequency estimates for verification.

A study by Alluvium (2013) identified that the Yanco Weir take-off point has limited controls for flows exceeding 10,000 ML/day in the Murrumbidgee River recorded at the Narrandera gauge. The Jacobs (2017) study reviewed PINNEENA hourly flood gauge data for the Murrumbidgee River at the Narrandera gauge and the Yanco Creek Offtake gauge for the flood event of March 2012, and were able to establish a relationship between the observed discharges in the Murrumbidgee River at the Narrandera gauge and the Yanco Creek offtake gauge. This flow relationship was not used in the calibration process as the level data was considered more stable and reliable considering the complexity of the relevant flow regulation structures. **Figure 7-10** shows the location of the Yanco Creek offtake relative to the regulated Yanco Weir on the northern branch and the fixed weir on the southern branch.

Figure 7-10 Arrangement of the Yanco Weir(s) and the Yanco Creek Offtake Upstream



The regulated Yanco Weir consists of two rectangular sluice gates within concrete channels. Environmental flows pass under the sluice while flood flows overtop the gates. The southern anabranch was the original regulated Yanco Weir but has been modified to be a fixed weir. Water backs up behind these weirs creating a level pool to the Yanco Creek offtake upstream. The offtake is simply a rock lined channel with an invert at 138.55m AHD.

7.1.4.17 Washpen Creek Flood Behaviour

SLR has carried out a detailed flooding analysis of flood flows along the Washpen Creek / Yanco Creek floodplain. This flooding analysis has concluded that:

- The Washpen Creek/Yanco creek floodplain adjacent to the site has capacity to convey the 5% AEP flood without overtopping the banks of Washpen Creek;
- In an extreme flooding event along Washpen Creek, floodwaters from the Washpen Creek/Yanco Creek floodway would overtop the existing banks of Washpen Creek, allowing floodwaters to discharge into the site; and
- The Project does not affect flood flows, flood levels, or velocities along Washpen Creek.

The estimated flood levels and flood envelopes derived from riverine sources along the edge of Washpen Creek are shown on Attachments A to H for the 5%, 1%, 1 in 200 and PMF floods on the Washpen Creek/Yanco Creek floodplain.

The Project does not include any works such as bulk filling that will reduce flood storage and/or redirect flood flows. Accordingly it is not expected that the Project will materially impact on riverine flooding behaviour in Washpen Creek.

7.1.4.18 Site Flooding from Riverine Sources

Modelling has been undertaken for flooding along the Murrumbidgee River for various AEP scenarios: (1 in 20) 5% AEP, (1 in 100) 1% AEP and (1 in 200) 0.5% AEP. The results of the flood modelling are described in detail in **EIS Appendix H**.

Figure 7-11 shows the output from the (1 in 100) 1% AEP modelling:

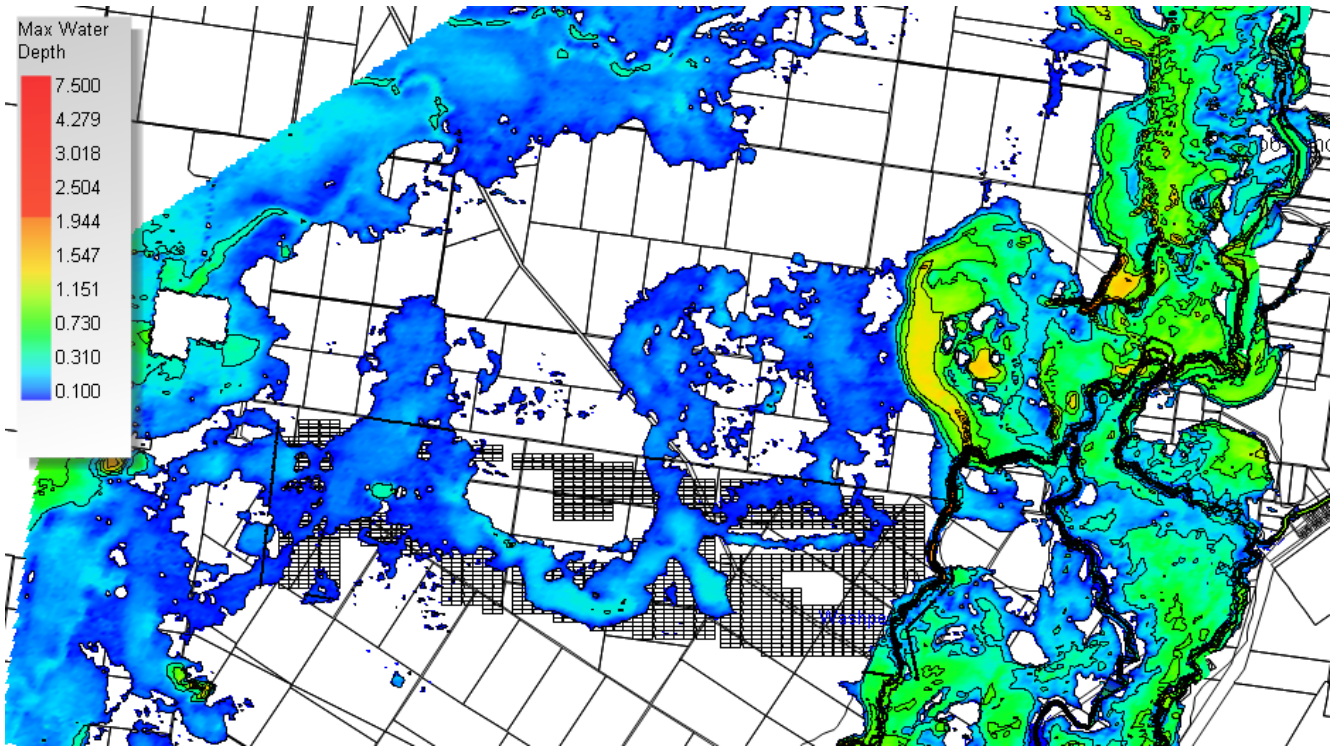
- A 1% AEP (1 in 100) in the Murrumbidgee River would peak at a level of approximately 140.75m AHD at the Yanco Creek offtake. This would result in significant surcharging of the Yanco creek system.
- Washpen Creek would flood a small section of the southeastern corner of the Project site, to depths of 1m
- An area of Back Creek which is north of the Project site, and upstream of Washpen Creek, breaks it banks during a 1% AEP event. This results in shallow surcharge flows which move west and south from Back Creek, then enter the Project site at the northeastern boundary, subsequently following a meandering path to the southwestern corner.
- Approximately 30% of the Project site would be inundated with depths exceeding 100 mm. Depths up to 0.8 m would be experienced in the central southern areas. The velocity of floodwaters would be slow, with peak velocities between 0.3 m/s and 0.8 m/s over the Project site. These conditions would be considered low hazard apart from the small section to the central southern area. However, the site could not be safely accessible by light vehicles during such an event.

Since the panels are mounted above the ground on posts the potential flood inundation should have no effect on the operation of the facility, provided that equipment sensitive to inundation is designed with adequate elevation. The posts supporting the PV panels will have negligible hydraulic effect on the passage of flood flows, so the flood behaviour across the site, and on the adjoining properties, is unchanged.

An access road along the southern boundary would be largely unaffected by the floodwaters. Any site access roads which realigned north-south will cross the overland flow path. It is not intended to provide flood free road access, and these roads would be built practically at grade with the existing terrain.

The proposed location for the Project substation is above the 1% AEP flood level and situated between two flow paths. A risk assessment would be performed in the detailed design phase for the substation to confirm the appropriate elevation for this infrastructure, with consideration to factors such as selection of AEP, climate change, accuracy of flood level estimation, and additional freeboard for waves.

Figure 7-11 Inundation of the Project site from a 1%AEP Event in the Murrumbidgee River



With such low velocities and flood depths the afflux of floodwaters discharging from the Project site to the west during the 1% AEP riverine event would be unaffected by the Project. Properties to the north and south would not experience a change in flood behaviour as the runoff through the Project site travels from a northeasterly to a southwesterly direction.

Surcharge Flows from a 0.5% AEP Event in the Murrumbidgee River

A more severe 1 in 200 year, or 0.5% AEP flood event in the Murrumbidgee River would peak at a level of approximately 140.9m AHD at the Yanco Creek offtake. This would result in significant surcharging of the Yanco Creek system including Back Creek to the north of the Project site. Approximately 45% of the Project site would be affected by surcharge floodwaters exceeding a depth of 100 mm, with the greatest depth of 1.1m attained in small pockets in the central southern area. The velocity of floodwaters would be slow with peak velocities between 0.3 m/s and 0.8 m/s expected over the Project site. The conditions would be considered low hazard over the majority of the Project site apart from the central southern zone. However, the site may not be safely accessible by light vehicle during such an event.

During an event of this magnitude the extent of site inundation from Washpen Creek in the southeastern corner of the site would be increased. PV panels and flood sensitive equipment at this location would need to be elevated to allow for flood depths of up to 1.1 m, plus freeboard.

The proposed infrastructure will not change the flood behaviour either upstream or downstream of the Project site caused by riverine flooding during a 0.5% AEP event. There would be negligible change in flood depths, velocities and flow distribution.

For a flood of this magnitude it takes two days for the flood peak to arrive at the Project site, after the flood peak has arrived at Narrandera. The total flood warning time available would therefore be in excess of two days.

If the project has a lifespan exceeding 50 years then the 0.5% AEP riverine event would be considered the Design Event for elevating infrastructure.

Further details regarding flooding in the Murrumbidgee River during various AEP events can be found in **EIS Appendix H**.

Surcharge Flows from a PMF in the Murrumbidgee River

A PMF in the Murrumbidgee River would be a catastrophic event resulting in widespread infrastructure damage and inundation at Narrandera and other towns. Catchment wide evacuation warnings would be in place days before the floodwaters reach the Project site. Modelling has indicated that there would be approximately 12 hours warning time between a peak in the Murrumbidgee River and a peak at the Project site.

A PMF in the Murrumbidgee River would result in almost total inundation of the Project site with depths between 0.1 m and 1.3 m and velocities between 0.2 m/s and 0.8 m/s. The combination of these levels and velocities would be considered hazardous at most parts of the site. A detailed Flood Management Plan will be prepared for the operational phase, and will outline procedures for flood awareness, flood warning, evacuation and/or refuge. Since safe egress will not be possible during a PMF event, a flood refuge site will need to be established. The flood modelling indicates that there are several areas not inundated in a PMF event which would be suitable for location of an extreme flood refuge. These are evident in the 1% AEP event modelling shown in **Figure 7-11.**

7.1.4.19 Site Flooding from Local Rainfall

Existing Conditions

Existing runoff characteristics at the Project site will not change as a result of construction and operation of the Project. While the Project involves constructing solar arrays with impervious surfaces, these would not increase runoff, since the same area of soil is still available for infiltration below the solar panels, and a good vegetation cover will be maintained to spread flows.

Proposed Drainage Structures

Overland flow pathways will be maintained in their natural state and locations. All PV arrays will be elevated above ground by at least 3 m, and will not impede the flow of runoff across the ground surface. Where PV arrays are located within overland flow pathways, their height above ground will be increased if warranted by the predicted flow depth and velocity, to reduce the risk of damage to arrays.

Site access tracks will have a table drain on the upslope side that will convey runoff towards the nearest overland flow path. The site access tracks will be graded to follow the existing terrain, which is very flat across most of the site, and the table drains will also be constructed at very flat grades. Some localised ponding is likely to occur in table drains following heavy rainfall.

The existing farm dam will be kept and has been included in the flood modelling.

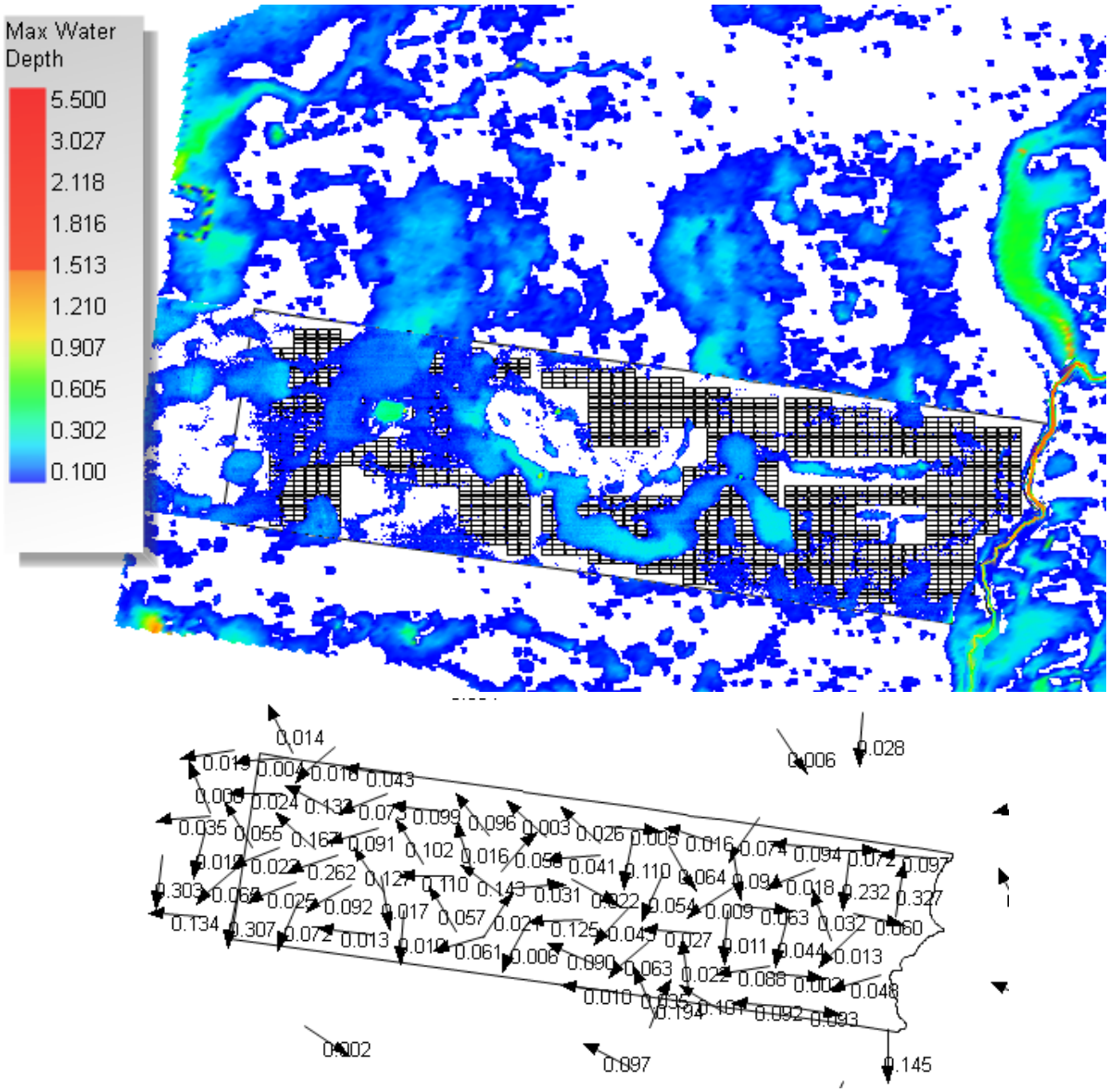
Due to flatness of the terrain, hydraulic modelling has been used to reveal the contributing catchment draining to and through the Project site, which is approximately 96 km^2. This catchment is shown in **Figure 26**. Rain falling outside this area will enter the Yanco Creek floodplain or pass by the Project site. The catchment is extremely flat so runoff rates will be low.

7.1.4.20 Example Site Flooding during a Local 1% AEP Event

A 1% AEP (1 in 100) local rainfall event would inundate approximately 20% of the site with depths exceeding 100mm. The shallow flat depression that meanders through the centre of the site would fill to depths between 0.1 m and 0.75 m with the greatest depths experienced in the central southern area. The water moves very slowly, with velocities of less than 0.3m/s – refer **Figure 7-12**. This indicates that no scour would occur with a rainfall event of this magnitude.

Results for the 5% and 0.5% AEP local rainfall event flood modelling can be found in **EIS Appendix H**.

Figure 7-12 Inundation and Site Velocities of the Project Site from a Local 1%AEP Rainfall Event



7.2 Run off

The results of the hydrological and hydraulic modelling of local rainfall event scenarios carried out using the XP-SWMM software to estimate the peak depths for both the existing site, and for the developed Project site, at all boundaries around the site are summarised in **Table 19**.

Table 19 Project Site Perimeter Discharges During Local Peak Rainfall Events

AEP	Flood level at boundary (existing)	Flood level at boundary (developed)	Change (%)
Western Boundary			
5%	131.4	131.4	0
1%	131.4	131.4	0
1 in 200*	131.4	131.4	0
Southwestern Boundary			
5%	130.3	130.3	0
1%	130.5	130.6	+0.1
1 in 200*	130.45	130.6	+0.15
Northwestern Boundary			
5%	131.0	131.0	0
1%	131.2	131.1	-0.1
1 in 200*	131.15	131.05	-0.1
Northeastern Boundary			
5%	134.3	134.3	0
1%	134.3	134.3	0
1 in 200*	134.3	134.3	0
Southeastern Boundary			
5%	131.6	131.6	0
1%	131.8	131.7	-0.1
1 in 200*	131.8	131.8	0

Note * the 1 in 200 AEP event was based on a 24 hour duration minimum as required by ARR2016. The 5% and 1% AEP events were based on the critical duration of 4.5 hours.

Hydraulic modelling of riverine flooding before and after development has not been tabulated as there is no difference in flood levels for both cases.

7.2.1.1 Risk to Loss of Life and/or Property

The Project will be designed to minimise risk to occupants from flooding events, in accordance with the *Floodplain Development Manual* (OEH), and any relevant requirements within a *Floodplain Management Plan* (DPI Water). This would include the risk of extreme events overtopping the banks of Washpen Creek and minimisation of hazardous environments. Hydraulic modelling has indicated that flood magnitudes up to the 1 in 200 AEP would not result in a hazardous environment on the Project site apart from a small area in the central southern portion of the Project site. Velocity depth ratios remain below 0.4 over 98% of the site which is considered low hazard.

A PMF would be considered a high hazard to personnel. A refuge location would be required to be identified.

As the critical inundation conditions are experienced during riverine flooding, significant warning times would be made available to ready the site for inundation.

PV arrays will be elevated above ground level on steel piles, so that they will not be susceptible to damage from flooding. The axis of arrays will be at least 3 m off the ground, and during normal operation the arrays will tilt to follow the sun, and the lowest part of the array will get no closer than 1 m off the ground. The elevation of the arrays and water sensitive equipment will be designed with regard to estimated flood depths, which vary across the Project site, so that flood damage is very unlikely. Similarly, arrays are not likely to be damaged by debris being carried by floodwater as it is so slow moving. The arrays themselves will not impede the passage of floodwaters. The steel piles which support the arrays are designed to withstand potential damage by water flows, and will not impede the movement of overland flows as the velocity is very low.

Cabling and electrical equipment is generally insulated and hence water resistant and can be either located in areas outside of flood risk, or designed to withstand inundation. Other project infrastructure such as the substation, potential energy storage, etc, will be provided with appropriate levels of flood immunity in accordance with relevant standards. These locations are not within overland flow paths, and any minor earthworks to provide elevated pads will not result in any significant loss of flood storage or flood level afflux.

7.2.1.2 Water Supply

Construction Phase

During the construction phase potable water may be transported to site in water trucks and stored in temporary water tanks for use by the construction work force. Options for non-potable water supply being considered include:

- Groundwater from the existing site bore, may be utilised subject to landowner agreement;
- Purchase of water from adjoining landholders;
- Trucking water in ;
- Harvesting of site surface water (within harvestable rights); and
- Recycled grey water.

Non-potable water use during construction would be mainly for dust suppression on unsealed roads and watering to re-establish vegetation on disturbed areas. Based on a staged construction of 100 ha per month, with up to 15% disturbance by area, and a dust suppression/watering application depth of 5 mm per day, then the daily demand for construction water may be up to maximum of 750 kL/day during dry weather. Since water usage would be less during and following rainy days, average water usage over the construction period may be less. Wastewater and greywater during construction will be captured and removed from site for off-site treatment. The provision of potable water, grey water and wastewater infrastructure would be confirmed during the detailed design phase of the project.

Operational Phase

During the Project's operational phase, water would be utilised for the following purposes:

- Potable water for site offices;
- Cleaning of PV arrays;
- Dust suppression on site access roads; and
- Topping up a fire fighting water tank for the Project. Subject to detailed design and consultation with firefighting authorities this will be a single 20,000 L tank or potentially two 10,000 L tanks.

Water demands during this phase of the Project would not be significant, and based on a review of similar projects in NSW are unlikely to exceed 5 ML per year. Potable water will be trucked into site to refill facility water tanks.

Demands for non-potable water may be met by several methods which are under consideration, including:

- Water tanks collecting roof water;
- Collection of surface water within harvestable rights;
- Groundwater from existing water bore on site (subject to landowner agreement); and
- Supplementary water as required via water trucked to site.

Toilet facilities may comprise waterless composting facilities, and would be provided in line with the requirements of Narrandera Council. The provision of potable water, grey water and wastewater infrastructure would be confirmed during the detailed design phase of the project. Methods for water supply would be finalised during the detailed design phase of the project. Water use approval is not required for State Significant Developments under section 89J (1)(g) of the EP&A Act.

7.2.1.3 Monitoring, Licensing and Reporting

Construction Environment Management Plan (CEMP)

A CEMP would be prepared during the detailed design phase of the project, and will outline the environmental measures, monitoring and reporting required to ensure satisfactory environmental performance. Minimum requirements for inclusion within the CEMP include:

- Water quality monitoring during the construction phase, as described below for the OEMP.
- An Erosion and Sediment Control Plan (ESCP) for construction activities that is consistent with the measures outlined in this EIS.

Minimum requirements for inclusion within the CEMP are documented in Section 5.5 of **EIS Appendix H**.

Operational Environment Management Plan (OEMP)

An OEMP would be prepared during the detailed design phase of the project, and would outline the environmental measures, monitoring and reporting required to ensure satisfactory environmental performance.

With regard to water quality monitoring, the default water quality triggers from ANZECC 2000 would be used as an initial baseline for water quality trigger values. These trigger values are considered to be conservative, and water management that achieves these outcomes is considered to pose a low risk to the downstream environment and downstream water users.

However, since there is no site specific baseline of water quality data, an adaptive approach is recommended, to enable the management regime to change as appropriate should unforeseen water quality issues become evident. The proposed mechanism for identifying changes is a bi-annual review of water quality.

Minimum requirements for inclusion within the OEMP are documented in Section 5.6 of **EIS Appendix H.**

7.3 Impact Assessment of Other Environmental Matters

7.3.1 Battery/Energy Storage

A Hazards & Risk Study prepared for the Project (refer **EIS Appendix G**) included a detailed assessment of the potential energy storage system that may be located adjacent to the Project substationas well as the other electrical equipment located on the site.

If implemented, the battery energy storage system would likely to have a storage capacity of approximately 35MW / 70MWhr. A decision on the inclusion of an energy storage system will be confirmed during the detailed design phase of the project, subject to feedback from TransGrid and grid operating authorities regarding their requirements.

Transportation Requirements

EIS Appendix G examines the dangerous goods handling considerations associated with the two preferred Tesla Li-ion battery energy storage system configuration options:

- A system based on individual Tesla PowerPack 2 (and inverter) cubicles would require:
  - Approximately 50 deliveries comprising 40 ft HC containers for the entire system.
- A system based on a Tesla containerised system would require:
  - 3 deliveries for the entire system, using a low-loader, flatbed vehicle.

EIS Appendix G shows that these transportation figures are substantially below the relevant ADG requirements for risk screening of Li-ion batteries (refer **EIS Appendix G Table 3**).

Space Requirements

The area required for either of the above system configurations is likely to be of the order of 1 ha (100 m x 100 m, 50 m x 200 m, etc).

- The chosen system would be located within its own secure enclosure, and in the vicinity of the Project sub-station, maintenance building and main office / control room building, with at least a 20 m separation from each of these for fire safety access, etc.
- The chosen system will be positioned at least 100 m from the nearest site boundary (located to the north) and over 4 km from the nearest residence to the north.

7.3.1.1 Potential Energy Storage System Hazards

EIS Appendix G includes a detailed examination of the potential hazards associated with energy storage systems, focussing in particular on Li-ion batteries. This is summarised in **Table 20**.

Table 20 Potential Energy Storage System Hazards and Associated Initiators

Category	Hazard Initiators
Electrical	• These risks are dependent on the voltage of the ESS and other connected equipment – such as earthing, protection devices, etc.
Energy	• Accidental contact between battery terminals with a conductive tool (e.g. an uninsulated socket wrench, spanner, etc) • A dead short within connected PCEs • A build-up of conductive material across conductors (e.g. fluid, metal shavings, etc) • Damage to cable insulation, resulting in electrical conductivity between copper conductors.
Fire	• Low ambient pressure • Overheating • Vibration and/or Shock or Impact • External short circuit • Overcharge or Forced Discharge
Chemical	• Discharge under normal operating conditions (eg venting of hydrogen gas when charging). • Spillage under fault or abuse conditions, including mechanical stress (impact, puncture, etc), thermal shock (exceedance of specified operating conditions) or electrical (e.g. forced discharge).
Explosive Gas	• Battery system isolation and overcurrent devices; • Switches internal to electrical components; • Fans and motors; and • General electrical switches (e.g. light & power).
Mechanical	• Inappropriate battery accommodation and arrangement; and • An external force – such as equipment impact, seismicity, etc.

As shown in **Table 20**, energy storage systems generally, including Li-ion systems, have the potential to constitute a safety risk involving electric shock, fire, flash burns, explosion or exposure to hazardous chemicals and released gases.

However, the hazards arising from battery-based energy storage system designs involving Li-ion batteries can be identified and appropriate safeguards can be implemented.

- In relation to the Construction and De-Commissioning Phases of the Project, the transportation requirements for the potential battery energy storage system are well within the ADG TRANSPORT limits for Li-ion battery systems.
- In relation to the Operational Phase of the Project, adherence to manufacturer's instructions and Safety Data Sheets (SDSs), maintenance of the potential battery energy storage system and its security fencing, adequate separation between battery energy storage system units within the enclosure and the battery energy storage system itself from any nearby buildings, restricted access to authorised personnel, documented emergency procedures, availability of appropriate PPE, etc, will all assist in minimising the hazards associated with the potential battery energy storage system.

Accordingly, in relation to the SEARs requirements relevant to the potential energy storage system:

- In relation to quantities and transportation of dangerous goods, none of the ADG screening threshold levels relevant to Li-ion batteries will be exceeded (refer **EIS Appendix G Tables 2 and 3**).
- The Project is therefore considered not potentially hazardous and hence a Preliminary Hazards Analysis (PHA) is not required per the normal SEPP 33 methodology assessment.
- SEPP 33 contains a definition of a *Potentially Offensive Industry* provided in **EIS Appendix G Section 2** and discussion suggesting that consideration of this aspect is not necessarily obviated by the normal SEPP 33 risk screening process.
- The identification of a development proposal as a *Potentially Offensive Industry* can lead to the requirement of a pollution control license or approval to address associated sensitivities with the receiving environment.
- In the case of the present Project and the potential battery energy storage system in particular, the main hazard identified is the potential for fire which can be managed through the mitigation recommendations described in previous section.
- Accordingly, a pollution control licence or approval is not required for the Project.

7.3.1.2 Battery Energy Storage System Hazard Mitigation

EIS Appendix G provides an extensive listing of battery energy storage system hazard mitigation measures, summarised in **Table 21**. It is noted that many of the mitigation measures, e.g. PPE, safety signage, etc, would apply to other electrical equipment on the site as well.

Table 21 Energy Storage System Hazard Mitigation

Category	Control Measure
Installation	• Regardless of the battery systems selected (i.e. Li-Ion or otherwise), installation to be in accordance with manufacturer's instructions and the accompanying Safety Data Sheets (SDSs).
Access	• Regardless of the ESS configuration (individual cubicle, containerised units, etc), access to the ESS will be restricted through maintenance of a dedicated enclosure within a secure (i.e. fenced) area. Note that pre-assembled (and containerised) ESS units constitute inherent and suitable enclosure. • Access to the ESS will be restricted only to authorised persons.

Category	Control Measure
Environmental	• Ensure that the selected ESS units have an IP rating appropriate for the environment in which they are installed in accordance with AS/NZS 3000. All equipment exposed to the outdoor environment shall be at least IP 54 and UV resistant. Connection of wiring, conduit and glands to IP rated equipment and/or enclosures shall be installed so the minimum IP rating is maintained.
External Influences	• Design for solar radiation and ambient temperature range (through proper ventilation); • Protect against the presence of water (flood avoidance) or high humidity; • Protect against solid foreign bodies (exposure to dust storms) and corrosive or polluting substances (suitable enclosures); • Protect against electrolyte spills through adequate enclosure, ESS perimeter fencing and separation distances for any nearby buildings; • Protect against impact, vibration or other mechanical stresses; and • Protect against influence of flora and fauna (eg surrounding vegetation management to minimise and eliminate where possible ignition sources).
Standards	• Relevant standards for (stand-alone) Li-ion batteries include IEC 62619, IEC 62620 and IEC 62133. • Relevant standards for pre-assembled (ie containerised) ESS units include AS 62040.1.1, AS 62040.1.2, IEC 62109, AS/ NZS 4777.2 and AS/ NZS 4509. • CEC (2017) *Battery Install Guidelines for Accredited Installers* contains an extensive of hazard minimisation strategies covering Isolation, Overcurrent Protection, Output Wiring and Earthing - for both stand-alone (cubicle) and pre-assembled (ie containerised) ESS units.
Safe Work Procedures	• Ensure safe work procedures exist to cover cracked or damaged battery casings, potential spillage of electrolyte, inhalation of, and physical exposure to, electrolyte; and a fire event.
PPE	• Ensure that proper Personal Protective Equipment (PPE) is provided on-site for the safe handling of all ESS equipment and protection of authorised persons, as well as spill kits and the safe work procedures needed for handling, repairing, maintaining, installing and inspecting ESS units.
Safety Signage	• Implement guidance covering ESS safety signage found in AS/NZS 5033 *Installation and safety requirements for photovoltaic (PV) arrays* and AS/NZS 4777.1 *Grid connection of energy systems via inverters Installation requirements* • Additional guidance can be found in … *www.solaraccreditation.com.au* which contains safety signage worked examples. • Finally, the UN number of the battery chemistry should be clearly sign-posted: • UN 3480 applies to Li-ion batteries • UN 3090 applies to Li-metal batteries • Note that safety signage should also cover all PPE requirements when accessing the ESS, and in particular, for emergency workers in a shutdown event.
Commissioning and Testing	• Once installed, the ESS should be commissioned in accordance with the manufacturer's instructions covering Labelling and Signage, all electrical "protections" (cable insulation, conduit integrity, fault protection, shrouding, terminal and other connection tightness, etc), all "physical" protections (enclosure integrity, access restrictions, etc); and all "system" protections (charge and discharge settings, conductor-to-earth resistance, ESS monitoring systems, anti-islanding and emergency power supply mode, etc).

Category	Control Measure
Documentation	• Once the ESS is installed, documentation in the form of a comprehensive System Manual shall be provided on-site, stored in a secure location and readily available to authorised personnel, inspectors, maintenance personnel and emergency service personnel, in accordance with AS/ NZS 5033 *Installation and safety requirements for photovoltaic (PV) arrays* and AS/ NZS 4777.1 *Grid connection of energy systems via inverters Installation requirements.*
Maintenance	• The ESS will be maintained in accordance with the manufacturer's instructions and Safety data Sheets (SDSs) • ESS maintenance will only be performed by authorised personnel; • Maintenance procedures will form part of the ESS System Manual; • Ensure battery system terminals are cleaned for dirt and electrolyte; • Ensure electrical terminals are set to correct torque settings; • Ensure battery accommodation integrity is maintained (e.g. not damaged, free from debris/ rubbish; and, access is not obstructed); • Ensure proper functioning of overcurrent and isolation devices; • Check charge and discharge parameters are correctly set; • Ensure correct ventilation has been provided and is maintained; and • Check cable mechanical support, protection and penetration is maintained.

As noted, at the present time, the likely contender for the potential energy storage system is a Tesla PowerPack 2 based system, comprising either stand-alone battery cubicle modules or a pre-assembled containerised system mounted on concrete plinths.

Tesla - refer https://www.tesla.com/en_AU/powerpack - provides extensive Specification and SDS information covering its PowerPack 2 units, whether in stand-alone cubicle form or in pre-assembled containerised units.

Fire suppression systems have been developed by Tesla - refer https://www.tesla.com/en_AU/powerpack – to address fire hazards.

Experience to date with Li-ion batteries supports the use of water as the most effective means of managing the fire risk associated with these battery types. Tesla itself recommends water be used to fight a fire involving any of its Energy Products.

The 20,000 L water supply to be made available on the Project site for general firefighting purposes, refer **Section 7.2.3.9**, will address the firefighting needs associated with the potential energy storage system.

Again, as previously noted, a final decision on the preferred technology provider for the battery-based potential energy storage system will be made during the detailed design phase of the project. The chosen system will comply with all applicable Australian standards and guidelines.

7.3.2 Fire and Bush Fire

The Hazards & Risk Study reported in detail in **EIS Appendix G** includes an assessment of Fire Safety in general and Bush Fire Hazard and Risk Assessment.

7.3.2.1 Fire Hazard Associated with Project Infrastructure

Only a small portion of the constituents of solar PV panels are flammable. These flammable components, which include the thin layers of polymer encapsulation surrounding the PV cells, polymer backsheets (framed panels only), plastic junction boxes found on the rear of a panel, and insulation on wiring, cannot self-support a significant fire.

EIS Appendix G includes references covering the ignition potential of PV panels and arrays, which indicate that:

- Heat from a small flame will not ignite a PV panel, but heat from a very intense fire or energy from a serious electrical fault has the potential to ignite a PV panel.
- However, the possibility of a fire resulting from or intensified by solar PV panels is low risk.
- A real-world example occurred during July 2015 in an arid region of California. Three acres of grass under a thin film PV facility burned without igniting the panels mounted just above the grass.

Large-scale solar facilities do not pose the same physical challenges for firefighters when encountering extensive solar PV systems mounted on buildings, which can inhibit the standard methods of fighting fires (e.g. through roof ventilation) and access for the firefighters themselves to the building via roof entry points.

In addition to the solar panels, the following electrical components (excluding the Project's potential Energy Storage System examined separately in **Section 7.3.1**) have been examined for potential fire risk and public health and safety risk in general :

- The inverters that convert the solar generated DC electricity to AC form for the grid;
- The synchronous condensers that adjust conditions throughout the system (by either generating or absorbing reactive power or improving the power factor); and
- The sub-station transformer(s) which boosts the inverter output voltage to the voltage of the utility grid connection.

In relation to the above:

- Inverters have weather-proof steel enclosures that protect the working components from the elements. They contain cooling system fluids similar to those found in all computer systems and are generally RoHS compliant, as will the models chosen for the Project.
- Synchronous condensers can be either air-cooled or hydrogen-cooled. The Project will be using air-cooled condensers.
- Transformers contain transformer oil for insulation and cooling. Toxic PCBs are no longer used as a cooling fluid; instead, non-toxic mineral or biodegradable oils are used.

The Project elements have been common elements in power installations for decades as part of substations, SVC facilities, etc. with proven fire-management and containment procedures.

7.3.2.2 Bush Fire Risks

Bush Fire Risk for the Project will be managed via a comprehensive Bush Fire Management Plan that will span all stages of the Project: construction, operation through to final de-commissioning.

A search on the NSW Rural Fire Service (RFS) website, using the RFS mapping tool, revealed that the Project is not identified as being within bush fire prone land (website search carried out May 2018) refer:

https://www.rfs.nsw.gov.au/plan-and-prepare/building-in-a-bush-fire-area/planning-for-bush-fire-protection/bush-fire-prone-land/check-bfpl

Nevertheless, mitigation measures have been considered as if the Project was located within such land.

7.3.2.3 Bush Fire Guidelines and Mitigation Measures

Bush Fire Protection Measures (BPMs) required for a development on bush fire prone land are found in the:

- NSW Rural Fire Service (RFS), *"Planning for Bush Fire Protection"*, 2006.

In order to achieve an acceptable level of protection, the above guidance document details six key BPMs to improve protection against bush fire attack:

- Asset Protection Zones (fuel reduced areas);
- Access Arrangements;
- Building Construction and Design;
- Water Supply and Utilities;
- Landscaping; and
- Emergency Management Arrangements.

In recent years, NSW RFS has written and published a multitude of fact sheets to clarify or update best practice in this area. These have now been incorporated into the following draft document:

- NSW Rural Fire Service (RFS), *"Planning for Bush Fire Protection"*, Draft Issued April 2017.

Key changes relevant to the Project include:

- A simplified approach for grasslands;
- Simplified access requirements;
- Improved alignment with Australian Standard 3959-2009; and
- Greater emphasis on strategic planning, which considers state, regional and local level plans.

7.3.2.4 Firefighting Resources in the Area

Available firefighting resources in the area are listed in **EIS Appendix G** (**Table7**).

7.3.2.5 Nearest Receivers and Assets

Receivers and assets at risk from bush fire surrounding the Project include farms and residences surrounding the site and the wider agricultural assets of the region, as shown in **EIS Appendix G** (**Figure 5**).

7.3.2.6 Site Access

The surrounding road network and access routes to the Project site are shown in **Figure 2-3 and Figure 2-4**.

7.3.2.7 Bush Fire Indicators

Potential bush fire risk initiators are summarised in **Table 22** according to the three main Project phases.

Table 22 Potential Bush Fire Initiators

Project Phase	Impact
Construction	Clearing activities (e.g. slashing, mowing and diesel-powered tool use), lightning strikes, storage of fuels/chemicals, hot welding activities, cigarette butts thrown from cars travelling within the site, traffic accidents, etc.
Operational	Ground cover/vegetation beneath and in between solar panels, ignition of electrical equipment, especially during repairs and maintenance activities, traffic accidents, ignition of site buildings, including the substation and site's potential energy storage system.
De-Commissioning	Decommissioning activities would have similar impacts to that for construction.

7.3.2.1 Guidance for Bush Fire Control Measures (Access, Set-backs, APZs, Water, Emergency Planning)

BMPs for the Project have been developed in accordance with the guidelines contained in:

- NSW RFS *Planning for Bush Fire Protection 2006* Chapter 4 "Performance Based Controls"

Chapter 4 also provides performance criteria for Water Protection and the preparation of an adequate Emergency and Evacuation Plan.

The NSW RFS *Planning for Bush Fire Protection 2017 Draft*:

- contains a new Chapter 9 covering developments in areas of grassland, with protection measures relevant to the Project;
- replaces the distances contained within Tables 2.4.2-2.4.5 in AS 3959-2009 with new Set-Back recommendations;
- revises the road carrying capacity for fully-loaded firefighting vehicles to 23 tonnes;
- expands the guidance dimensions for access roads to be used by firefighting vehicles;
- expands the guidance criteria for the site static water supply available for firefighting; and
- provides a new table (Table 5.3e) of firefighting water supply, which for the Project would be 20,000 litres.

7.3.2.2 Mitigation and Management Measures

Project Stage - Construction

- Bush Fire risks during construction will be managed through the implementation of a comprehensive Construction Bush Fire Management Plan (CBMP), to be prepared by the successful Project Contractor and signed off by all appropriate authorities.
- The CBMP will ensure adequate site access for the NSW RFS along with water supply resources (20,000 L) needed to supress any fire within the Project site.

Project Stage – Operational

- Bush Fire risks once the facility is fully operational will be managed through the implementation of a comprehensive Operations Bush Fire Management Plan (OBMP), to be prepared by the successful Project Operator and signed off by all appropriate authorities.

- The OBMP will ensure adequate site access for the NSW RFS along with water supply resources (20,000 L) needed to supress any fire within the Project site.
- The OBMP will detail how ground cover beneath and in between the solar panels will be managed to minimise their fire risk, including ground cover monitoring and implementing increased growth suppression activities during high bush fire periods of the year.
- The OBMP will detail all Set-Backs and Asset Protection Zones around the site and all buildings, including the Project substation, Main Office/Control Centre and potential energy storage system.
- It has been previously noted that risk associated with electrical equipment ignition would be manageable – refer **Section 7.3.2.1**.
- The Project has the benefit of two primary emergency access points to the site, from the east via Back Morundah Road, and from the wests via Old Morundah Road.
- There will also be extensive access tracks within the Project site itself, ensuring adequate access for emergency services vehicles and personnel. The OBMP will ensure that adequate egress (including turning circles, etc) exists within the internal access route network.

Project Stage – De-Commissioning

- The OBMP will detail De-Commissioning phase management strategies similar to those deployed for the Construction phase to address the similar risks expected during this last phase of the Project.

General Management and Mitigation Aspects

In addition to the above stage-related measures, the Project CBMP and OBMP will:

- Comply with all relevant Bush Fire Policies, Standards and Guidelines, specifically the NSW RFS's Draft 2017 *Planning for Bush Fire Protection*;
- Detail the emergency and evacuation measures adopted for the site;
- Ensure there are adequate setbacks in the Project design (e.g. 20 m from the site perimeter fencing for any solar arrays, 20 m setbacks from wooded areas and any *"Vegetation and Heritage Protection Exclusion Zones"*;
- Detail storage and maintenance requirements for firefighting water tanks and any other on-site firefighting equipment, including fire extinguishers for all site vehicles, as well as relevant operational procedures for bush fire suppression;
- Develop a system for the continuous monitoring of the NSW RFS website for bush fire alerts (especially during the bush fire season) http://www.rfs.nsw.gov.au;
- Detail the storage and sign-posting requirements for any fuel or flammable liquids stored on-site, including a register of all such material along with their Material Safety Data Sheets (MSDSs);
- Ensure that burning of vegetation or any other waste materials does not take place on-site;
- Ensure that smoking is prohibited in work areas, and within 5 m of any door, window or air conditioner intake;
- Ensure that all employees receive training and instruction on the relevant fire procedures as part of their induction training; and

- Ensure that firefighting equipment which is identified during the risk assessment process undertaken in the development of the site-specific Fire Management Plan, is made available to the appointed Emergency Response Team as well as for emergency service personnel entering the site.

Alignment of the CBMP, OBMP and ERP

It is important that the Project Construction and Operations Bush Fire Management Plans and Project Emergency Response Plan (ERP) are aligned so that there is no conflict between activities such as the risk control measures adopted for minimising electrical hazards for firefighters attending emergency situations on-site.

The CBMP, OBMP and ERP will be provided to the NSW RFS with copies stored locally within an appropriate "emergency cabinet" located within the Project Main Office/Control Room building.

These plans will detail how fire emergencies will be addressed via a site-specific *Fire Emergency Procedure* and the *Emergency Management Procedure.*

7.3.3 Electric and Magnetic Fields (EMFs)

A Hazards & Risk Study has been carried out for the Project, reported in detail in **EIS Appendix G**, which included an assessment of the potential sources of hazard and risk associated with Electric and Magnetic Fields (EMFs).

7.3.3.1 Background

EMFs

Electric and Magnetic Fields (EMFs) are part of the natural environment; they are present within the Earth's core and in the atmosphere. Whenever a power line is energized, an Electric Field is created with a strength that depends directly on the voltage across the line creating it. A Magnetic Field is created whenever current flows through a power line (at any voltage).

EMFs associated with the generation, distribution and use of electricity power systems in Australia are classified by Energy Networks Australia (ENA) as being extremely low frequency (ELF). As a result, they do not normally radiate from their sources.

EmFs

At much higher frequencies, Electric Fields and Magnetic Fields exist in a mutual relationship known as an Electromagnetic Field (EmF) and with a unique ability to radiate beams of energy from an antenna (hence their "electromagnetic radiation" property), thereby making communication systems possible. The Project-related hazards and risks assessed in this present study however are restricted to the properties of the independent Electric and Magnetic Fields (herein denoted electric and magnetic fields) associated with solar facility equipment, cabling and power lines (operating at a frequency of 50 Hz).

Confusion between EMFs and EmFs is understandable, but the distinction is important as the electromagnetic radiation properties of EmFs are in sharp contrast to solar facility ultra-low frequency EMFs that do not create a radiating energy beam (hence the nomenclature of EMFs as a "field" and not "radiation").

7.3.3.2 Typical EMF Strengths

Typical examples of the strength of commonly encountered magnetic fields are shown in **Table 23**.

Table 23 Typical Magnetic Field Strength Examples: Domestic & Power Sources

Example Domestic Source	Magnetic Field	Example Power Source	Magnetic Field
TVs, Fans	0.2 – 2 mG	Sub-station (at perimeter fence)	1 - 8 mG
Toasters, Kettles	2 - 10 mG	Suburban transmission line: . Under the line . 10 m away	 2 - 30 mG 0.5 - 10 mG
PCs, Laptops	2 - 20 mG	High voltage transmission line: . Under the line . Edge of easement	 10 - 200 mG 2 – 50 mG
Electric stoves, Electric blankets	2 - 30 mG	Underground cables	5 - 200 mG

Sources: (Transgrid 2016 & ARPANSA 2006)

The electric field close to typical domestic appliances is around 10 V/m. At the surface of an electric stove or electric blanket, electric field strength can reach 500 V/m. Near power source underground cabling, electric field strength is typically negligible, due to the shielding attenuation of cable insulation and the intervening ground soil. Directly under high voltage transmission lines, electric field strength can range up to 10 kV/m.

7.3.3.3 EMF Guidelines – Magnetic Field Exposure Limits

Some communities have shown concern regarding the potential for adverse health impacts associated with exposure to EMFs.

ARPANSA (the Australian Radiation Protection and Nuclear Safety Agency) advises that:

- *"On balance, the scientific evidence does not indicate that exposure to 50 Hz EMFs found around the home, the office or near power lines is a hazard to human health".*
  and
- *"The majority of scientists and Australian radiation health authorities in particular, do not regard chronic exposure to 50 Hz EMFs at the levels commonly found in the environment as a proven health risk. Moreover, the evidence we have is inconclusive and does not allow health authorities to decide whether there is a specific magnetic field level above which chronic exposure is dangerous or compromises human health".*

The broad consensus therefore amongst the Australian scientific community, and indeed internationally, is that adverse health impacts have not been established, but the possibility cannot be ruled out. The logical outcome of this situation is a cautionary approach, which will be adopted in the design of the proposal.

Scientific studies surrounding the health impacts of EMFs were previously focussed on electric fields. Currently, most interest and research centres on the impacts of magnetic fields. Criteria associated with this research have been developed by ARPANSA, Australia's NHMRC (National Health and Medical Research Council, note: criteria rescinded), the International Radiation Protection Association (IRPA) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The Magnetic Field exposure limits prescribed by these bodies are shown in **Table 24**.

Table 24 Australian and International Magnetic Field Exposure Limits

Exposure Class	NHMRC 1989	ARPANSA 2016	ICNIRP 2010	IEEE 2002
Public Exposure				

Exposure Class	NHMRC 1989	ARPANSA 2016	ICNIRP 2010	IEEE 2002
Normal	na	1,000	9,040	1,000
Controlled Activity	na	3,000	na	na
Up to 24 hours	1,000	na	na	na
A few hours per day	10,000	na	na	na
Limbs	na	na	758,000	na
Occupational Worker Exposure				
Normal	na	5,000	27,100	5,000
Controlled Activity (head)	na	15,000	na	na
Controlled Activity (other)	na	18,000	na	na
Whole working day	5,000	na	na	na
2 hours per day	50,000	na	na	na
Limbs	250,000	na	758,000	na

7.3.3.4 Project EMFs

While the final design selection for all of the Project electrical equipment has not yet been made (solar panels, cabling, inverters, synchronous condensers, substation, potential energy storage, etc), all of the Project's electrical equipment would comply with relevant Australian Standards for exposure to electromagnetic radiation, including:

- ARPANSA Radiation Protection Standard (Publication Series 3), *"Maximum Exposure Level to Radiofrequency Fields – 3 kHz to 300 GHz"*, update May 2016 (originally published 2002).

As a result, the magnitude of the EMFs from all equipment types, in particular their magnetic fields, will be highly localized and should remain well below the exposure limits found in the Australian and International guidelines shown in **Table 24**.

Field studies of large-scale solar facilities indicate that large-scale solar facility EMF strengths are likely to be imperceptible at all locations accessible to the public. An example is the comprehensive, US EPRI-funded study of EMFs (frequency range 0 Hz and 3 GHz) at two large-scale solar facilities operated by the Southern California Edison Company in Porterville, CA, and San Bernardino, CA:

- Tell, R.A., Hooper, H.C, Sias, G.G, Mezei, G., Hung, P. and Kavet, R., *"Electromagnetic Fields Associated with Commercial Solar Photovoltaic Electric Power Generating Facilities"*, Journal of Occupational Environmental Hygiene, 2015 12(11) pp795-803.

The above study included the measurement of static DC magnetic fields, power-frequency AC EMFs (up to 3 kHz), and radio-frequency EMFs (up to 3 GHz) and concluded that these EMFs all complied with IEEE and ICNIRP exposure limits (refer the detailed results summary in **EIS Appendix G**).

On the basis of the above, the magnetic fields produced by all of the equipment within the Project should be substantially below the exposure limits shown in in **Table 24**, even at close distances from the relevant equipment, and certainly at "background" levels at the nearest relevant perimeter fence of the Project.

Inverter (Systems)

The Project inverter systems will be designed to comply with the International standards and guidelines that ensure their conformance to performance criteria with respect to EMFs, including:

- IEC / EN 61000-6-4 (EMC emission); IEC / EN 61000-6-2 (EMC immunity); EN 55011/ CISPR 11 (EMC emission); EN 55022 / CISPR 22 (EMC emission); and FCC Part 15 Class A (EMC emission).

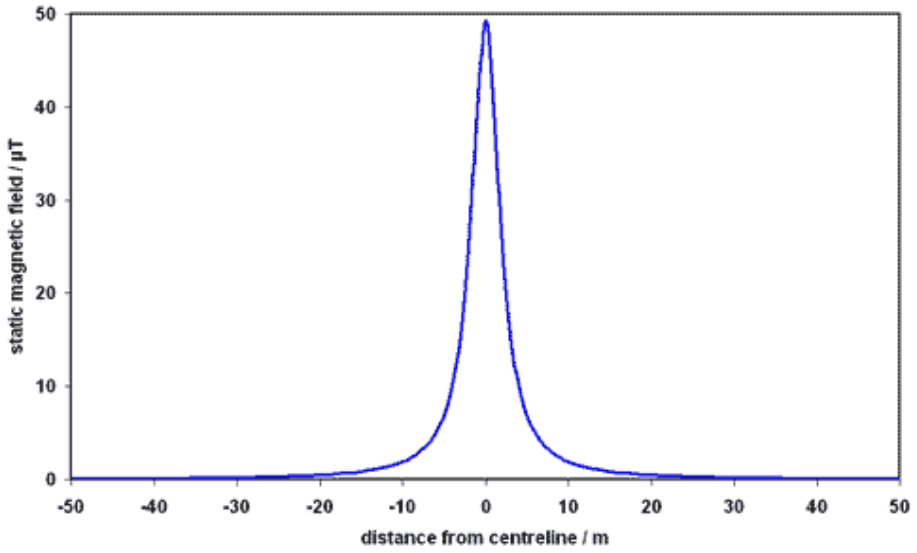
The step-up transformers within inverter stations are essentially identical to those installed within residential distribution kiosks commonly found in public spaces. All of the inverter stations planned for the Project will be positioned at a sufficient distance (minimum 20 m) from the external security fence such that no further assessment is necessary to confirm that the impact to the public will be negligible.

Underground Cabling

Underground cables always include a metal sheath which screens the electric field. Given the additional (electric field) shielding from the surrounding soil mass, interest in underground cable EMF is restricted to potential magnetic field strength.

A typical underground cable will produce a maximum magnetic field of about 50 µT at approximately 1 m above ground – refer data shown in Figure **7-13** obtained from PHE (Public Health England) Radiation Protection Division. Cable magnetic field strength falls rapidly with distance. Beyond about 15 m, the magnetic field strength would be below 1 µT and indistinguishable from the earth's own magnetic field.

Figure 7-13 Typical Underground Cable Magnetic Field Distance Attenuation



Substation (Transformers)

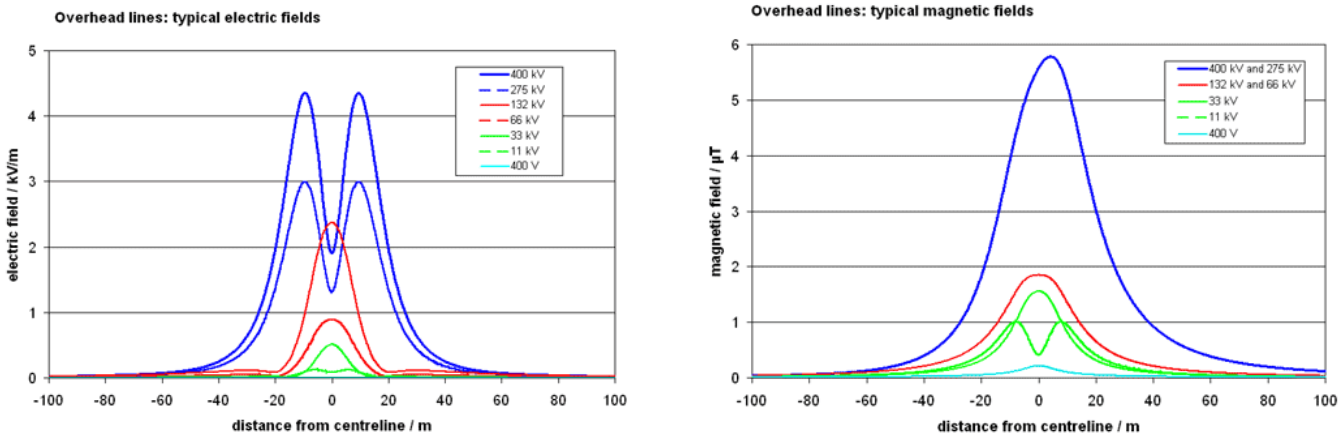
It is expected that the location of the Project substation along with its own security fencing will ensure that EMF exposure to the public is well below the limits found in the guidelines provided in **Table 24**.

The UK's National Grid Company conducted a 2004 substation survey for PHE involving measurements 0.5 m above ground level and one metre away from substation enclosures. Magnetic field strength averaged 19 mG and became indistinguishable from background levels within 5 m.

Transmission Line Connector

The Project will connect to the existing NSW grid system via a limited length "connector" overhead line to the existing 330 kV transmission line which runs along the northern boundary of the Project site. Typical EMF attenuation characteristics for overhead transmission lines relevant to this "connector" are shown in **Figure 7-14**. EMF strength can be seen to fall rapidly with distance.

Figure 7-14 Typical Transmission Line EMF Attenuation Curves



Source: PHE 2018 EMFS.info

Summary and Mitigation Measures

As a consequence of the above considerations, the only measureable EMFs present outside the boundary of the Project site would almost entirely be from the existing 330 kV transmission line which runs along the northern boundary of the proposal site.

Given that the nearest sensitive receiver is over 900 m from the Project site boundary (at its closest point) and hence from any area of EMF-generating, EMF will not be a concern and is not addressed further in this assessment.

Despite the above, and in line with the cautionary approach recommended in this study, in addition to compliance with the guidelines and standard shown in **Table 24**, the Project proponent has made a commitment:

- To develop the design of the facility in accordance with Energy Networks Association (ENA), *"ENA Policy Statement on Electric and Magnetic Fields"*, adopted by the ESAA Board in 1991 and reconfirmed by the ENA EMF Committee, March 2006; and Nutall, K., Flanagan, P. and Melik, G., *"Prudent Avoidance Guidelines for Power Frequency Magnetic Fields"*, 23rd Annual Conference of the Australasian Radiation Protection Society, 1998; and
- To maintain the integrity of all project security fencing through the lifetime of the Project to ensure adequate exposure separation for all members of the public.

Construction & De-Commissioning

During the Project construction phase, construction staff may be intermittently exposed to EMFs in areas near the overhead transmission lines and when working near selected equipment (e.g. inverters) once testing of the substation and entire system begins. Potential EMF impacts are expected, in particular for sensitive workers (e.g. workers with implanted medical devices). They are however likely to be short term and negligible and will be managed according to the Project's Occupational Health & Safety Management Plan.

7.3.4 Historic Heritage

Register Searches

The Historic Heritage assessment was carried out by OzArk as part of the Preliminary Environmental Assessment for Project, and is referenced in **EIS Appendix**. The following searches[9] have been made:

- Narrandera Shire Council Local Environmental Plan (LEP);
- NSW State Heritage Register and Inventory; and
- Australian Heritage Database.

No listed historic sites or places were identified within the Project site.

7.3.4.1 Existing Environment

The existing use of the development site is traditional agricultural production. The project site comprises fields that have been consistently cropped and grazed for many years.

During further detailed Aboriginal and Cultural heritage field surveys no historic heritage items were recorded in the proposed Project area.

7.3.4.2 Potential Impacts

A site inspection undertaken by suitably qualified archaeologists during the Aboriginal and Cultural heritage field surveys undertaken By OzArk, revealed no specific historic heritage items within the Project site.

7.3.4.3 Mitigation and Management Measures

If an item of potential historic heritage is uncovered during the works, works would cease and the Heritage Division (OEH) would be contacted for advice.

7.3.5 Noise & Vibration

A Noise & Vibration Impact Assessment has been carried out by SLR for the Project, described in detail in **EIS Appendix K**. This section summaries study methodology, assessment criteria, assessment of noise emissions and noise mitigation recommendations, where applicable, in relation to the following specific areas of acoustic significance:

- Construction Phase noise and vibration emissions; and
- Operational Phase noise and vibration emissions.

[9] First searched in September 2017, and then again in February 2018.

A glossary of acoustic terminology is included in **EIS Appendix K Attachment A**.

7.3.5.1 Nearest Noise Sensitive Receivers

EIS Appendix K Attachment B shows the Project site boundary and all surrounding noise sensitive receivers. The closest and potentially most impacted residential noise sensitive receivers to the Project are listed in **Table 25**.

Table 25 Nearest Noise Sensitive Receivers

Address	Approximate distance from nearest Project site boundary (m)
2354 Back Morundah Road (house)	1200
2354 Back Morundah Road (house)	970
2354 Back Morundah Road (house)	1050
1714 Back Morundah Road (house)	1500
1714 Back Morundah Road (house)	1350

The noise sensitive receiver closest to the Project main office and nearby substation is approximately 2,600 m to the north.

7.3.5.2 Assessment Criteria

The Project SEARs relevant to noise and vibration require:

- An assessment of the construction noise impacts of the development in accordance with the NSW Interim Construction Noise Guideline (ICNG) – including a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria; and
- An assessment of operational noise impacts in accordance with the NSW Noise Policy for Industry 2017 (NPfI).

Construction Noise - NSW Interim Construction Noise Guideline (ICNG)

EIS Appendix K describes how the ICNG sets out ways to manage the impacts of construction noise on residences and other sensitive land uses through the development of construction noise management levels (NMLs) for residential and other noise sensitive receptors based on the background noise environment and the proposed times of construction work.

The construction Noise Management Levels (NMLs) for the Project, and how they are to be applied, are detailed in **Table 26.** The NMLs apply at the property boundary that is most exposed to construction noise and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence.

Table 26 Determination of NMLs for Residential Receivers

Time of Day	NML $L_{Aeq(15minute)}$	How to Apply
Standard hours Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or public holidays	RBL + 10 dBA **45 dBA** (35 dB LA90 + 10 dBA)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq(15minute) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practises to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly Noise Affected **75 dBA**	The Highly Noise Affected (HNA) level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restructuring the hours that the very noisy activities can occur, taking into account: • Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools or mid-morning or mid-afternoon for works near residences. • If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	RBL + 5 dBA **35 dBA** (30 dB LA90 + 5 dBA)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practises have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community.

Note 1 The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW *Industrial Noise Policy*.

Construction Vibration

Given that the nearest sensitive receiver is over 900 m from the Project site boundary and hence from any area of construction-related activity, and a lack of significant vibration generating activities, vibration would not expected to be a concern and is not addressed further in this assessment.

Operational Noise – NSW Noise Policy for Industry 2017 (NPfI)

NPfI 2017 aims to ensure that industrial-related noise is kept to acceptable levels in balance with the social and economic value of industry in NSW. Implementation is achieved by setting criteria for (a) "intrusive" noise (so that noise from any single source does not greatly intrude greatly above the prevailing background noise level) and (b) "amenity" (so that the background noise level does not exceed the level appropriate for the particular locality and land use).

The NPfI intrusive and amenity criteria for the Project are presented in **Table 27**. Their derivation is described in detail in **Appendix K**.

Table 27 NPfI Assessment Criteria (Rural Amenity Area)

Intrusive $L_{Aeq(15min)}$ – RBL +5dB			Amenity (Rural) $L_{Aeq(period)}$		
Day	Evening	Night	Day	Evening	Night
40 dBA	35 dBA	35 dBA	50 dBA	45 dBA	40 dBA

Modifying factors are to be applied to the predicted noise levels if the source noise, at the receiver, is low frequency, tonal or intermittent in nature. The NPfI modifying factors relevant to the Project are:

- Tonal Noise: 5 dB
- Low Frequency Noise: 2-5 dB
- Intermittent Noise: 5 dB

The NPfI also provides two options for taking into account noise-enhancing meteorological effects (refer NPfI Fact Sheet D). Operational noise from the Project was assessed in accordance with NPfI weather effect Option 1 using "worst-case" meteorological conditions. Compliance under these conditions provides confidence that compliance can be expected throughout the entire range of possible weather conditions experienced at the site.

7.3.5.3 Construction Noise Assessment

Working Hours

It is expected that the majority of construction works would be undertaken in accordance with the ICNG during the standard daytime working hours of:

- 7.00 am to 6.00 pm Monday to Friday
- 8.00 am to 1.00 pm on Saturdays.

Limited works may be conducted outside of these hours provided they are managed so as to generate noise levels below the relevant ICNG noise management levels.

Construction Noise "Scenarios"

In practice, potential construction noise impacts at any particular location will vary greatly depending on a number of factors, including the following:

- The position of the works within the site and distance to the nearest sensitive receiver;
- The overall duration of the works;
- The number if plant items operating simultaneously;
- The time at which the works are undertaken; and
- The character of the noise.

A conservative approach was taken in the present noise assessment, consistent with the ICNG, by adopting a "realistic worst-case" noise impact scenario based on the expected construction works within a peak 15-minute period, with the works assumed to be located nearest to a particular receiver.

- Noise propagation and attenuation was based on the CONCAWE methodology;

- Meteorological conditions were set to NPfI "worst-case", which assumes a prevailing wind blowing from the source directly towards the nearest receiver;
- Noise sources associated with the construction works are summarised in **Table 28**; and
- Worst-case scenarios involved assuming that at least five items of the plant listed in **Table 28** would be operating simultaneously at the same location adjacent to a site boundary position closest to each nearest receiver.

Table 28 Construction Noise Sources – Sound Power Levels

Noise Source	Expected No of Plant	Sound Power Level per Item (dBA)
Excavator	5	105
Piling	10	115
Trucks	4	110
Grader	1	107
Crane / Telehandlers	2	100

7.3.5.4 Construction Noise Impact

Worst case construction noise levels (without any assumed mitigation such as boundary or local screening) at the most exposed receiver (970 m from the closest site boundary) are predicted to be approximately 45 dB LAeq. For receivers further afield, it is expected that the construction noise levels would be significantly lower than predicted at the most-exposed receiver.

Construction noise levels are therefore expected to meet the ICNG construction standard hours NMLs at all surrounding residential receivers.

7.3.5.5 Operational Noise– Source and Propagation Assumptions

The principal sources of industrial noise associated with the operation of the Project (refer **EIS Appendix K** for details) will likely consist of the following:

- Substation/transformers and inverters
- Single-axis tracking system mechanism – assumed to be insignificant (no further analysis)
- Maintenance activities

The "worst-case" combined cumulative noise model developed for the Project assumed the following noise source levels:

- Substation/transformer: 90 dBA SWL[10] (includes 5dB penalty for potential tonal noise); and
- Inverter: 101 dBA SWL[11] (includes 5dB penalty for potential tonal noise).

[10] Derived based on AS/NZS 60076.10.1:2009 *Power transformers Part 10.1: Determination of sound levels—Application guide* and a transformer size of 352 MVA.
[11] Based on published data from SMA Solar Technology AG

Calculations were undertaken based on the CONCAWE methodology for the calculation of noise propagation and attenuation. As in the case of the construction noise impact assessment, meteorological conditions were set to "worst-case" options in accordance with NPfI guidance, e.g. the prevailing wind was assumed to be blowing from the source directly towards the nearest receiver.

7.3.5.6 Operational Noise – Predicted Noise Levels

Operational noise levels predicted at the nearest sensitive receiver are shown in **Table 29**.

Table 29 Predicted Operational Noise Levels at Most Exposed Receiver (L_{Aeq})

Daytime			Evening/Night-time [1]		
Intrusive Criterion	Amenity Criterion	Predicted Level	Intrusive Criterion [1]	Amenity Criterion [1]	Predicted Level
40 dBA	50 dBA	< 25 dBA	35 dBA	40 dBA	< 25 dBA

1 – The more pessimistic night-time period criterion was adopted as a conservative approach for both evening and night-time periods

The "worst-case" predicted noise levels (including a potential 5 dB penalty for tonality) meet the NPfI intrusive and amenity criteria during daytime, evening and night-time periods.

Assuming the established SWLs are achieved from the transformer and inverter equipment (to be confirmed during the detailed design phase), compliance with NPfI is readily anticipated to be met at the surrounding noise sensitive receivers during daytime, evening and night-time periods.

7.3.5.7 Construction Noise Mitigation Measures

Mitigation measures related to construction noise are provided in **Table 30**.

Table 30 Noise Mitigation Measures

Category	Control Measure
Work Hours	Where possible, undertake works during the ICNG standard daytime construction hours (i.e. 7.00 am to 6.00 pm Monday to Friday and 8.00 am to 1.00 pm on Saturdays). Where it is necessary to undertake works outside of these hours, it is recommended that AS 2436-2010 *"Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites"* is used to assist in mitigating construction noise emissions. Measures that would be applied in such instances are outlined below.
Universal Practices	• Regular reinforcement (such as at toolbox talks) of the need to minimise noise. • Regular identification of noisy activities and adoption of improvement techniques. • Avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents. • Where possible, avoiding the use of equipment that generates impulsive noise. • Minimising the need for vehicle reversing for example (particularly at night), by arranging for one-way site traffic routes. • Use of broadband audible alarms on vehicles and elevating work platforms used on site. • Minimising the movement of materials and plant and unnecessary metal-on-metal contact. • Minimising truck movements.

Category	Control Measure
Plant & Equipment	• Choosing quieter plant and equipment based on the optimal power and size to most the required tasks. • Selecting plant and equipment with low vibration generation characteristics. • Operating plant and equipment in the quietest and most efficient manner.
On-Site Mitigation	• Maximising the distance between noise activities and noise sensitive land uses. • Installing purpose built noise barriers, acoustic sheds and enclosures.
Work Scheduling	• Scheduling work to coincide with non-sensitive periods. • Planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from the sensitive receivers. • Optimising the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours. • Including contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.
At-Source Control	• Where reasonably practical, noisy plant or processes should be replaced by less noisy alternatives. • Modify existing equipment: Engines and exhausts are typically the dominant noise sources on mobile plant such as cranes, graders, excavators, trucks, etc. In order to minimise noise emissions, residential grade mufflers should be fitted on all mobile plant utilised on site. • Use of siting of equipment: Siting noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise. • Regular and effective maintenance.
Noise Barriers	• Temporary noise barriers are recommended where feasible, between the noise sources and all nearby potentially affected noise sensitive receivers, wherever possible. Typically, 7 dBA to 15 dBA of attenuation can be achieved with a well-constructed barrier. • Orientation of the noisy equipment whereby the least noisy side of the equipment is facing the closest receiver. • The positioning of any site huts/maintenance sheds adjacent to the noisy equipment, in the direction of the closest receiver.
Noise measurements of equipment	• Measuring equipment after installation to that all equipment including the transformer and inverters SWLs.

There are no noise mitigation measures required for the Project's operational period.

7.3.5.8 Cumulative Impacts

Due to the distance from the Project to other nearby major projects (over 4.5 km, refer **Figure 7-28**) there are no expected cumulative noise effects associated with the Project.

7.3.6 Landscape and Visual Impact

A Landscape and Visual Impact Assessment (LVIA) has been carried out by SLR for the Project, reported in detail in **Appendix J** of the EIS and summarised in this section.

7.3.6.1 Existing Environment

The existing visual environment for the subject site and surrounding area is largely characterised by open, flat, rural land (mainly agricultural), that is broken up by stands of vegetation along creeks, roads and property boundaries. Although the vast majority of the land has been cleared of vegetation, the remaining stands break up the landscape and compartmentalise views that, in most cases are quite long and generally featureless (apart from the presence of vegetation). The rural character is also enhanced by the presence of scattered agricultural buildings in the landscapes, but due to the large distances and the relative scale of these structures, these appear very sparse in the landscape. The landscape character of the site and its local context is typical of the local farming country and rural setting and plays an important role in the local sense of identity.

The site itself is quite contained and separated from any local public receptors (roads) due to the physical distance from them and the screening nature of the existing vegetation around it. There are no localised high points where the site can be seen as these are a reasonable distance from the site and encumbered by stands of vegetation.

A number of private residences/houses are located near the Project Site with the closest being located on the Yarrabee Farm property. Most of the local buildings that were considered habitable structures (and therefore viable receptors) were located at distance greater that 3 km from the edge of the subject site. The closest local residence outside of the property (and accessed off Back Morundah Road) is approximately 1.5 km from the subject site. Again, the presence of existing vegetation along Washpen Creek significantly limited any views into the site and therefore views of the future facility. Given the flat nature of the topography and local stands of existing vegetation in and around these local houses, few if any of them had any noticeable views of the site.

7.3.6.2 Methodology

The LVIA included an assessment of potential landscape and visual impacts as a result of the project, and generally applied the assessment techniques set out in the 'Guidelines for Landscape and Visual Impact Assessment, Third Edition' (2013) prepared by The Landscape Institute and the Institute for Environmental Management and Assessment (UK).

The assessment included the following:

- Review of the proposal (scale, bulk, height, technical specifications and landscape);
- Analysis of the subject site (visual exposure, visual qualities and landscape values);
- Mapping of Theoretical visual catchment, visual receptors and sensitive receptor groups;
- Identification of potential impacts on key receptors including the rating of magnitude for each receptor group;
- Rating of impact significance for each receptor group. The significance is evaluated as a product of the sensitivity or value of the receptor, and the magnitude of impacts on the receptor; and
- Potential mitigation measures to meet the necessary planning requirements and any community expectations.

The assessment included a desktop analysis and a detailed site investigation and analysis in March 2018. The desktop review included the following:

- Data review;
- Aerial photography review; and

- GIS modelling of the topography and the proposal.

Photomontages were also prepared to inform the assessment.

Representative visual receptors were identified and are described below based on a number of parameters:

- Proximity of the Receptor – most effected visual receptors are anticipated to be located within a 4km radius of the Project (unless in an elevated position);
- Drivers or passengers of vehicles travelling past, through or alongside the Subject site;
- Workers on or near the site that visit or work in one of the many agricultural buildings, sheds or structures;
- Members of the general public accessing adjoining public areas (Creeks, Canals, open spaces) for recreational or visual purposes; and
- Permanent residents living near the subject site.

Public receptors (views visible by the general public) are accepted as the most suitable for Visual Impact Assessments, because they represent the highest number of visitations or views to the nominated site in question. Private receptors (namely form private residences) can be selected if the views are unique, significant or the combined effects on a number of residents are considered high.

Receptors were initially identified through desktop assessment including the review of aerial photography and GIS data sets as well as the Zone of Theoretical Visibility (ZTV) map. From the initial assessment of the ZTV and in identifying preliminary sensitive receptors for the site prior to the site inspection and analysis it appeared as though there were a limited number of locations in which the future development would be seen.

Following the identification of the visual catchment, a number of potential receptor groups were identified. These represented groups that experienced a similar visual environment and were affected by the proposed Solar Project. Private residences in the area (the closest being 1.5km from the site) were discounted as a receptor group, because of the limited numbers of people effected by the development, the distance from the site and the existing vegetation between the houses and the site.

Ground-truthing of mapped information during the site inspection was important in confirming and classifying the key visual receptors. It was found that there were fewer receptors than identified in the ZTV due to the presence of site vegetation around the site and the large distances between receptors and the site.

The following viewpoints were selected and described as follows and are located on **Figure 5** in **Appendix J** of the EIS. They were selected to provide a representative range of views for the subject site from public areas:

- **VP1, The Yamma Road** – travelling eastbound approx. 1.8km past the Morundah Road intersection (views to the north east). Receptor is described as vehicular users/ travellers using a public road.
- **VP2, Old Morundah Road** – travelling southeast as the road veers to the south (views to the east). Receptor is described as vehicular users/ travellers using a public road.
- **VP3, Main Canal Road** – at the intersection of Morundah Road travelling east Views to the east). Receptor is described as vehicular users/ travellers using a public road.
- **VP4, Devils Bridge Road** – at the intersection of Mundarra Road (views to the south). Receptor is described as vehicular users/ travellers using a public road.

In general, there were very few viable receptors that would be influenced by the future works on site. This was, as stated above primarily due to the long distances from the sight to any public and private receptors. There were no discernible views from public receptors from the east, again due to the distance of the roads from the site and the influence of existing vegetation in blocking views back to it.

7.3.6.3 Potential Impacts

Potential landscape and visual impacts from the Project are considered to be negligible. A summary of the impact assessment for each receptor/viewpoint is described in **Table 31**.

Table 31 Potential Impacts to receptor/viewpoints

Receptor	Sensitivity Rating	Impact Magnitude Rating	Impact Significance
VP1	This viewpoint whilst providing relatively unencumbered expansive views of the general landscape in the foreground of the site does not represent clear views into the subject site primarily because of the distance from it. The views form this location are generally low quality and any views of the site could not be distinguished from those of the surrounding landscape. The views are not unique or of regional significance. As Yamma Road is not an identified scenic route, the overall sensitivity of the receptors at this viewpoint would be **Negligible**.	Generally, the elements of the Project are fairly low to the ground in comparison to other infrastructure elements (maximum height of 4m). This means that in terms of overall visibility to the receptors they would not be prominent. They would appear typically as a long low element on the horizon, sometimes broken up by stands of vegetation in the foreground. The existing rural and pastoral landscape is extremely flat and is therefore more susceptible to changes (both horizontal and vertical) and the impact of introduced elements. Whilst the introduction of these elements would constitute a change to this view, it would cause little or no change to the local character of the landscape. This would be due mainly to the large distance between the receptor and the site (approx. 8km). The Impact Magnitude Rating for this receptor would be **Negligible**.	The impact of significance for receptors at this view point would be considered **Negligible**.
VP2	This viewpoint whilst providing relatively unencumbered expansive views of the general landscape in the foreground, it does not represent clear views into the subject site primarily because of the distance from it (approx. 5km). The views form this location are generally low quality and any views of the site may be distinguished from those of the surrounding landscape but not easily and given long-term views. The views are not unique or of regional significance.	Generally, the elements of the Project are fairly low to the ground in comparison to other infrastructure elements (maximum height of 4m). This means that in terms of overall visibility to the receptors they would not be prominent. They would appear typically as a long low element on the horizon, sometimes broken up by stands of vegetation in the foreground.	The impact of significance for receptors at this view point would be considered **Minor-Negligible**.

Receptor	Sensitivity Rating	Impact Magnitude Rating	Impact Significance
	As Morunda Road is not an identified scenic route the overall sensitivity of the receptors at this viewpoint would be **Negligible**.	The existing rural and pastoral landscape is extremely flat and is therefore more susceptible to changes (both horizontal and vertical) and the impact of introduced elements. Whilst the introduction of these elements would constitute a change to this view, it would cause little or no change to the local character of the landscape. This would be due mainly to the large distance between the receptor and the site (approx. 5km). The Impact Magnitude Rating for this receptor would be **Low**.	
VP3	From this receptor most views will be short term and obstructed (few seconds and at considerable distance). As an unsealed public road, a low number of people would travel along it during the day with the views being in the distance general receptor sensitivity would be low. This viewpoint has a number of detailed elements in the foreground that would 'distract' most detailed investigations of the background where the site is. It does not represent clear, unencumbered views into the subject site primarily because of the distance from it (approx. 8km) and vegetation in the foreground. The views form this location are generally low quality and any views of the site are not distinguished from those of the surrounding landscape. Any views are not unique or of regional significance. As Old Morunda Road is not an identified scenic route the overall sensitivity of the receptors at this viewpoint would be **Negligible.**	Generally, the elements of the Project are fairly low to the ground in comparison to other infrastructure elements (maximum height of 4m). This means that in terms of overall visibility to the receptors they would not be prominent. They would appear typically as a long low element on the horizon, in most cases broken up by stands of vegetation in the foreground. The existing rural and agricultural landscape is extremely flat and is therefore more susceptible to changes (both horizontal and vertical) and the impact of introduced elements. Whilst the introduction of these elements would constitute a change to this view, it would cause little or no change to the local character of the landscape. The Impact Magnitude Rating for this receptor would be **Negligible.**	The impact of significance for receptors at this view point would be considered **Negligible.**

Receptor	Sensitivity Rating	Impact Magnitude Rating	Impact Significance
VP4	From this receptor most views will be short term (few seconds and at considerable distance). As an unsealed public road, a low number of people would travel along it during the day with the views being in the distance general receptor sensitivity would be low. The views form this location are generally low quality and any views of the site are not distinguished from those of the surrounding landscape. Any views are not unique or of regional significance. As both Mundarra and Devils Bridge Roads is not an identified scenic route, the overall sensitivity of the receptors at this viewpoint would be **Negligible.**	Generally, the elements of the Project are fairly low to the ground in comparison to other infrastructure elements (approx. 3m high). This means that in terms of overall visibility to the receptors they would not be prominent. They would appear typically as a long low element on the horizon, in most cases broken up by stands of vegetation in the foreground. The existing rural and agricultural landscape is extremely flat and is therefore more susceptible to changes (both horizontal and vertical) and the impact of introduced elements. Whilst the introduction of these elements would constitute a change to this view, it would cause little or no change to the local character of the landscape. The Impact Magnitude Rating for this receptor would be **Negligible.**	The impact of significance for receptors at this view point would be considered **Negligible.**

7.3.6.4 Mitigation and Management Measures

As described in **Appendix J**, the visual assessment for each of the four receptors identified above found that the height and nature of the proposed solar project and the distance from local viewpoints suggest that mitigation measures to screen the development are not considered necessary.

The height and extent of the development in relation to the scale of surround vegetation means that visibility will be negligible.

7.3.7 Reflective & Illumination Glare

A Reflective & Illumination Glare Impact Assessment has been carried out by SLR Consulting Australia Pty Ltd (SLR) for the Project, reported in detail in **EIS Appendix L**. Two potential sources of glare were considered:

- Daytime Reflective glare (and glint) arising from the solar PV panels within the facility
- Night-time Illumination glare from 24/7 operational security lighting within the facility

The potential glare scenarios analysed in **Appendix L** are:

- Residential "Nuisance" Glare from daytime (PV panel) reflections or night-time (lighting) illumination;
- Motorist "Disability" Reflective Glare and Pedestrian "Discomfort" Reflective Glare;
- Rail Operators Reflective Glare;
- Aviation Sector Reflective Glare; and
- Industrial critical machinery operators (heavy vehicles, etc) Reflective Glare.

7.3.7.1 Key Project Elements of Interest

The key components of the Project from a glare point of view are:

- the photovoltaic (PV) modules in relation to daytime reflective glare and
- the facility's lighting design in relation to night-time illumination glare.

Solar Modules and Trackers

As described in **Section 3.3.2**, the Project will utilise approximately 3 million standard flat PV solar panels mounted on single-axis tracking systems. The trackers axis will be aligned north-south to track the sun from east to west through the day and to maximise solar exposure on the solar modules. The trackers will be mounted on steel piles driven into the ground to approximately 3 m to 5 m.

At this stage, two tracking systems (NEXTracker, SunPower Oasis) are being evaluated for the Project, with the final selection to be made during detailed design. These are illustrated in **Section 3.3.2**.

7.3.7.2 Nearest Potential Receivers

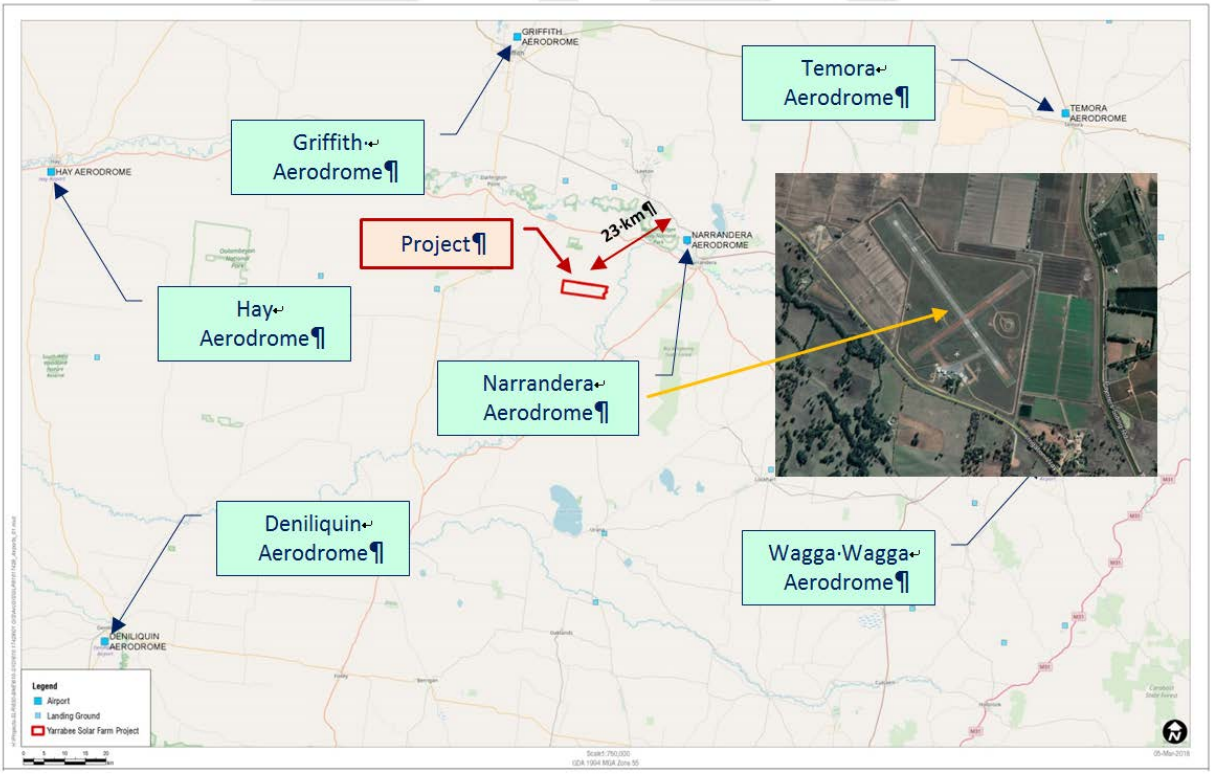
Receivers of interest surrounding the site are as follows:

- Residential receivers — refer **Figure 2-2**
- Road network (drivers) — refer **Figure 2-3 and Figure 2-4**
- Rail network (drivers, operators) — refer **Figure 7.15**
- Airfields & Aviation — refer **Figure 7-16**

As can be seen the Project is located some distance from nearby major roads, over 20 km from the nearest rail line, and similar distances from the closest airport operations.

Figure 7-15 Surrouinding Rail Network

Figure 7-16 Surrouinding Airfields



7.3

The impact assessment carried out in **Appendix L** adopted the following criteria:

Residential-Road-Rail Criteria: Australian Standards AS 1158.2, AS 1158.3.1 and AS 1158.4

Table 2.10 of AS 1158.3.1 provides TI Value criteria and Table 3.2 of AS 1158.4 lists Cd (Candela) criteria associated with the control of glare. The TI Value is calculated as the ratio of "veiling" luminance to the overall average luminance, with the necessary constant and exponent parameters provided in AS 1158.2:2005.

- For (Motorist) Traffic Disability Glare, the TI Value should remain:
  - Below 10: for major roads
  - Below 20: for minor roads
- For Pedestrian Discomfort Glare, the TI Value should remain:
  - Below 2: at critical locations such as pedestrian crossings
  - Below 3: for other locations
- For Rail Traffic Disability Glare, the relevant AS1158 criteria are:
  - The TI Value should remain below 20%
  - The Cd Value at 70° incidence should remain below 6,000.

Aviation Criteria: US FAA and SGHAT (Solar Glare Hazard Analysis Tool)

The US FAA regulates and oversees all aspects of American civil aviation. In relation to glare and glint issues, the FAA issued a Technical Guidance Policy in 2010 and a subsequent (and over-riding) Interim Policy in 2013.

- FAA, *"Technical Guidance for Evaluating Selected Solar Technologies on Airports"*, Federal Aviation Administration, Washington, D.C., November 2010.
- FAA, *"Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports"* Federal Register, Oct. 23, 2013,

In support of the above, the FAA contracted Sandia Labs to develop their Solar Glare Hazard Analysis Tool (SGHAT) software tool as the standard for measuring the potential ocular impact of any proposed solar facility on a federally obligated airport. SGHAT has been used to assess the potential for aviation-related glare and glint. Using SGHAT, ocular impact must be examined over the entire calendar year in 1-minute intervals, from sunrise to sunset. Additional details regarding SGHAT can be found in **Appendix L**.

Industrial Machinery Criteria: Australian Standards AS 1158.2, AS 1158.3.1 and AS 1158.4

The acceptability criteria used for Residential/Road/Rail glare conditions, in particular Traffic Disability Glare, were adopted to deal with potential glare situations that might arise in relation to mining operations where machinery operators can be located in elevated locations, e.g. dragline operations, where a line of sight may be possible to a solar facility located in very close proximity.

Night-Time Illumination Glare: AS 4282-1997

The effect of light spill from outdoor lighting impacting on residents, transport users, transport signalling systems and astronomical observations is governed by AS 4282-1997, which provides criteria for light technical parameters (illuminance, lux and luminous intensity, Cd) for the control of obtrusive lighting.

The Project is located in a quiet, rural area. The residential properties surrounding the Project would therefore be classed as lying within a residential area with "Dark Surrounds". It is understood that the Project's main control centre, located close to the new substation, will be operational 24/7.

- Accordingly, the light spill from the Project onto the facades of the surrounding residential dwellings should be kept below 1 lux.

7.3.7.4 Glare Impact Assessment

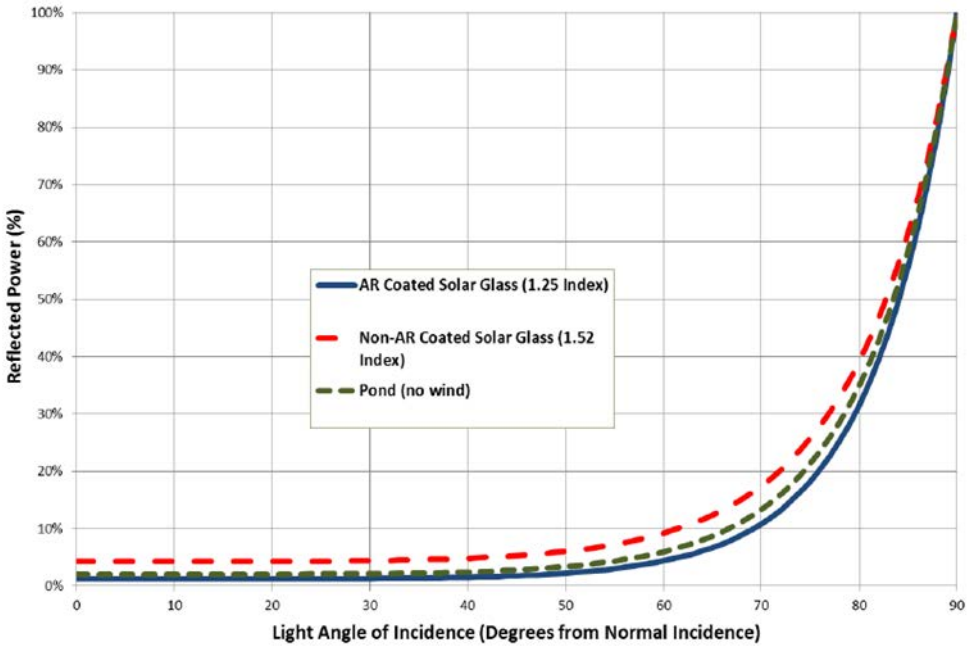
Assumptions

Solar PV panels are designed to capture (absorb) the maximum possible amount of light within the layers below the front (external) surface. As a consequence, solar PV panels are designed to minimise reflections off the surface of each panel. Representative reflectivity curves are shown in **Figure 7-17**.

- When an oncoming solar ray strikes the surface of a solar PV panel close to perpendicular to the panel surface (i.e. low incident angle), the reflectivity percentage is minimal (less than 5% for all solar panel surface types).

- It is only when an incoming solar ray strikes the panel at a high incident angle (i.e. almost parallel to the panel) that reflectivity values increase. When this happens, reflections become noticeable and potentially at "glare" level for all solar panel surface types. However, in such instances, it would almost always be the case that the observer would perceive reflections coming from virtually the same direction as the incoming solar rays themselves. Such a condition would not constitute a glare situation as the incoming solar ray intensity would dominate the field of vision perceived by the observer.

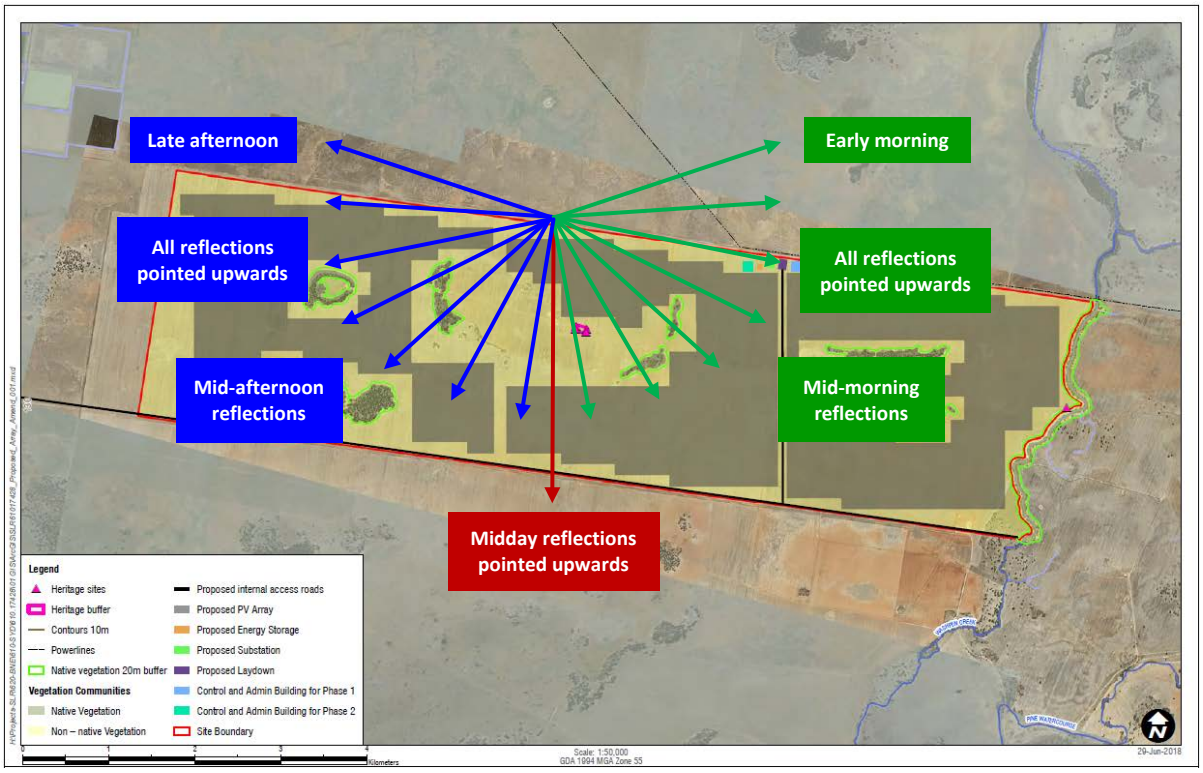
Figure 7-17 Typical Reflectivity Curves as a Function of Incidence Angle



In "plan" view, reflections from the project's panels will be directed as shown in **Figure 7-16** for a representative area of panels located close to the northern boundary of the Project.

Generally, reflections will be directed upwards and hence not visible by ground-based receivers. Where such reflections can be observed by surrounding elevated receivers they would be seen as "low incidence" reflections with corresponding low reflectivity. This is the inevitable outcome of the objective of maximising the solar gain of each panel (where the reflectivity is minimal), and justifying the benefit of using a tracking system for the panels which follows the sun, rather than a fixed panel system.

Figure 7-18 Potenital Project PV Panel Reflection Angles



Residential "Nuisance" Glare

The nearest residential receivers to the Project are identified in **Figure 2-2**. The closest receivers are at least 1.5 km from the nearest PV panels located within the Project site. TI calculations made for these receivers, assuming no intervening topography or vegetation to obscure reflections from the Project yielded zero TI Values (i.e. zero reflective glare) at all nearest receivers.

Motorist "Disability" Glare

In terms of "major" thoroughfares (refer **Figure 2-3 and Figure 2-4**) in the immediate vicinity of the site, the Newell Highway is located over 12 km to the east of the nearest PV panels on the site. The Sturt Highway is located over 13 km to the north of the nearest panels. TI calculations (even assuming no intervening topography, vegetation, etc, which could block the line of sight of reflected rays) demonstrate that reflected rays off the Project's solar PV panels create zero TI Values on these carriageways.

Closer to the site are "local" roads: Back Morundah Road to the east, Yamma Road to the south and Morundah Road and Main Canal Road to the west. Again, due to a combination of distance and receiver height (essentially 1 m above ground level for motorists) and again assuming there is no intervening topography or vegetation blocking driver line of sight, TI calculations show that glare potential is essentially non-existent.

In the above cases, apart from the distances involved, the main contributor to the minimisation of glare is the low incidence angle (and hence low reflectivity) of incoming solar and outgoing reflected rays arising from the tilting action of the panel tracking system and the general "upwards" (away-from the-ground) angle of reflected rays.

In reality, for large sections of the relevant carriageways mentioned above, the solar facility and its panels will in fact not be visible, due to the intervening undulation in local topography and vegetation, trees, etc, in the area.

Rail Operator Reflective Glare

There are no operational rail lines in the immediate vicinity of the project – refer **Figure 7-6**.

- The Country Regional Network line passing through Narrandera is never closer than 20 km from the Project, similarly the section passing through Lockhart.
- The planned major Inland Rail Link Project will pass well to the east of the Project (passing through Wagga Wagga).

TI Values in relation to rail disability glare are non-existent.

Aviation Sector Reflective Glare

Narrandera Airport (IATA: NRA, ICAO: YNAR) is the nearest major airport servicing the area. It is located approximately 23 km northeast of the Project. The airport is serviced by Regional Express Airline and general aviation aircraft. The present assessment reviewed the airport's two runways:

- The main 1,616 m long asphalt Runway 14/32 is oriented roughly northwest-southeast. The line of sight for pilots on either approach path would therefore essentially perpendicular to the line of any incoming reflected rays from the Project.
- The secondary 1,020 m long gravel Runway 05/23 is oriented roughly southwest-northeast. The line of sight for pilots on approach path R23 would therefore be roughly in the direction of the Project.

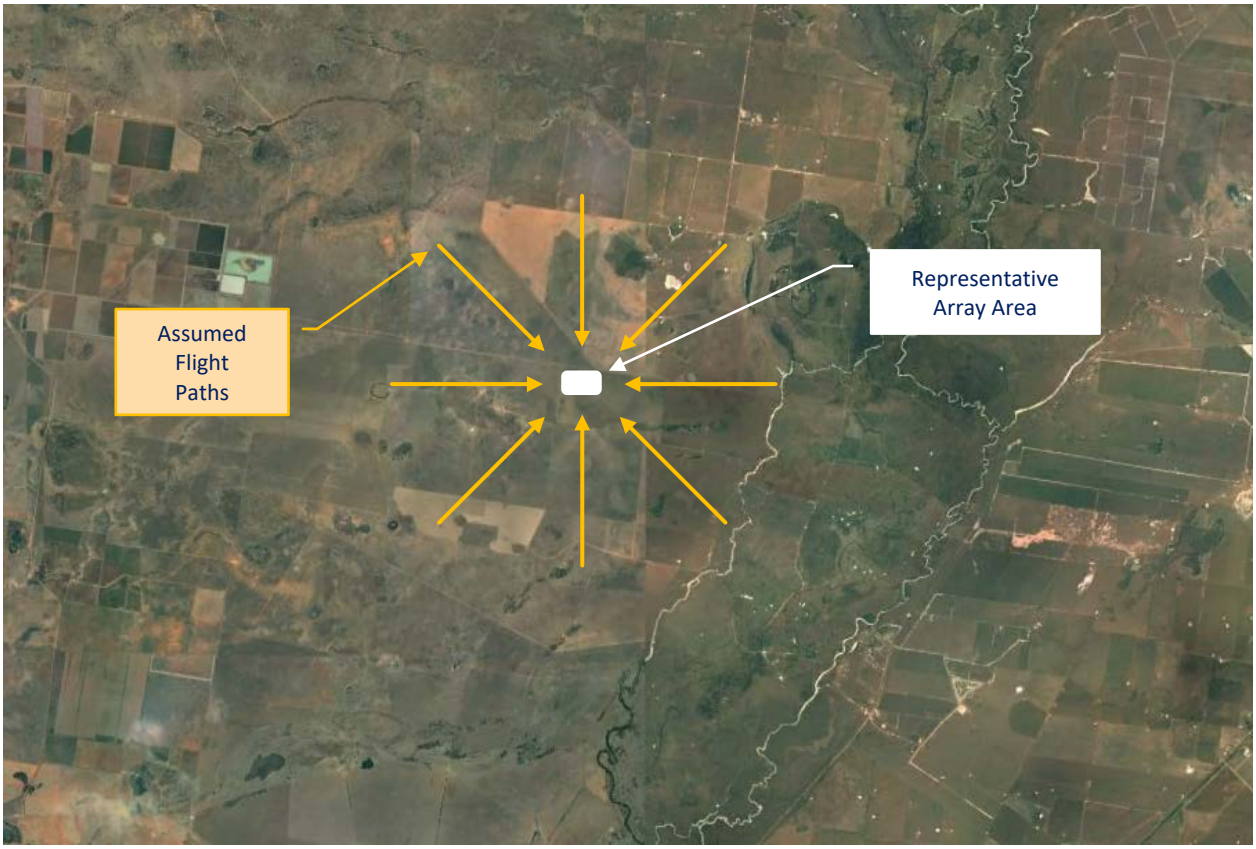
A quantitative examination of the possible reflected rays from the Project's PV panels for all times of the year (summer solstice to winter solstice) demonstrates that, due to the tiling action of the PV panel tracking systems, reflections from the Project cannot physically occur in the direction of the airport.

Aerial Spraying / Crop Dusting

Consultation with the Yarrabee Park land owners and surrounding neighbours revealed that aerial spraying takes place within several kilometres of the Project. There are no "standard" aircraft flight paths associated with this aviation activity.

Accordingly, a quantitative analysis was carried out using the Sandia Labs Solar Glare Hazard Analysis Tool (SGHAT) software tool. The flight path scenarios examined are a series of worst-case flight paths path which could apply to any PV panel array within the Project site, refer **Figure 7-19**.

Figure 7-19 Potenital Project PV Panel Reflection Angles



SGHAT Modelling Assumptions:

- A worst-case scenario for flight paths was assumed.
- Eight cardinal direction flight paths were chosen (see orange flight path lines in above diagram) starting approximately 4 km out from a representative array area anywhere within the Project and ending just less than 1 km from the same array area.
- For each flight path, aircraft were assumed to be flying horizontally TOWARDS the Project site representative array at an elevation of 200 ft (60 m) above local ground level.
- Panels were assumed to track the sun from 60 east of north to 60 west of north, about a horizontal axis oriented north-south.

The reflectivity of the PV panels was assumed to be of the same magnitude as the standard solar glass shown in **Figure 7-17**. The SGHAT analysis was run for a full year of potential incoming solar angles.

The SGHAT Ocular Plot results are provided in **EIS Appendix L**. Primarily due to the low incidence angle of reflected rays (regardless of the time of the year) and tilting action of the tracking systems, the potential for reflected glare was found to be zero.

Industrial Critical Machinery Operators

There are no industrial operations in the vicinity of the site (e.g. mining operations) and none planned, with machinery where the relevant operators have the potential to experience reflective glare from the Project. The nearest industrial facility is the planned (and approved) Euroley Poultry project approximately 10 km due north of the Project. There are no elevated receivers at this facility with the potential to experience reflective glare from the Project.

7.3.7.5 Night-Time Illumination Glare Assessment

As noted previously, key areas within the Project (e.g. the Project Control Building) will be operational 24/7. Night-time illumination will therefore be required for all relevant areas, including parking lots etc.

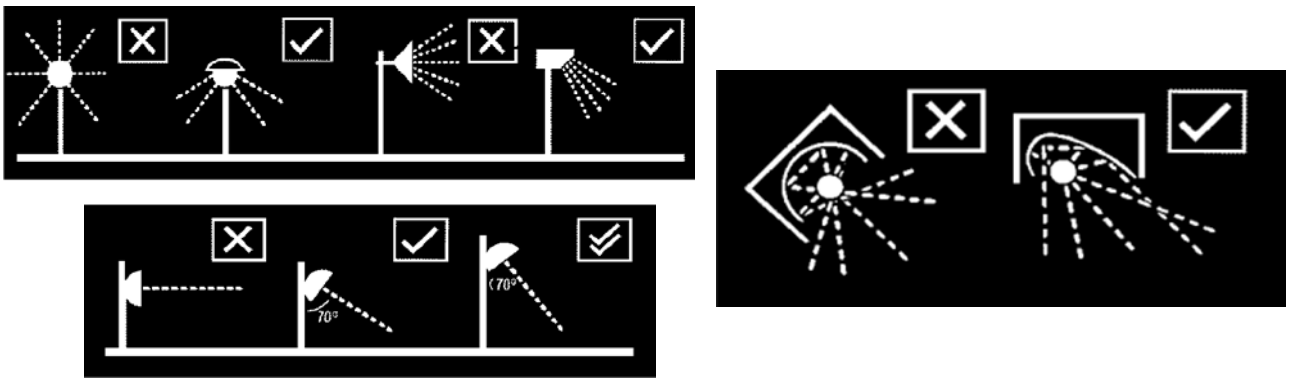
The nearest thoroughfares and rail lines are located such that the potential for adverse night-time illumination glare from any luminaires chosen for these areas will be zero.

The only potential for night-time illumination glare is associated with the nearest residential receivers to the Project – refer **Figure 2-2**.

At this stage of the design and given the preliminary nature of the plant layout developed to date, preliminary lighting analysis indicates that the potential for nuisance glare will be non-existent if the general principles for designing outdoor lighting provided in *AS4282-1997 Control of the Obtrusive Effect of Outdoor Lighting* are followed, namely:

- Direct lights downward as much as possible and use luminaires that are designed to minimise light spill, e.g. full cut off luminaires where no light is emitted above the horizontal plane, ideally keeping the main beam angle less than 70°. Less spill light means that more of the light output can be used to illuminate the area and a lower power output can be used, with corresponding energy consumption benefits, but without reducing the illuminance of the area – refer **Figure 7-20**;
- Do not waste energy and increase light pollution by over-lighting; and
- Wherever possible use floodlights with asymmetric beams that permit the front glazing to be kept at or near parallel to the surface being lit.

Figure 7-20 Typical Reflectivity Curves as a Function of Incidence Angle



7.3.7.6 Summary

The reflective and illumination glare impact assessment described in detail in Appendix l has found that, in all cases, the potential for adverse glare from the proposed facility will be negligible.

This is due to a number of factors, including:

- A lack of residential receivers in the immediate vicinity of the facility;
- The location of main surrounding thoroughfares being some distance from the site and not within the line of sight of drivers with respect to solar reflections from the facility;
- The absence of any nearby rail lines;
- The distances of the nearest airport facilities and associated flight paths;
- The absence of industrial facilities with elevated operator machinery; and
- The tracking system of the panels, which results in almost all reflections occurring at low incidence angles, where the reflectivity of the panels is very low.

The absence of immediately adjacent receivers will result in negligible impact from the 24/7 lighting that will be present on the site for operational purposes, assuming the lighting design is in accordance with *AS4282-1997 Control of the Obtrusive Effect of Outdoor Lighting*. This would also address any potential adverse eco-lighting issues in relation to nocturnal fauna within or surrounding the site.

Several key design issues, e.g. the specific PV panel to be selected, confirmation of the tracking system, etc, have yet to be finalised. Once these are decided, during detailed design, and in particular if the assumptions made in this report no longer apply, the present analysis will need to be re-visited to confirm the conclusions set out above.

7.3.8 Socio-economic and Community

Socio-economic impacts on local communities have the potential to occur as a result of large-scale developments such as this Project. These impacts can be both positive and negative, and may occur at different stages of the development, e.g. construction or operation of the Project.

As required by the Project SEARs, this section provides an assessment of the likely social and economic impacts of the Project on the local community, including consideration of construction workforce accommodation.

7.3.8.1 Existing Conditions

The proposed Yarrabee Solar Project is located approximately 23 km southwest of Narrandera in Western NSW, within the Narrandera LGA.

Narrandera Shire is centrally located in the Riverina Region of NSW, 554 km southwest of Sydney, 339 km west of Canberra, 437 km north of Melbourne and 824 km east of Adelaide. The Shire covers an area of 4,116 km^2. It sits mid-way between the main regional centres of Wagga Wagga (99 km to the east) and Griffith (98 km to the west), and marks the transition between extensive broadacre agricultural areas of the western slopes and plains of NSW to the east and the Murrumbidgee Irrigation Area (MIA) to the west. The Shire lies within the catchment area of the Murrumbidgee River and is the start of the MIA[12].

[12] Narrandera Shire Economic Development Strategy 2017- 2020. Narrandera Shire Council, www.narrandera.nsw.gov.au

The Narrandera Tourist Centre promotes Narrandera Shire as an attractive place to live, boasting all the advantages of a country lifestyle with easy access to great services and facilities, and offering an array of business and employment opportunities. The Centre points out that real estate prices are well below those of major centres, while quality education, health care and numerous sporting and cultural facilities combine to make Narrandera Shire an ideal lifestyle choice.

The Australian Bureau of Statistics (ABS) regional data states that a population of 5,976 reside in Narrandera (2016). The four main industries providing employment in the region include:

- Agricultural, forestry and fishing 19%
- Health care and social assistance 11.4%
- Manufacturing 10.7%
- Retail trade 9.1%

A total of 2,440 persons were employed within the region.

Narrandera Population

Narrandera is a town of approximately 5,853 people (ABS 2016) located on the banks of the Murrumbidgee River, in Riverina in Narrandera Shire LGA. Sydney is 550 km to the northeast of Narrandera, and Melbourne 440 km to the south.

The median age is 44 years and the proportion of female to male is 50/50. Aboriginal or Torres Strait Islander people made up 9.7% of the population.

The town centre of Narrandera provides infrastructure including police station, post office, schooling, healthcare and recreational parks.

Employment and Industry

The main form of employment in Narrandera is Grain-sheep or Grain Beed cattle feeding and other grain growing at 9.1%. The unemployment rate for Narrandera is 7%.

It is anticipated that the Project would support between 150 and 200 direct jobs during the construction phase and between 10 and 15 direct jobs during the operational phase of the project.

For the purpose of the EIS, it is assumed the Project would be developed in three (3) phases, each of 300 MWac and each phase having a construction period of approximately 18 months. This has the potential for employment opportunities over a greater time period.

Whilst the construction phase of the Project will create short to medium skilled employment opportunities, the operational phase will also create long term skilled employment opportunities to ensure the optimal operation for the estimated life 30-50 year life of the project.

Reach Solar has drawn from experience at their 300 MWac Bungala solar PV project near Port Augusta in South Australia.

Bungala has had 220 MWac under construction since mid-2017, is now generating grid-connected power and is currently the largest solar PV project in Australia.

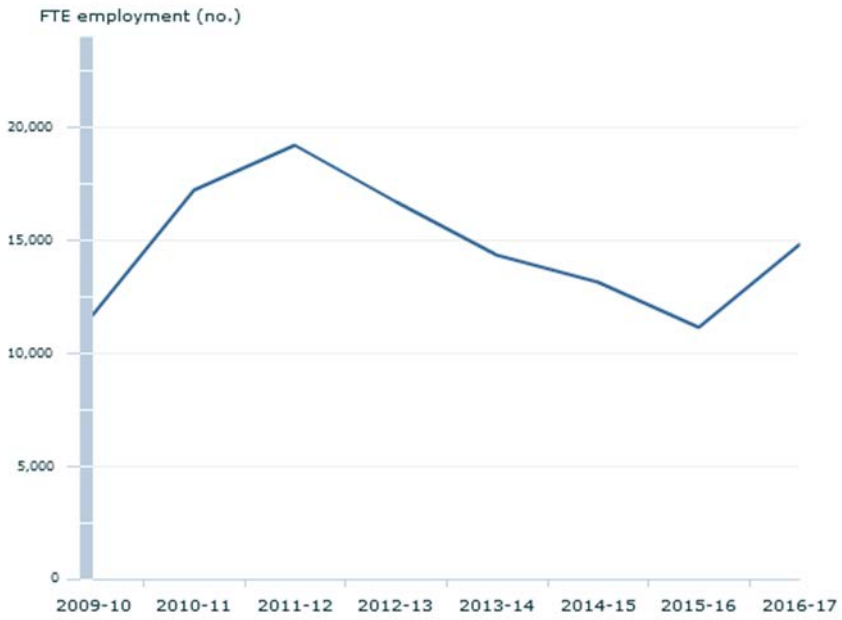
The EPC contractor appointed by the owner of the Project is responsible for employment and training of the construction personnel and for typically 5 years after completion of the operation and maintenance activities.

These types of opportunities in electricity generation have been rare in rural communities until recent years as the cost to build and operate renewable generation has reduced.

The Australian Bureau of Statistics (ABS), *4631.0 Employment in Renewable Energy Activities, Australia, 2016-17* states that "annual direct full time equivalent (FTE) employment in renewable energy activities in Australia was estimated at 14,820 in 2016-17".

As **Figure 7-21** shows, this is an increase of 3,680 in FTE employment (33%) from the previous year (2015-16) and represents the highest level of FTE employment in renewable energy activities since 2012-13.

Figure 7-21 Annual Direct FTE Employment in Renewable Energy in Australia, 2009-10 to 2016-17[13]



According to the ABS, the increase in FTE employment in renewable energy activity has been primarily driven by an increase in construction activity for large scale solar photovoltaic (PV) systems and wind farms. Increases in FTE employment in large scale solar PV (1,240 additional FTE jobs) and wind (1,370 additional FTE jobs) accounted for over two thirds (71%) of the increase in FTE employment in renewable energy. Roof-top solar PV also saw an increase in installations, resulting in 860 additional FTE jobs in 2016-17.

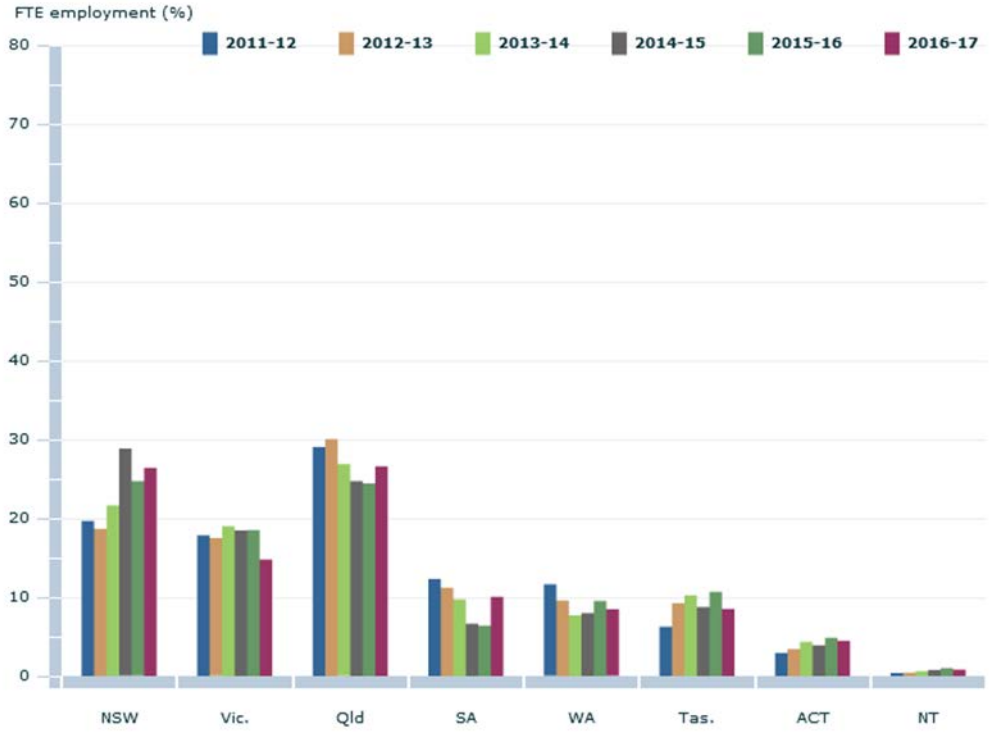
All states and territories have seen an increase in FTE employment related to renewable energy generation in 2016-17. New South Wales and Queensland have seen the largest increases in total FTE employment, both increasing by over 1,000 FTE jobs. This was driven by construction of wind generation facilities in New South Wales and construction of large scale solar PV facilities in Queensland.

[13] 4631.0 – Employment in Renewable Energy in Activities, Australia, 2016-17. Australian Bureau of Statistics (ABS), 24 May 2018. http://www.abs.gov.au/ausstats/abs@.nsf/mf/4631.0.

Figure 7-14 demonstrates the increase in employment opportunities in NSW due to the increase in the number of renewable energy projects in recent years.

The positive employment opportunity trend is likely to continue with development of new projects including the Yarrabee solar project. The national 2020 Renewable Energy Targe (RET) has driven the development in clean energy technologies such as solar in Australia and around the world, which has resulted in cheaper power generation. In some instances, this power generation a Lower Cost of Energy ('LCOE') basis is cheaper than new coal or gas projects.

Figure 7-22 Proportion of Annual Direct FTE Employment by State and Territory, 2009-10 to 2016-17[14]



In addition to the direct employment opportunities, indirect employment opportunities will also be generated through local supply chains including equipment suppliers, suitably skilled tradespersons, fuel supply, engineering maintenance companies, hotels/motels/B&B's, local supermarkets, cafes and pubs, vehicle maintenance, bus suppliers and many other businesses. The Project will look to provide direct and indirect employment opportunities to suitably qualified individuals, local suppliers and tradespersons as a priority.

During the construction and operation of the Project, the balance part of Yarrabee Park will continue to be utilised for crop farming. Income generated from the lease of the land for the Project enables Morundah Land Trust to reinvest this income back into its agricultural operation if desired. It is possible that sheep will graze on the Project site on a periodic basis (as is done at the Bungala solar site) although this needs to be considered by the landowner.

[14] 4631.0 – Employment in Renewable Energy in Activities, Australia, 2016-17. Australian Bureau of Statistics (ABS), 24 May 2018. http://www.abs.gov.au/ausstats/abs@.nsf/mf/4631.0.

The Project would also provide the landowner with continuity in income during any period of drought for the life of the project, providing a level of security when droughts impact crops. This diversification of income base will enable further potential injection into the local economy. It is noted that significant parts of NSW are currently in the midst of a serious drought with no easing currently in sight according to Bureau of Meteorology forecasts over the next 6 months or so.

Housing and Accommodation

There are 2,786 (ABS 2016) dwellings in Narrandera, 26% were rented and 15% were unoccupied.
It is expected that accommodation in Narrandera will be utilised by resources required for the Project. These resources are also expected to commute from other nearby towns such as Wagga Wagga and Griffith.

Narrandera Shire Economic Development Strategy 2017-2020

Narrandera Shire Council's vision is to build the Shire into a prosperous, diverse and sustainable community with a growing economy which is strong and resilient.

This vision will be realised through addressing strategies identified in the Narrandera Shire Council's Economic Development Strategy 2017-2020. This strategy is a blueprint for how Council will work with small business, industry, the community and all levels of government to drive diversified and sustainable economic development.[15]

The Project is aligned to the Narrandera Shire Economic Development Strategy 2017 – 2020. This plan outlines the economic growth strategies for the Riverina District. Section 4.1.2.3 outlines the compatibility of the Project with the Strategy.

Riverina Murray Regional Plan 2036

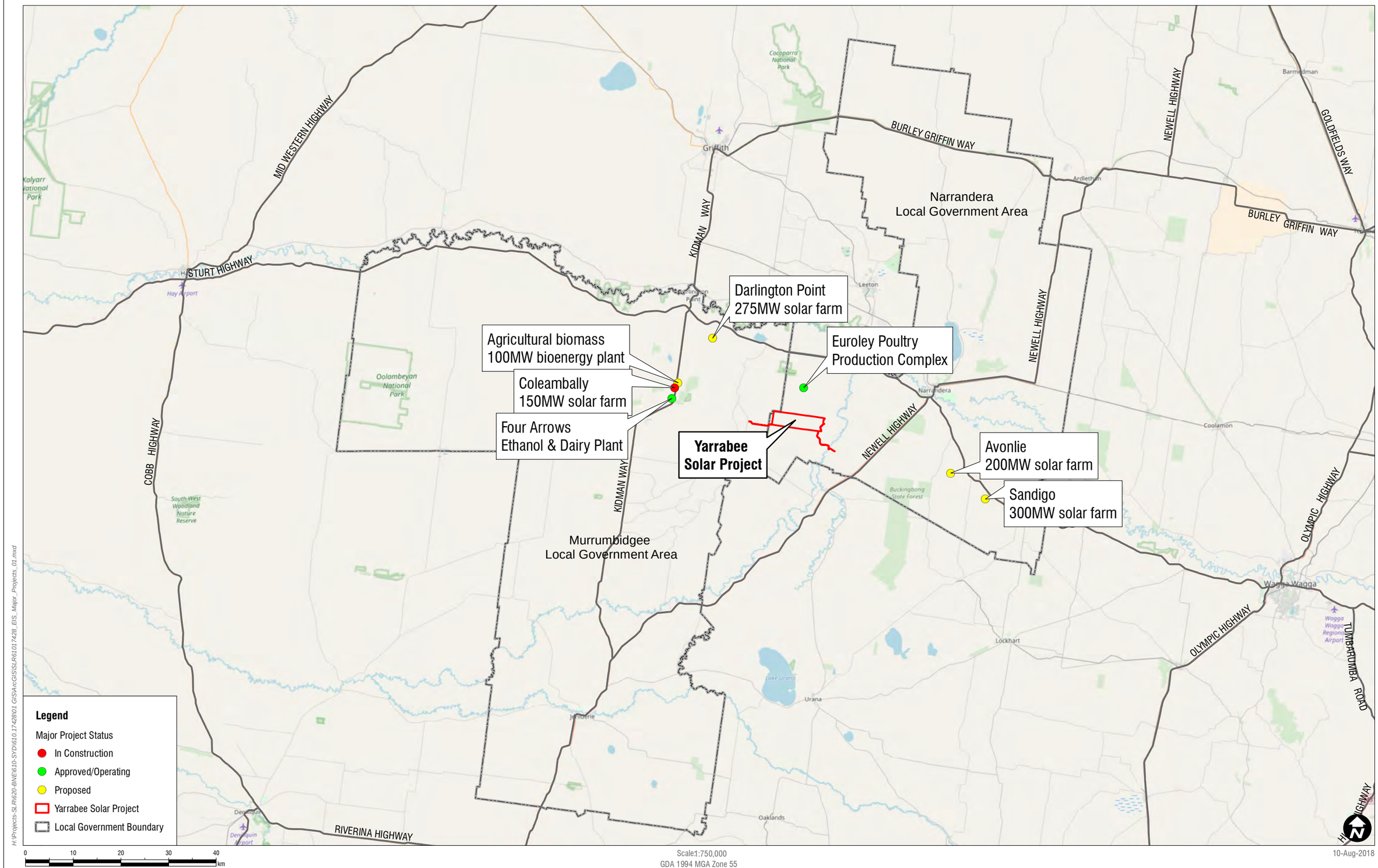
The Riverina Murray Regional Plan 2036 establishes a framework to grow the region's citied and local centres, supports the protection of high-value environmental assets and makes developing a strong, diverse and competitive economy central to building prosperity and resilience in the region.

Goal 1 of the Plan is to achieve "a growing and diverse economy". The strategic location of the region as well as its evolution as a centre of knowledge and innovation for agribusiness and value-added manufacturing, and green technologies and products, has seen the region recognised as an economic powerhouse. The Plan provided an outline of priority growth sectors that will further encourage growth within the region primarily through diversification of the economy. Section 4.1.2.2 outlines the compatibility of the Project with the Strategy.

Mineral, Coal & Petroleum

A search through the NSW Department of Planning and Environment, Division of Resources & Geoscience's MinView application was undertaken of May 17, 2018. No mineral, coal or petroleum titles were identified in or adjacent to the project site. The outcome of the search for current mining and exploration titles and applications is shown in **Figure 7-23.**

[15] Narrandera Shire Economic Development Strategy 2017- 2020. Narrandera Shire Council. www.narrandera.nsw.gov.au.



SLR

Major Projects

FIGURE 7.28

Project Consultation Activities and Outcomes

Community Consultation and Stakeholder Engagement for the Project has been coordinated using a Community Consultation and Stakeholder Engagement Strategy (refer to **Section 6.3 and Appendix O**). Consultation activities undertaken to date, community responses and relevant sections of the EIS are detailed in Section 6.

Reach Solar facilitated a community information session on 15 March 2018 at Narrandera Ex-Services Club. The purpose of the meeting was to update the community on the project and to encourage feedback that could be considered further in the technical work that was ongoing. During this meeting the following issues were raised by the community:

- Employment opportunities in the region;
- Cumulative impacts of other major projects identified in the region; and
- the impact of the changing demographics of the region as a result of an influx of a temporary construction work force.

7.3.8.2 Impact Assessment

There is the potential for positive and negative social and economic impacts as a result of the Project, including upon local land use, long term employment opportunities and ancillary support services. The Project area is located within the Narrandera Local Government Area (LGA). Negative impacts such as on existing agricultural production will be minor and limited to short-to-medium term with no impact following decommissioning of the site (also noting that the entire Project area comprises approximately 23% of Yarrabee Park). There is the option for grazing to occur amongst the solar panels during the operational phase. Any grazing would be subject to the consent of the landowner.

The Project will have a temporary impact on the township of Narrandera and its surrounds during construction. This is discussed in more detail in the following section. The Project may be undertaken in stages, with possibly differing MW capacities.

Each construction phase will have a peak work force of up to 450 workers on site. Work force numbers will be phased over the 12 month construction period, representing an average over the construction period of between 150 and 200 workers.

The operation workforce will likely consist of 10-15 full-time staff attending the site on a daily basis. The staff will have a range of skills to address any near-term defects, whilst long-term defects will be scheduled with the use of skilled technicians on a contract basis.

The Project would diversify the use of land in the area. The predominant land use in the area is agriculture. This Project would provide the landowner with an additional source of income that will be directed to enhancing the productivity and quality of the remaining farm. The Project will also generate income for the broader business community in Narrandera Shire and surrounding areas through expenditure, use of trades people and specialist services and flow-on effects from the additional employment opportunities that is creates.

Construction

The Project is expected to have an overall positive impact on the local and broader economy during the construction phase. Any adverse impacts will be temporary in nature due to the duration and phased approach to the construction of the Project. The key potential social and economic impacts that may result from the construction phase of the project include:

- Increase in local employment, as the Project will create direct employment for up to between 150 and 200 staff and contractors (average), with as many as possible drawn locally as well as from surrounding areas such as Griffith and Wagga Wagga.
- Additional workers sourced from outside of the local Narrandera area will assist in stimulating local accommodation, hospitality and retail services.
- Additional workers sourced from outside of the local Narrandera area would likely also assist in increased use of local sporting facilities including swimming pools and gyms, as well as an increase memberships/participation in local sports such as football and netball, as workers look for opportunities to participate in recreational sports and activities. The increase in revenue for sporting clubs and facilities would enable greater investment in their facilities.
- There may be short-term pressure on accommodation during the different construction phases of the Project. There are a number of short-term accommodation options within the Narrandera LGA. These include:
  - Ten (10) hotel/motel options with varying capacities; and
  - Two caravan/tourist parks with cabin facilities that would be better suited for worker accommodation.
  - These short-term accommodation options are expected to accommodate the majority of the construction workforce. During peak construction periods the Project would look to other regional centres such as Wagga Wagga and Griffith for short term accommodation options (as required).
- The 2016 ABS census data suggests that in Narrandera LGA, 84.9% of private dwellings were occupied and 15.1% were unoccupied. Rental estate prices are considered by Narrandera Tourist Centre to be below those of other major centres.
  - On the basis of a recent search of the four (4) listed real estate agents in Narrandera, only one showed available local rental properties[16], identifying a number of 2, 3 and 4-bedroom rental properties in Narrandera as well as in surrounding areas including Griffith. No rental properties were identified in Leeton during these searches.
  - The Project could consider longer term real agreements for rental properties where it is determined that this provides greater benefit to the construction employee or manager, or the local community. This would be dependent on the number of additional workers that would need to travel to the area to support the Project.
- Pressure on accommodation and some retail services (including supermarkets, restaurants, etc), as well as increases in traffic in Narrandera and to the Project site might intermittently impact local tourism, especially if peak construction activities coincide with local events.
- There will be an increase in waste produced during the construction phase on the Project. A project specific waste assessment has been undertaken as part of this EIS to ensure that all waste volume and streams are identified. This enables appropriate waste management practices be established prior to the construction phase commencing.

Operation

The key potential social and economic impacts that may result from the operation of the Project include:

[16] Real estate agents websites reviewed as part of this assessment included Narrandera Real Estate Services/QPL Rural, Elders Real Estate Services, Ray White Real Estate and Landmark Harcourts Narrandera. These websites were most recently viewed 11 June 2018.

- Temporary loss of agricultural land, although this loss for the landowner of Yarrabee Park will be offset by income generated from the lease arrangements for the Project site. The Project site will occupy a maximum of 2,600 hectares of the 11,326 hectares Yarrabee Park property. This diversification of income for the landowner will provide them with the opportunity to further invest in the agricultural production for the remaining farm. Following decommissioning, agricultural activities including the existing cropping practices could recommence as the project is not expected to have any long term impacts on the existing land capability.
- Additional employment opportunities are likely to be available to the landowner through opportunities that may arise in terms of vegetation management during the solar project's operation.
- An increase in local employment opportunities as the Project will require ongoing staff numbers of between 10 to 15 permanent staff with a further 10 staff required on an ongoing (permanent) basis for specialist contract work, e.g. inverter maintenance, panel replacement, panel cleaning, vegetation management, fencing. Other operational and maintenance activities will be performed by contractors.
- Whilst maintenance activities will be irregular and seasonal in nature, it is assumed that additional traffic from such contracts could involve up to 5 heavy goods vehicles per days and 5 light vehicles per day. An operational traffic management plan will be implemented for the Project to ensure that all traffic and transport movements are managed with minimal impact to the surrounding community.
- Change in visual character of the Project site to the nearest neighbouring property, when undertaking farming practices. Once the operation has ceased and decommissioning has been completed the site will return to its existing land use and visual character.
- The positive employment opportunity trend is likely to continue with development of new projects including the Yarrabee solar project. The national 2020 Renewable Energy Targe (RET) has driven the development in clean energy technologies such as solar in Australia and around the world, which has resulted in cheaper power generation that offsets fossil fuel use.
- The Project will bring advanced technologies to the region and support the ongoing development of skills and resources in an emerging market.
- The Project would provide support to the electricity network, providing electricity generation close to local consumption centres, contributing to a more diverse mix of energy sources as well as improving the security of supply to the grid through the use of an energy/battery storage system.

Decommissioning

The impacts during decommissioning are expected to be similar to those outlined for Construction above. Through the decommissioning of all of the equipment, buildings, solar panels/arrays, there may be opportunities to further support regional business through identifying opportunities for recycling or reuse of these materials. Other regional businesses may be able to utilised recycled infrastructure from the Project for their economic benefit. These opportunities would be identified at the decommissioning planning stage.

7.3.8.3 Management and Mitigation

A Community Consultation and Stakeholder Engagement Strategy prepared for the Project (refer Section 6) has been prepared and is being implemented by Reach Solar. This plan will continue to be implemented throughout the ongoing development phase of the project to ensure that all stakeholder expectations are understood, impacts identified and appropriately managed.

- Regular community updates about the progress of the proposal and findings of the assessments.

- Consultation and notification of local residents and other relevant stakeholders regarding the timing of major deliveries and other activities which may produce particular social and economic impacts.
- An accessible 24 hour complaints and incident management process will be implemented to ensure that all complaints and incidents relating to the Project are promptly and effectively addressed. Appropriate documentation of complaint/incident handling will assist in identifying and implementing measures to negate the possibility of re-occurrence in the future.

In addition to the Community Consultation and Stakeholder Engagement Plan the following mitigation measures will be adopted for during the project.

Mitigation measures	Phase
Reach Solar will liaise with the appropriate local community representatives to reduce the potential for adverse impacts on local services or events due to the accommodation of the construction workforce.	Pre-construction Construction
Neighbours of the Yarrabee Solar Project would be consulted and notified regarding the timing of major deliveries which may require traffic control and disrupted access.	Construction Operation Decommissioning
Property owners along identified Project transport routes would be consulted and notified regarding the timing of major deliveries which may require traffic control and disrupted access.	Construction Operation Decommissioning
As part of Reach's commitment to the Project, it will be consulting with key stakeholders including the Narrandera Shire Council and other neighbouring Shire Councils, local businesses including accommodation services and car and bus hire, as well as the local community to ensure that all long-term support business opportunities are identified early.	Construction Operation Decommissioning
Large deliveries involving oversize or overmass vehicles requiring traffic control which may inconvenience road users on the Sturt, Newell Highway, Old Morundah Road, Back Morundah Road, Yamma Road and Main Canal Roads would not be scheduled during major tourism activities. Local tourism industry representatives would be consulted to manage potential timing conflicts with local events.	Construction Decommissioning
Community support in the form of a financial contribution to various local activities in the future. Reach Solar will continue discussion with Narrandera Shire Council to determine which local projects/initiatives are suitable to financially contribute to.	Construction Operation
Ongoing engagement with Narrandera Shire Council will be undertaken to discuss and resolve any concerns.	Pre-construction Construction Operation Decommissioning

7.3.9 Traffic and Transport

A Traffic and Transport Impact Assessment has been carried out by SLR for the Project, described in detail in **EIS Appendix M.**

7.3.9.1 Existing Environment

The road network in the vicinity of the project site is characterised by lower order rural roads facilitating connectivity to the surrounding National Highways. Access from the project site to the National Highway is facilitated by Back Morundah Road, Main Canal Road and Old Morundah Road.

Annual Average Daily Traffic (AADT) data sourced from Transport for NSW for the 2017 calendar year identifies the following existing vehicle volumes:

- Sturt Highway
  - 1,208 vehicles per day with 37% heavy vehicles
  - 1.11% annual traffic growth surveyed over the past 3 years
- Newell Highway
  - 1,166 vehicles per day with 41% heavy vehicles
  - -1.78% annual traffic growth surveyed over the past 3 years
- The AADT data indicates relatively high heavy vehicle percentages reflective of the freight task performed by both the Sturt and Newell Highways.

Crash data sourced from Transport for NSW indicates that a number of crashes were recorded during the data collection period. Importantly however the data does not include any crashes within proximity to the proposed Project site, nor were there any “serious” crashes reported to have occurred at the study intersections.

The only major road upgrade reported as being planned by RMS of relevance to the Project is the Newell Highway Improvement Project at Grong Grong (approximately 20km east of Narrandera). This upgrade, which was completed in early 2018, was delivered as a strategy to improve freight efficiency along the State-controlled road network, as well as improving safety for all road users.

It is also understood that RMS has recently completed the Newell Highway Corridor Strategy planning exercise, which seeks to provide freight, road users and local communities with a safer, more reliable and accessible road. As a result of this study, there will be several minor upgrades along this entire State-controlled road over the next several years which will include upgraded rest areas, road geometry changes and the addition of overtaking lanes.

With regards to rail infrastructure, the nearest operational rail line is located on the north-eastern side of Narrandera being the Hay Branch. In addition, the disused Tocumwal Branch rail line parallels the Newell Highway to the east of the Project site.

7.3.9.2 Potential Impacts

Project Traffic Demands

It has been assumed that container based haulage travelling to the Project would originate from Sydney. For trips associated with the delivery of road based aggregates, it has been assumed that the trips would originate from local quarries within the vicinity of the Project site which based on a desktop assessment of the surrounding suppliers, has been assumed to be sourced from the east towards Wagga Wagga.

Workforce movements have been distributed to the external network as identified with 50% to/from the east towards Narrandera, and 50% to/from the east towards Wagga Wagga. **Table 32** summarises the adopted in / out splits for the traffic generated by the Project.

Table 32 Project Traffic In/Out Split

Project Element	AM Peak		PM Peak	
	In	Out	In	Out
Material Deliveries	20%	20%	20%	20%
Workforce	100%*	0%	0%	100%*

Reach has advised that it is proposed that vehicle access to the site will be separated between light vehicles and busses and heavy vehicles. Further site access requirements will form part of the construction Traffic Management Plan (TMP). The TMP will form one of the management plans required to be completed by the preferred EPC contractor. The EPC will be advised prior to their appointment of the intended site access protocol (i.e. splitting light and heavy vehicle traffic).

Reach has advised that preliminary traffic and site access requirements have been discussed with local council authorities and the local community during stakeholder communication meetings. The relevant council authorities will be engaged once more detail is available, to finalise the traffic plan and enter into any arrangements that may be required with respect to the initial condition of the road, proposed upgrades and ongoing maintenance.

Reach's preliminary plan is for heavy vehicles to enter and exit the site via the Western Access Route (via Main Canal Road) and for light vehicles and buses to access the site via the Eastern Access Route (via Back Morundah Road).

Reach expects that not more than 80% of total traffic would utilise either access route. In order to minimise potential rework of the traffic assessment upon finalisation of the material and workforce logistics strategy following award of the construction contract, SLR has however considered two potential demand scenarios whereby all project traffic has been assumed to utilise each of the access routes. This approach is highly conservative but provides road authorities confidence that irrespective of the ultimate proportionate use of the two proposed access routes that the road infrastructure will provide an appropriate level of safety and performance for the expected demands.

Traffic Generation

The traffic generation of the Project has been forecast based upon the workforce and material information previously discussed in this report.

- **Table 33** details the vehicle fleet anticipated to be associated with the Project.
- **Table 34** details the traffic demands assumed to be associated with the full construction period including all stages of construction (i.e. 900 MWac capacity)
- **Table 35** identifies the forecast operational traffic demands.

Table 33 indicates that the Project is anticipated to generate an average of 56 vehicle movements per day during the construction period (i.e. 28 vehicles travelling to the Project site and 28 vehicles travelling from the Project site per day). Of the 28 vehicles associated with the Project, 15 are anticipated to be light vehicles, 7 are anticipated to be Toyota Coaster (or similar) buses and the remaining 6 are anticipated to be freight vehicles such as B-doubles and 19 m articulated.

Table 33 Project Vehicle Fleet

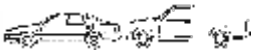
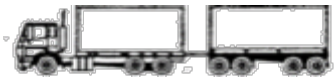
Vehicle	Typical Vehicle Profile	Haulage Material
Private Vehicle		Workforce
Coach		Workforce
Concrete Truck		Concrete
Heavy Rigid Vehicle		20ft Containers
25m B-double (under General Mass Limit (GML))		40ft Containers Demountables
32t Truck and Dog		Aggregate
Low Loader		Excavator Bulldozer Grader Compactor Piling Rig

Table 34 Total Project Construction Traffic Demand – 900MWac Project Capacity (4.5 Years)

Material/Component	Quantity	Delivery Vehicle	Delivered per Vehicle	Project Traffic Demands	Average Vehicles Per Day	Peak Vehicles Per Day
Phase One - Site Clearance and Access Roads						
Construction Vehicles[2]	30	Low Loader	1	60	<1	21
Access Track Road Base[1]	23,750t	32t Truck and Dog	32t	1,484	1	
Road Surface	4,750t	32t Truck and Dog	32t	298	<1	
Fencing[1]	30,000m	12.5m HRV	375m	160	<1	
Demountable Buildings[2]	12	19m AV	1	24	<1	
Phase Two - Establish Site Compounds						
Concrete[2]	1750m^3	8m^3 Truck	8m^3	438	<1	17
Compound Aggregate[1]	2,375t	32t Truck and Dog	32t	184	<1	
Substation Aggregate[1]	11,875t	32t Truck and Dog	32t	740	<1	
Phase Three - Delivery and Installation of Electrical Equipment						
Piling Rig[2]	9	Low Loader	1	18	<1	47
Upright Piles[1]	450,000	25m B-Double	400	2,250	1	
Tracking Horizontals[1]	390,000	25m B-Double	150	5,200	3	
Solar Panels	3,000,000	25m B-Double	1176	5,102	3	
Telehandlers	9	Low Loader	1	18	<1	
Trencher[2]	9	Low Loader	1	18	<1	
AC Reticulation[1]	85,000m	19m AV	10,000m	18	<1	
DC Reticulation[1]	2,700,000m	19m AV	10,000m	540	<1	
Inverters[1]	450	19m AV	1	900	<1	
Mobile Crane	3	Low Loader	1	6	<1	
Battery Storage	30 Units	19m AV	1	60	<1	
Power Conditioning Unit	220	19m AV	4	110	<1	
Waste Collection						3
Waste Allowance	702	Waste Vehicle	1	1,404	1	
Workforce Requirements						96
Labour	135 per day	20 pax Coaster	20	22,996	14	
Engineer / Supervisor	15 per day	Light Vehicles	1	49,276	30	
Total Vehicle Movements						145 (Phase 3 +Waste + Workforce)
Total Light Vehicles				49,276	30	
Total Heavy Vehicles (including buses)				41,008	26	
Total Vehicles				90,284	56	

Source: Reach Solar

[1] Material is delivered consistently throughout relevant project phase
[2] Only one two-way trip per component is required to deliver and return from trip origin. It is assumed that only one construction vehicle type will be delivered per day (i.e. Bulldozers on day one, graders on day two etc.).

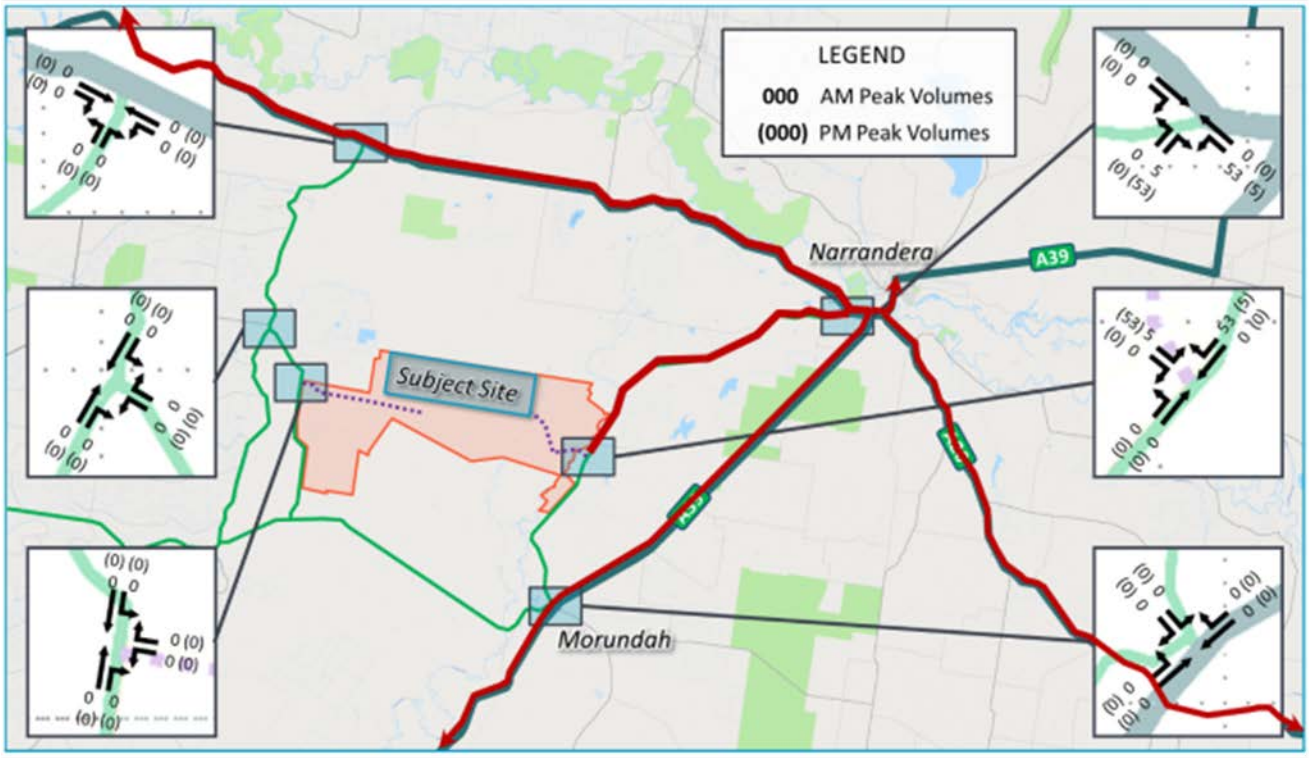
Table 35 Operational Traffic Demands

Component	Quantity	Delivery Vehicle	Per Vehicle	Daily Two-Way Trips
Workforce	25	Private Vehicle	1	50
Maintenance Vehicle	2	Remains On-site	-	0

Traffic Volumes

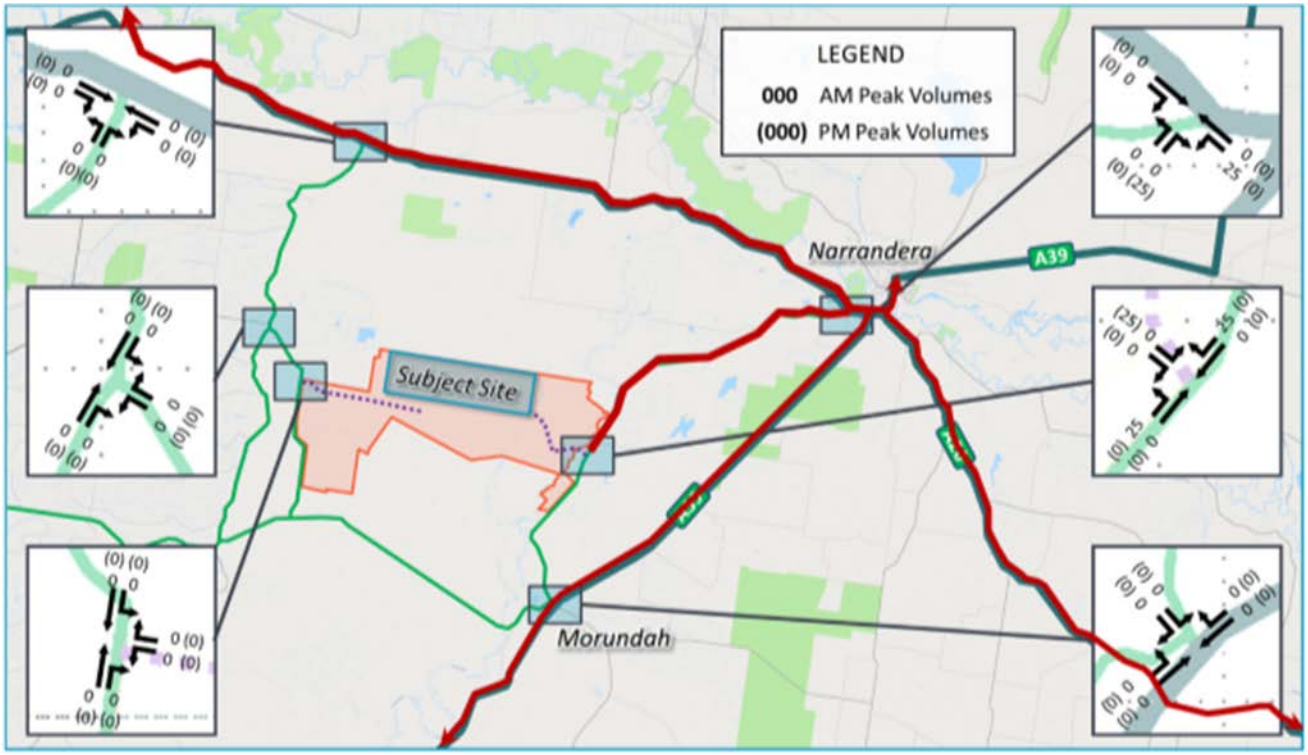
- **Figure 7-24** illustrates the assessed Project generated traffic demands for access from the East during the Construction Phase.
- **Figure 7-25** illustrates the assessed Project generated traffic demands for access from the East during the Operational Phase.
- **Figure 7-26** illustrates the assessed Project generated traffic demands for access from the West during the Construction Phase.
- **Figure 7-27** illustrates the assessed Project generated traffic demands for access from the West during the Operational Phase.

Figure 7-24 Peak Hour Construction Traffic – Eastern Access Only



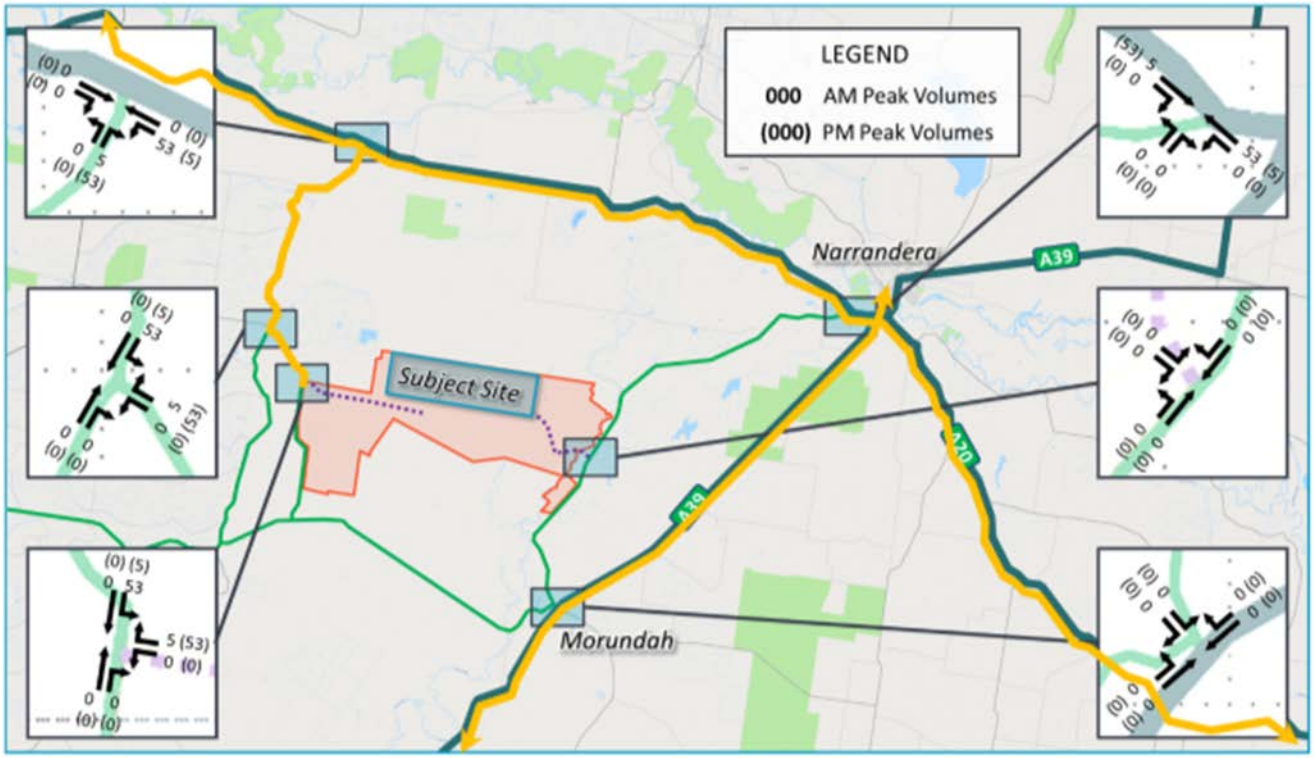
Source: Google, Note: Site bounds indicative only.

Figure 7-25 Peak Hour Operational Traffic – Eastern Access Only



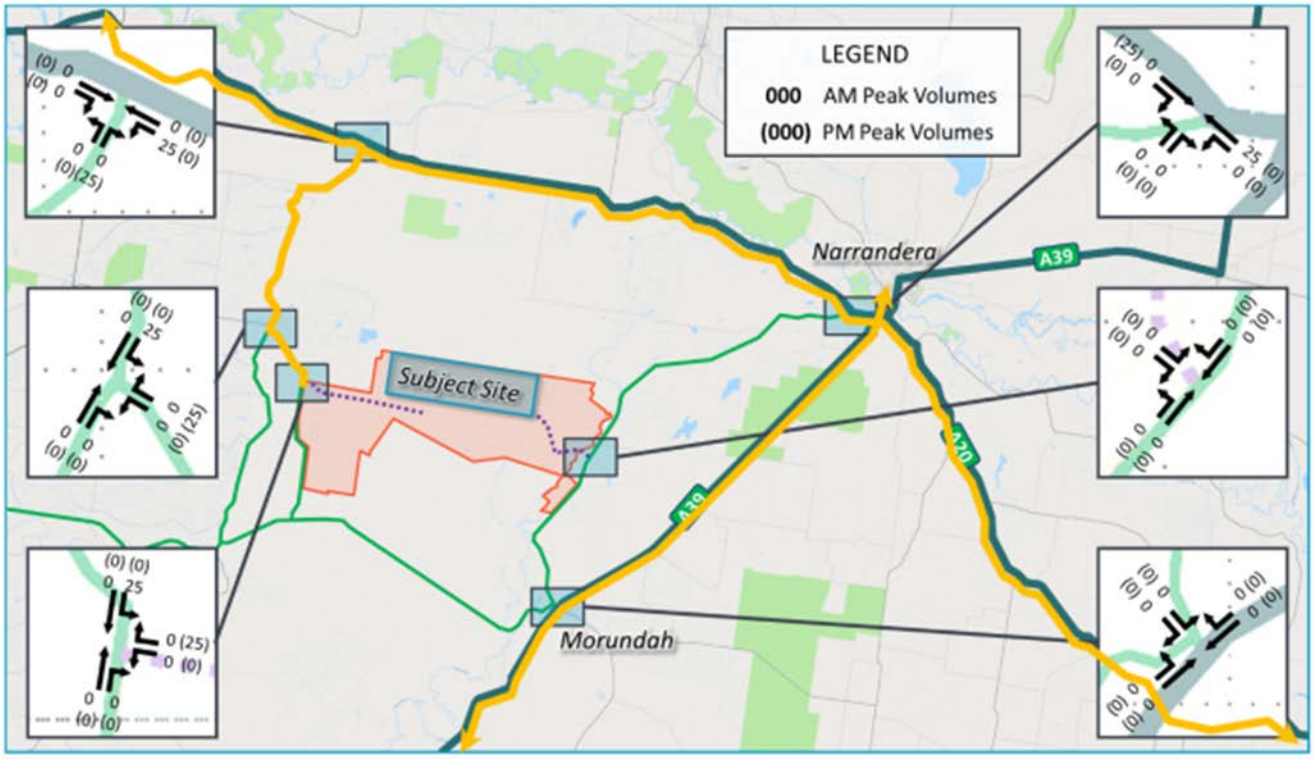
Source: Google, Note: Site bounds indicative only.

Figure 7-26 Peak Hour Construction Traffic – Western Access Only



Source: Google, Note: Site bounds indicative only.

Figure 7-27 Peak Hour Operational Traffic – Western Access Only



Source: Google, Note: Site bounds indicative only.

State-Controlled Network Pavement Impacts

The Newell and Sturt Highways are sealed high speed highways that are already designed to cater for significant traffic volumes including heavy vehicles. Traffic associated with the Project will not require modification of the highway cross-sections as they are already fit for purpose for the transport task associated with the Project.

Haulage associated with the Project is likely to increase existing heavy vehicle traffic (including buses) on the State-controlled road network by not more than 5.7% during the peak construction phase with this reducing to well less than 1% following conclusion of construction activities. This maximum level assumes all heavy vehicle traffic utilises a single access route.

Whilst this increase has the potential to accelerate deterioration of the State-controlled road network and is above the typical assessment threshold of 5%. Therefore a proponent contribution towards pavement maintenance activities is not considered warranted. This is because typical assessment practice has been to only require a contribution where an impact greater than 5% is sustained over a number of years not just for a project's construction phase. For example quarry's which continue to generate haulage demands for the life of their operations are commonly required to contribute toward pavement maintenance however shopping centre developments are typically not required to as the associated construction activity and heavy vehicle demands only occur for the construction period.

This practice is a result of the long timeframes of the maintenance and rehabilitation regimes associated with road pavements. For example an increase of 5.7% in the pavement loadings for a 4.5 year period as associated with the Project will only bring forward the likely timing of rehabilitation activities by 3 months in a 20 year management regime which is unlikely to significantly change the road authorities funding requirements and therefore necessitate a proponent contribution.

Furthermore, a contribution is not considered warranted as the potentially impacted section of the State-controlled network also forms part of the National Land Transport Network which by definition preforms a nationally significant freight task and as a result the maintenance of which is already partially funded by the Federal Government.

Council – Controlled Network Pavement Impacts

Haulage associated with the Project is likely to accelerate deterioration of the Council-controlled road networks in particular Main Canal Road, Back Morundah Road and a short section of Reas Lane dependant on the proportionate use of the western and eastern access routes that ultimately eventuates.

Whilst numerical analysis could potentially be undertaken to quantify at this early stage the likely extent of deterioration and to define an appropriate contribution such analysis at this stage is at best an estimate only. In practice it has been found to be problematic to pre-estimate the extent of deterioration of Council-controlled road networks as it exposes Councils to the risk that greater deterioration may eventuate than initially calculated. This issue is particularly relevant to the Council-controlled road networks given the greater relative increase in pavement loadings that will potentially eventuate as a result of the Project and the typically lower and more variable construction standard of the Council-controlled road networks.

To minimise risk it is therefore recommended that a make good agreement be entered into with the Council road authorities in relation to road deterioration. Such an agreement would likely be established with assistance from the successful EPC following EIS approval. The agreement would likely involve road dilapidation surveys occurring prior to and following the completion of each construction stage. A comparison of the pre and post construction surveys would identify areas that require rectification with the repairs undertaken in accordance with the relevant Council standards.

Typically a make good agreements also stipulate the requirement for daily and weekly inspections and require that if the pavement deteriorates to a degree that safety issues arise that rectification works occur immediately rather than at the conclusion of the relevant construction stage. In addition, the RMP associated with a project will typically define haulage restrictions that occur in instances where safety issues arise such as temporary suspension of haulage until a safety issue is rectified.

It is recommended that the pre and post construction dilapidation surveys be undertaken in consultation with the relevant Council and to a suitable standard. A potential methodology could include that detailed in the *Condition Assessment & Asset Performance Guidelines – Road* Pavements, issued by the Institute of Public Works Engineering Australia (IPWEA).

Section 3.4 of Appendix M identifies the restricted access for B-doubles applies to Main Canal Road and Old Morundah Road. The restricted access has been conditionally provided solely for the Global AG Properties II Australia Pty Ltd property to the north of the Project site along Old Morundah Road.

In order to facilitate 25m/26m B-double construction traffic required for the Project, via the western access route, an application would be required to be made to the NHVR. It is anticipated that the approval could be achieved with similar conditions to those currently applied to the property north of the Project site which includes for example restricted wet weather use. For the wet weather restriction to be removed it is anticipated that any existing unsealed sections of Main Canal Road and Old Morundah Road would need to be sealed to a width of 8 m with and an appropriate pavement capacity for the design traffic volumes provided.

7.3.9.3 Mitigation Measures

A Road Management Plan (RMP) or equivalent document be prepared following EIS approval and award of the EPC contract but prior to the substantial commencement of construction.

The purpose of the RMP will be to:

- Summarise and update (where appropriate) the latest condition of the road network and estimates of the Project's traffic generation potential considering the finalised workforce, procurement and logistics arrangements based upon advice from the EPC contractor;
- Update (if appropriate) the analysis presented herein where either the underlying road conditions or assumed traffic generating characteristics of the Project have changed;
- Identify any known over-dimension movements and the associated logistics strategy and required approvals; and
- Detail proposed/negotiated impact mitigation strategies, both "soft" strategies (for example, bussing workers, variable message signs/ media notices about increased project traffic and road-use management strategies such as avoiding peak hour traffic, fatigue management) and "hard" infrastructure strategies (for example, upgrading an intersection or contributing to maintenance).

A Traffic Management Plan (TMP) will also be required for construction activities, and is a separate document to the RMP. The TMP should be prepared using the relevant template prepared by RMS.

Detailed assessment has been undertaken to establish the transport mitigation strategies recommended to support the Project which include the following:

- Enter into make good agreements for the pavement damage that occurs to the Council-controlled road networks during the duration of construction activity;
- Provide an 8m seal on Old Morundah Road with a pavement capacity suitable for the design traffic demands should all weather access be sought along the Western Access Route (i.e. should this be the primary point of access for any construction stage).
- Prepare a RMP generally in accordance with the specifications provided in Section 9 and in addition prepare any TMPs required to support works undertaken within the public road reserve; and
- Undertake the upgrade works documented in **Tables 36** and **37**.

Table 36 Summary of Required Road Upgrades (Should the Western Access Route be Utilised)

Location	Required upgrade
General	• Enter into make good agreements for the pavement damage that occurs to the Council-controlled road networks during the duration of construction activity; • Prepare a RMP generally in accordance with the specifications provided in Section 9 and in addition prepare any TMPs required to support works undertaken within the public road reserve;
Old Morundah Road	• Provide an 8m seal on Old Morundah Road with a pavement capacity suitable for the design traffic demands should all weather access be sought along the Western Access Route (i.e. should this be the primary point of access for any construction stage).
Sturt Highway / Main Canal Road Intersection	• Provide AUxiliary Left (Short) turn lane (AUL(s)) within bridge constraints
Main Canal Road / Old Morundah Road Intersection	• Provide shoulder widening (i.e. BAsic Left (BAL) treatment) to aid left turn; and • Trim vegetation along the northern approach.
Old Morundah Road / Site Access Road Intersection	• Provide shoulder widening (i.e. BAsic Left (BAL) treatment) to aid left turn.

Table 37 Summary of Required Upgrades (Should the Eastern Access Route be Utilised)

Location	Required upgrade
General	• Enter into make good agreements for the pavement damage that occurs to the Council-controlled road networks during the duration of construction activity; • Prepare a RMP generally in accordance with the specifications provided in Section 9 and in addition prepare any TMPs required to support works undertaken within the public road reserve;
Sturt Highway / Reas Lane (Back Morundah Road) Intersection	• Provide AUxiliary Left (Short) turn lane (AUL(s))
Back Morundah Road / Site Access Road Intersection	• Provide shoulder widening (i.e. BAsic Right (BAR) treatment) to aid left turn;

7.3.10 Waste Management

A Waste Management Assessment has been carried out by SLR for the Project, described in detail in **EIS Appendix N**. While Waste Management is not directly referenced in the Project SEARs, an accompanying submission by Narrandera Council states that it expects the SEARs to consider:

> *"Management of large quantities of unsorted waste generated, and the processing capability of local landfill facilities, during the construction phase"*

The report describes the types of waste likely to be generated during construction, normal operations through to de-commissioning, the quantities in each case and how each waste type will be handled on-site, transported off site, recycled and disposed of, as the case may be. The report covers:

- Landfills, Waste Contractors and Scrap Metal Contractors in the Project area;
- Waste management for the Construction, Operational and De-Commissioning Phase Phases; and
- Sewer-related issues.

7.3.10.1 Regional Infrastructure

Despite the distance between the main urban centres in the Riverina, the area is well served by waste management contractors and facilities.

Appendix N	**Table 1** provides:	Riverina District Landfills
Appendix N	**Table 2** provides:	Riverina District Major Waste Contractors
Appendix N	**Table 3** provides:	Riverina District Scrap Metal Merchants

Gregadoo Waste Management Centre is the largest landfill in the region. The facility will accept a range of waste and recyclables, including most of those generated by this development, and hence appears to be the most likely destination for waste generated during construction. The other sites listed in **Appendix N Table 1** are very small and designed to receive waste only from local residents and small businesses. These sites would only be suitable for disposing of small amounts of waste during ongoing operations.

In relation to the major waste contractors listed **Appendix N Table 2**, all but one is based in Wagga Wagga, but all can provide a range of services to the site.

In relation to the scrap metal merchants listed in **Appendix N Table 3**, scrap metal can be delivered to these operators either personally by staff or contractors, or alternatively, by waste contractors. Some of these operators are also able to arrange bins for metals to be delivered to, and collected from, the site.

7.3.10.2 Waste Streams, Quantities, Handling and Disposal

Table 38 below summarises the expected waste types, estimated quantities and proposed handling and recycling and disposal methods.

Table 38 Waste Quantities and Recycling/Disposal Strategy

Phase	Waste Type	Estimated Quantity	Handling Method	Disposal or Recycling	Locations
Construction	General waste	1500 L – 2700 L per week	Front lift bins collected by a contractor	Disposal	Likely Wagga Wagga
	Food waste	150 kg – 270 kg per week	In with general waste	Disposal	Likely Wagga Wagga
	Contaminated soil	Nil	N/a	N/a	N/a
	Chemicals and hazardous waste	Small quantities	Clinical waste to a hospital	Disposal	Possibly Narrandera District Hospital
	Road construction waste	5,800t or 3,200 m^3 total	Taken off site by contractors	Recycling	Likely Wagga Wagga
	Car park waste	119.3 t or 73.7 m^3 total	Taken off site by contractors	Recycling	Likely Wagga Wagga
	Fencing	375 kg total	Taken off site by contractors	Recycling	Likely Wagga Wagga
	Building materials	100 tonnes	Taken off site by contractors	Recycling	Likely Wagga Wagga
	Timber pallets	842 kg per day (3 m^3 per day chipped)	Chipped, some used on site, remainder collected by contractor	Recycling	Likely Wagga Wagga
	Cardboard	178 kg per day	Baled and stored for collection by a contractor	Recycling	Wagga Wagga
	Plastic film	90 kg per day	Baled and stored for collection by a contractor	Recycling	Wagga Wagga
	Excavated soil	N/a	Reused on site	Reuse	On-site
	Concrete	20 t total per year	Taken off site by contractors	Recycling	Likely Wagga Wagga
	Metals	95 kg per day	Taken off site by contractors	Recycling	Wagga Wagga
Operations	General waste	100 L per week	Taken to landfill by staff	Disposal	Narrandera waste facility
	Food waste	10 kg per week	Placed in worm farm by staff	Vermiculture	On-site
	Office paper	5 kg per month	Taken to waste facility by staff	Recycling	Narrandera waste facility
	Chemicals and hazardous waste	Small quantities	Handled according to OEMP		
	Timber, cardboard and plastic film	37.4 kg 8 kg 4 kg	Taken to waste facility by staff	Recycling	Narrandera waste facility

Phase	Waste Type	Estimated Quantity	Handling Method	Disposal or Recycling	Locations
	Concrete	Small amounts	Taken off site by contractors	Recycling	Likely Wagga Wagga
	Metals	Small amounts	Taken off site by contractors	Recycling	Likely Wagga Wagga

7.3.10.3 Sewer-Related Issues

Construction Phase

The site is not connected to sewer. Portable toilets will be hired for the duration of the construction period.

Appendix N Table 7 provides: Wagga Wagga Portable Toilet Hire Contractors

Operational Phase

At least two toilets will be installed at the operations and maintenance building.

The possibility of composting toilets will be considered. The types of available composting toilets that will be considered during the detailed design and project planning is summarised in **Table 38.**

Table 39 Composting Toilet Types

Type	Function Description
Batch Composting	These systems have least two composting chambers. After one is filled, it is put aside to continue composting, and the second chamber is used. When it is time to change chambers again, the contents of the first chamber are composted. The compost is removed and used for landscaping. The empty chamber is re-used.
Continuous Composting	In this system, waste materials are continuously composted in process in one large chamber. Older, fully composted material settles to the bottom of the chamber where it is easily removed through an access hatch.
Hybrid	In this system compost is continually added to a 'bio-drum' but when half full some is fed into a 'finishing tray' by rotating a handle. The compost sits in isolation in this finishing tray until it is removed as humus and used as required.

7.3.10.4 Summary

During the Construction Phase, the Project is expected to generate significant quantities of timber, cardboard and plastic film, with smaller amounts of building material waste, such as concrete and steel, and organic waste, food waste associated with construction crews.

Emphasis has been placed on re-use and recycling of the bulk of this material and those that generate it being responsible for its disposal.

The Riverina is well served for waste contractors and waste facilities and these will adequately handle all waste generated during the construction phase and which will be disposed off-site.

During its Operational Phase, the Project is expected to generate only a few types of waste and only in very small quantities. Emphasis again is placed on re-use and recycling of this material.

Riverina waste contractors and waste facilities will easily handle all waste generated on site during the operational phase which must be disposed off-site.

7.4 Cumulative Impacts

7.4.1 Existing Environment

Cumulative impacts relate to the combined effect of similar or different impacts on a particular value or receiver, and may occur concurrently or sequentially. For these purposes, cumulative impacts are associated with other known or foreseeable projects occurring in proximity to the proposed Project. This Section deals with the potential for the Project to impact with existing conditions in proximity to the Project site.

There are a number of proposed and approved major projects in the Narrandera and Murrumbidgee LGA's that have the potential to have a cumulative impact on the local community – refer to **Figure 7-26** for the location of these major projects.

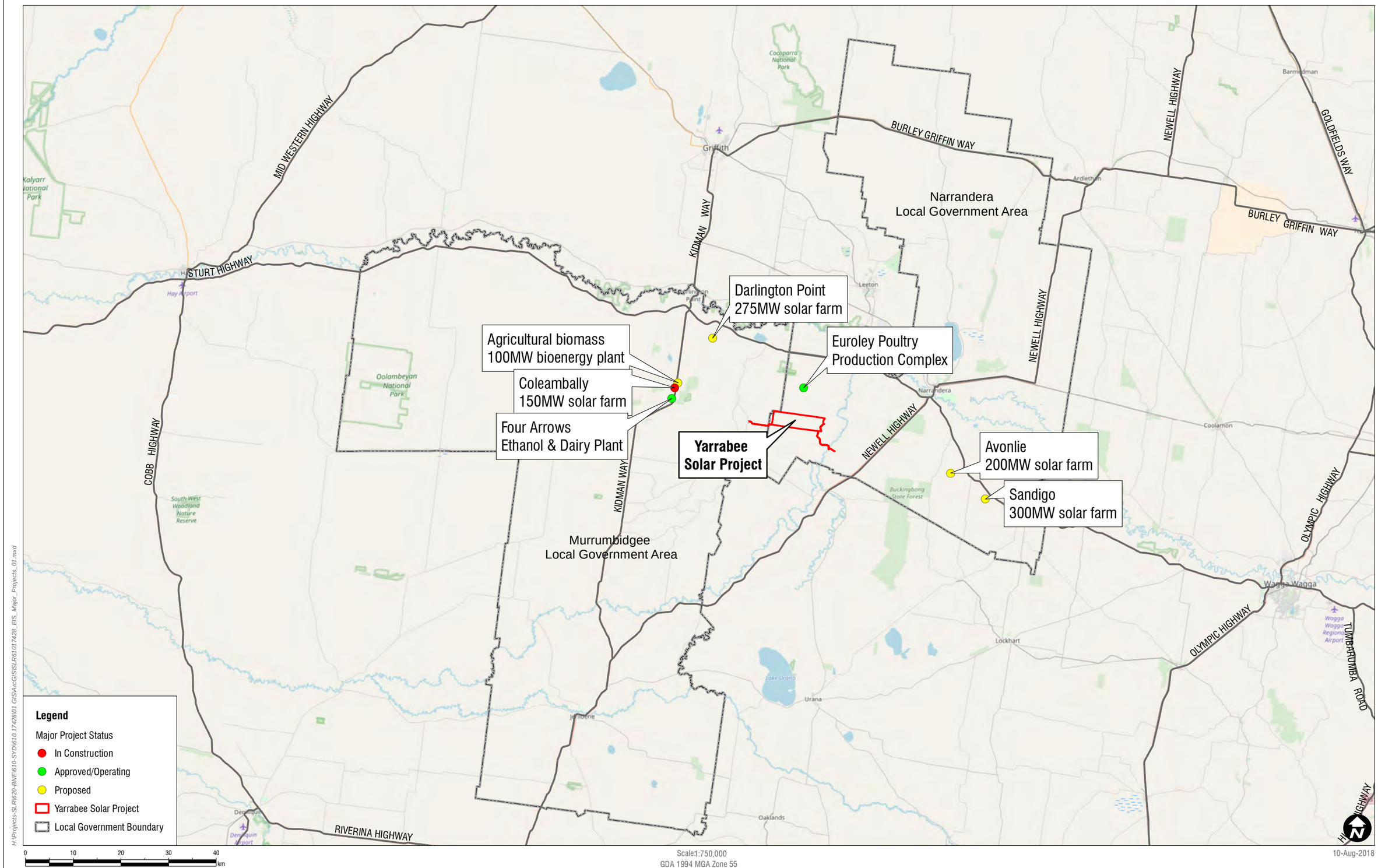
The Project SEARs requires the EIS to assess the likely impacts of all stages of the development (which is commensurate with the level of impact), including any cumulative impacts of the site and existing or proposed developments (including Euroley Poultry Production Complex and the proposed Avonlie and Sandigo solar projects), taking into consideration any relevant legislation, environmental planning instruments, guidelines, policy, plans and industry codes of practice.

7.4.2 Potential Impacts

For impacts identified as requiring further assessment in the EIS, consideration will be given to their potential contribution to cumulative impacts. The potential cumulative impacts identified as requiring further assessment as part of this EIS, include:

- Aboriginal cultural heritage;
- biodiversity;
- noise;
- socio-economic impacts including workforce and accommodation;
- traffic on local roads; and
- landscape and visual amenity, and
- waste

These issues have been considered and assessed individually in relation to the Project in the relevant sections of the EIS. Each potential cumulative impact has had mitigation measures development in order to reduce the potential for cumulative impacts on the region. A summary of the cumulative impact assessment for each impact area is provided below.



SLR

Major Projects

FIGURE 7.28

Aboriginal Cultural Heritage

The Project adds to the cumulative impact on the region's Aboriginal cultural heritage as six sites will be harmed. However, the heritage impact value of this loss is low as the six sites consist of isolated finds and low density artefact scatters. The proponent has designed the impact footprint of the development in order to avoid a large number of Aboriginal sites, particularly those sites deemed to have higher archaeological significance.

Biodiversity

Cumulative impacts arise from the interaction of individual elements within the proposal and the additive effects of other external projects. At the time of writing, no other projects have been identified close to the Project site. Given that the proposal will not result in the clearing of native vegetation, and large areas of native vegetation will remain undisturbed outside the Project site within the locality, cumulative impacts of the proposal are expected to be negligible.

Hydrology and Flood Modelling

Other major projects in the region need to be considered in terms of cumulative impact on flood flows and flood behaviour. These projects include:

- Avonlie Solar Farm
- Sandigo Solar Project
- Euroley Poultry Complex

Most of these projects are outside the catchment for the Yanco Creek system, and are not considered to have any potential to contribute to cumulative impacts associated with the Project.

The Euroley Poultry Production Complex shares the Yanco catchment with the Project but cumulative impacts associated with the Project are not expected. Hydrological calculations from the EIS indicate that this proposal will have zero discharge under most rainfall conditions since runoff will be captured in dams have been sized at 170% of the estimated runoff volume from a 100 year 72 hour rainfall.

Noise

Due to the extensive distance from the Project site to other nearby major projects (over 4.5 km) there are no expected cumulative noise effects associated with the Projectl.

Socio-economic including workforce and accommodation

Depending on the relative timing of peak construction periods, the Avonlie and Sandigo solar projects may place pressure on local Narrandera labour supply, businesses and local social infrastructure including medical services, retailers and the availability of accommodation.

The Project is expected to require accommodation for an average of 150 workers with a peak of 450 workers expected during peak construction. There may be short-term pressure on accommodation during the different construction phases of the Project. There are a number of short-term accommodation options within the Narrandera LGA. These include:

- Ten (10) hotel/motel options with varying capacities; and
- Two caravan/tourist parks with cabin facilities that would be better suited for worker accommodation.

- These short term accommodation options would accommodate the majority of the construction workforce. During peak construction periods the Project would look to other regional centres such as Wagga Wagga and Griffith for short term accommodation options (as required).

The potential for labour, services and resource shortages during the construction phase of the project would be over come through sourcing labour from the broader Riverina region where local labour, services and resources are not available.

To ensure that any potential cumulative negative impacts on Narrandera LGA are minimised, the Project would be required to engage with DPE, Narrandera Shire Council, local business owners and Narrandera Tourism Centre early in the pre-construction phase in order to develop an informed employment strategy that identifies local opportunities in terms of construction as well as operation employment opportunities. Developing a focused employment strategy that can be used to inform key stakeholders including local business owners during the project planning phase (pre-construction) would provide local business owners and labour with the greatest opportunity to benefit from the project.

A project specific accommodation strategy would be developed early in the project planning phase, pre-construction to identify suitable local accommodation options available to support a percentage of the workforce that would need to be sourced from outside the Narrandera LGA. The accommodation strategy would incorporate a community and stakeholder strategy to identify all local accommodation options for the benefit of the local Narrandera region as a priority. The cumulative impacts on the availability of accommodation are not expected to be significant as a result of early project planning and early stakeholder engagement to ensure that Narrandera derive optimal economic benefit from the Project.

Traffic

In preparing the Traffic Impact Assessment for this EIS (refer to Section 7.2.9) a number of other developments that have the potential to result in the cumulative impacts on the surrounding road network have been identified. It is understood that traffic associated with the Avonlie Solar Farm, Sandigo Solar Farm and Euroley Poultry Production projects will only use common elements of the State Controlled road network, and that traffic associated with these projects is not likely to use sections of the Council-controlled road network that are anticipated to be used for the Project.

Waste

The Riverina is well served for waste contractors and waste facilities and these will adequately handle all waste generated during the construction phase and which will be disposed off-site. During its Operational Phase, the Project is expected to generate only a few types of waste and only in very small quantities. Emphasis again is placed on re-use and recycling of this material. Riverina waste contractors and waste facilities will easily handle all waste generated on site during the operational phase which must be disposed off-site. The cumulative impacts of increase waste streams in the region would be adequately managed by the existing waste management operators in the Riverina region.

7.4.3 Mitigation Measures

Mitigation measures to avoid and minimise cumulative impacts are provided in **Table 39**.

Table 40 Cumulative Impact Mitigation Measures

Mitigation measures	Phase
Develop an informed employment strategy that identifies local opportunities in terms of construction as well as operation employment opportunities.	Project planning Pre-construction
A project specific accommodation strategy would be developed to identify suitable local accommodation options available to support a percentage of the workforce that would need to be sourced from outside the Narrandera LGA.	Project planning Pre-construction
Reach will liaise with the appropriate local community representatives to reduce the potential for adverse impacts on local services or events due to the accommodation of the construction workforce.	Pre-construction Construction
As part of Reach's commitment to the Project, it will be consulting with key stakeholders including Narrandera Shire Council and other neighbouring Shire Councils, local businesses including accommodation services and car and bus hire, as well as the local community to ensure that all long-term support business opportunities are identified early.	Construction Operation Decommissioning

Reach SOLAR ENERGY

SECTION 8

Environmental Mitigation Measures

8 ENVIRONMENTAL MITIGATION MEASURES

8.1 Statement of Commitments

Reach commits to the implementation of the mitigation measures, monitoring activities and management strategies that have been identified in **Section 7** for all activities associated with the Project.

The mitigation measures outlined in **Table 41** detail the key commitments proposed in the EIS, in order to effectively mitigate and management the potential environmental and socio-economic impacts of the project.

Table 41 Mitigation Measures

Impact	Potential Impact	Approach	Phase
Aboriginal heritage			
Aboriginal heritage	Impacts to Aboriginal heritage items	Prescriptive Measure Avoid impacts by altering the project proposal or by avoiding impact to a recorded Aboriginal site	Construction
Aboriginal heritage	Impacts to Aboriginal heritage items	Mitigation Measure If impacts can be avoided, a suitable curtilage around the site must be provided to ensure its protection both during the short-term construction phase of development and in the long-term use of the area.	Construction
Aboriginal heritage	Impacts to Aboriginal heritage items	Prescriptive Measure If plans are altered, care must be taken to ensure that impacts do not occur to areas not previously assessed.	Construction
Aboriginal heritage	Impacts to Aboriginal heritage items	Management Plan If impact is unavoidable then appropriate management of the site/object will be determined through policies set out in an Aboriginal Cultural Heritage Management Plan (ACHMP).	Construction
Aboriginal heritage	Impacts to Aboriginal heritage items	Management Plan The ACHMP should include measures for site conservation, as well as detailing methods for the management of sites to be impacted. The management will depend on many factors including the assessed significance of the sites	Construction
Aboriginal heritage	Impacts to Aboriginal heritage items	Management Plan The ACHMP will be developed in consultation between the proponent, RAPs and DPE.	Construction
Aboriginal heritage	Impacts to Aboriginal heritage items	Mitigation Measure Site Yarrabee IF-1 and Yarrabee OS-4 are both within 50m of the impact footprint and special management should be applied to these sites to ensure they are not harmed by the proposal. It is recommended that a 10m buffer around the site extent be erected using high visibility ground markers (i.e. staking and flagging or fencing), prior and during construction works. The removal of the site buffer following construction will be left to the discretion of the proponent.	Construction
Aboriginal heritage	Impacts to Aboriginal heritage items	Mitigation Measure	Construction

Impact	Potential Impact	Approach	Phase
		It is recommended that the six sites on existing access tracks be salvaged through the recording and collection of surface artefacts. However, if there is to be any ground disturbing activities relating to upgrading or maintenance of the existing access tracks (i.e. grating, widening, etc.) then further subsurface archaeological investigation will be necessary prior to these activities.	
Aboriginal heritage	Impacts to Aboriginal heritage items	Mitigation Measure All land-disturbing activities must be confined to within the assessed study area, in particular the impact footprint. Should the parameters of the proposed work extend beyond this, then further archaeological assessment may be required. This includes existing access tracks outside the impact footprint.	Construction
Biodiversity			
Biodiversity	Impacts to biodiversity	Mitigation Measure Avoidance measures to reduce potential impacts to biodiversity values within the subject site include reducing the development footprint where possible during the detailed design phase.	Construction
Biodiversity	Erosion and sedimentation impacts	Mitigation Measure Installation of erosion and sediment control measures prior to any works	Construction
Biodiversity	Erosion and sedimentation impacts	Mitigation Measure Regular inspection of erosion and sediment control measures, particularly following rainfall events, to ensure their ongoing functionality	Construction
Biodiversity	Potential contamination impacts from excavated materials	Mitigation Measure Continued soil testing to confirm absence of contamination.	Construction
Biodiversity	Impacts to biodiversity from stockpiling of materials	Mitigation Measure Avoid stockpiling of materials adjacent to native vegetation, but instead use areas that are already cleared/ disturbed. Undertake maintenance of silt fences and other Mitigation Measure to isolate runoff.	Construction

Impact	Potential Impact	Approach	Phase
Biodiversity	Dust impacts	Mitigation Measure Setting maximum speed limits for all traffic within the study area to limit dust generation	Construction
Biodiversity	Dust impacts	Mitigation Measure Use of a water tanker or similar to spray unpaved access tracks during the construction phase where required	Construction
Biodiversity	Dust impacts	Mitigation Measure Application of dust suppressants or covers on soil stockpiles.	Construction
Biodiversity	Potential impacts to biodiversity from spills	Mitigation Measure All chemicals must be kept in clearly marked bunded areas.	Construction
Biodiversity	Potential impacts to biodiversity from spills	Mitigation Measure Regularly inspect vehicles and mechanical plant for leakage of fuel or oil.	Construction
Biodiversity	Potential impacts to biodiversity from spills	Mitigation Measure No re-fuelling of vehicles, washing of vehicles or maintenance of vehicles and plant to be undertaken within 20 m of natural drainage lines.	Construction
Biodiversity	Impacts to asset protection zones	Mitigation Measure Fuel management specifications to be used as a guide to achieve the performance requirement of an Inner Protection Area (IPA) and Outer Protection Area (OPA) within the APZ are in accordance with the Bushfire Protection Assessment (ELA 2015) as follows: • No tree or tree canopy is to occur within 2 m of building rooflines • The presence of a few shrubs or trees in the APZ is acceptable provided that they: • Are well spread out and do not form a continuous canopy; • Are not species that retain dead material or deposit excessive quantities of ground fuel in a short period or in a danger period; and • Are located far enough away from buildings so that they will not ignite the buildings by direct flame contact or radiant heat emission.	Construction

Impact	Potential Impact	Approach	Phase
		• A minimal ground fuel is to be maintained within the IPA to include less than 4 tonnes per hectare of fine fuel consisting of any dead or living vegetation of <6 mm in diameter (e.g. twigs less than a pencil in thickness); and • The OPA may contain 8 tonnes per hectare of fine fuel.	
Biodiversity	Impacts to biodiversity resulting in displaced fauna	Mitigation Measure The following recommendations apply to the management of any displaced fauna species during earthworks activities: • All handling of fauna species should be conducted by the suitably qualified person; • In the event that arboreal animals do not move or they cannot be captured because the tree hollow to be removed is too large, too high or its recovery would breach OH&S requirements then the tree will be felled (i.e. in the direction of other tree debris if possible) and animals recovered and relocated to suitable adjacent habitat; • Animals are to be removed and relocated to the adjacent bushland/nest boxes within the Western Offset Area prior to felling or the tree shall be sectioned and dismantled under the supervision of the Project Ecologist before relocating the animals; • Nocturnal fauna species, such as microbats, are to be 'soft released' using bat boxes placed in adjacent habitat; • Nocturnal fauna species, such as gliders and possums, are to be secured in suitable enclosures and kept in a quiet, dark and cool environment until they can be released into suitable habitat after dark; and • If any injured fauna species are found during the construction period, construction must stop immediately so that the injured animal can be taken to a vet or wildlife carer.	Construction
Biodiversity	Impacts to threatened species	Mitigation Measure Induction materials containing detailed information pertaining to the identification of *Tetratheca juncea* (Black-eyed Susan) should be prepared prior to the commencement of construction activities. These materials should be provided to contractors prior to carrying out construction works within the subject site (i.e. including vegetation clearing to achieve Bushfire Asset Protection Zones). This will allow contractors to identify the *T. juncea* and avoid the removal or disturbance of plants (i.e. trampling) during earthwork activities.	Construction
Biodiversity	Spread of high threat weeds	Mitigation Measure	Construction

Impact	Potential Impact	Approach	Phase
		Induction materials containing detailed information pertaining to the identification of high threat weeds should be prepared prior to the commencement of construction activities. These materials should be provided to contractors who will carry out construction works within the subject site.	
Biodiversity	Spread of high threat weeds	Mitigation Measure All vehicles, equipment, footwear and clothing should be clean and free of weed propagules prior to entering the subject site.	Construction
Biodiversity	Spread of high threat weeds	Mitigation Measure Any weeds that are removed during the construction phase should be disposed of via an appropriate waste facility.	Construction
Biodiversity	Impact on terrestrial fauna species	Mitigation Measure Monitoring should be conducted annually for a three to five year period following project construction to assess the abundance and welfare of Kangaroos and Emus within the Project site. A quantitative survey approach should be employed by a suitably trained project ecologist. This method should involve walking transects to estimate Kangaroo and Emu numbers. Statistical analysis may involve using distance analysis to estimate population size and density (Thomas et al. 2010). Each monitoring event should also assess the impacts of grazing pressure on native vegetation via permanent monitoring plots. At least one monitoring plot should be placed in each vegetation type to assess grazing impacts. Vegetation integrity should be assessed using the Biodiversity Assessment Method (OEH 2017c).	Operation
Biodiversity	Impact on nocturnal fauna species	Prescriptive Measure To reduce impacts to these species, including the vulnerable Inland Forest Bat (*Vespadelus baverstocki*), artificial lighting should be reduced where possible within the Project site. Lights should be turned off at night and any essential lighting should be directed away from fauna habitats such as woodland areas.	Operation
Hazards			
Hazards	Bushfire risk	Management Plan Bush Fire risks during construction will be managed through the implementation of a comprehensive Construction Bush Fire Management Plan (CBMP), to be prepared by the successful Project Contractor and signed off by all appropriate authorities	Construction
Hazards	Bushfire risk	Management Plan	Construction

Impact	Potential Impact	Approach	Phase
		The CBMP will ensure adequate site access for the NSW RFS along with water supply resources (20,000 L) needed to supress any fire within the Project site.	
Hazards	Bushfire risk	Management Plan Bush Fire risks once the facility is fully operational will be managed through the implementation of a comprehensive Operations Bush Fire Management Plan (OBMP), to be prepared by the successful Project Operator and signed off by all appropriate authorities.	Operation
Hazards	Bushfire risk	Management Plan The OBMP will ensure adequate site access for the NSW RFS along with water supply resources (20,000 L) needed to supress any fire within the Project site.	Operation
Hazards	Bushfire risk	Management Plan The OBMP will detail how ground cover beneath and in between the solar panels will be managed to minimise their fire risk, including ground cover monitoring and implementing increased growth suppression activities during high bush fire periods of the year.	Operation
Hazards	Bushfire risk	Management Plan The OBMP will detail all Set-Backs and Asset Protection Zones around the site and all buildings, including the Project substation, Main Office/Control Centre and potential energy storage system.	Operation
Hazards	Bushfire risk	Management Plan There will be extensive access tracks within the Project site itself, ensuring adequate access for emergency services vehicles and personnel. The OBMP will ensure that adequate egress (including turning circles, etc) exists within the internal access route network.	Operation
Hazards	Bushfire risk	Management Plan The OBMP will detail De-Commissioning phase management strategies similar to those deployed for the Construction phase to address the similar risks expected during this last phase of the Project.	Operation
Hazards	Bushfire risk	Management Plan The Project CBMP and OBMP will: • Comply with all relevant Bush Fire Policies, Standards and Guidelines, specifically the NSW RFS's Draft 2017 Planning for Bush Fire Protection;	Construction/ Operation

Impact	Potential Impact	Approach	Phase
		• Detail the emergency and evacuation measures adopted for the site; • Ensure there are adequate setbacks in the Project design (e.g. 20 m from the site perimeter fencing for any solar arrays, 20 m setbacks from wooded areas and any "Vegetation and Heritage Protection Exclusion Zones"; • Detail storage and maintenance requirements for firefighting water tanks and any other on-site firefighting equipment, including fire extinguishers for all site vehicles, as well as relevant operational procedures for bush fire suppression; • Develop a system for the continuous monitoring of the NSW RFS website for bush fire alerts (especially during the bush fire season) http://www.rfs.nsw.gov.au; • Detail the storage and sign-posting requirements for any fuel or flammable liquids stored on-site, including a register of all such material along with their Material Safety Data Sheets (MSDSs); • Ensure that burning of vegetation or any other waste materials does not take place on-site; • Ensure that smoking is prohibited in work areas, and within 5 m of any door, window or air conditioner intake; • Ensure that all employees receive training and instruction on the relevant fire procedures as part of their induction training; and • Ensure that firefighting equipment which is identified during the risk assessment process undertaken in the development of the site-specific Fire Management Plan, is made available to the appointed Emergency Response Team as well as for emergency service personnel entering the site.	
Hazards	Bushfire risk	Management Plan The CBMP, OBMP and ERP will be provided to the NSW RFS with copies stored locally within an appropriate "emergency cabinet" located within the Project Main Office/Control Room building.	Construction/ Operation
Hazards	Bushfire risk	Management Plan The CBMP, OBMP and ERP will detail how fire emergencies will be addressed via a site-specific *Fire Emergency Procedure* and the *Emergency Management Procedure.*	Construction/ Operation
Hazards	Potential impacts to the Energy Storage System (EES)	Prescriptive Measure Regardless of the battery systems selected (i.e. Tesla Li-Ion or otherwise), installation will be in accordance with manufacturer's instructions and the accompanying Safety Data Sheets (SDSs).	Construction

Impact	Potential Impact	Approach	Phase
Hazards	Potential impacts to the Energy Storage System (EES)	Mitigation Measure Regardless of the ESS configuration (individual cubicle, containerised units, etc), access to the ESS will be restricted through: • Maintenance of a dedicated enclosure within a secure (i.e. fenced) area. Pre-assembled (and containerised) ESS units constitute inherent and suitable enclosure; • Restricting access to the ESS only to authorised persons; and • Use of personal protective equipment (PPE), spill kits and safe work procedures when handling, repairing, maintaining, installing and inspecting ESS units.	Construction
Hazards	Potential impacts to the Energy Storage System (EES)	Prescriptive Measure Pre-assembled ESS units will have an IP rating appropriate for the environment in which they are installed in accordance with AS/NZS 3000.	Construction
Hazards	Potential impacts to the Energy Storage System (EES)	Prescriptive Measure All equipment exposed to the outdoor environment shall be at least IP 54 and UV resistant. Connection of wiring, conduit and glands to IP rated equipment and/or enclosures shall be installed so the minimum IP rating is maintained.	Construction
Hazards	Potential impacts to the Energy Storage System (EES)	Mitigation Measure The factors which will be considered in the ESS design to ensure that the ESS operates properly and external hazard initiators are minimised include: • Design for solar radiation and ambient temperature range (through proper ventilation); • Protection against the presence of water (flood avoidance) or high humidity; • Protection against solid foreign bodies (exposure to dust storms) and corrosive or polluting substances (suitable enclosures); • Protection against electrolyte spills through adequate enclosure, ESS perimeter fencing and separation distances for any nearby buildings; • Protection against impact, vibration or other mechanical stresses; and • Protection against influence of flora and fauna (eg surrounding vegetation management to minimise and eliminate where possible ignition sources).	Construction

Impact	Potential Impact	Approach	Phase
Hazards	Potential impacts to the Energy Storage System (EES)	Mitigation Measure Proper PPE will be provided on-site for the safe handling of all ESS equipment and protection of authorised persons.	Construction
Hazards	Potential impacts to the Energy Storage System (EES)	Mitigation Measure Safety signage will also cover all PPE requirements when accessing the ESS, and in particular, for emergency workers in a shutdown event.	Construction
Hazards	Potential impacts to the Energy Storage System (EES)	Mitigation Measure Once installed, the ESS will be commissioned in accordance with the manufacturer's instructions.	Operation
Hazards	Potential impacts to the Energy Storage System (EES)	Prescriptive Measure Once the ESS is installed, documentation in the form of a comprehensive System Manual shall be provided on-site, stored in a secure location and readily available to authorised personnel, inspectors, maintenance personnel and emergency service personnel, in accordance with: • AS/ NZS 5033 Installation and safety requirements for photovoltaic (PV) arrays; and • AS/ NZS 4777.1 Grid connection of energy systems via inverters Installation requirements.	Operation
Hazards	Potential impacts to the Energy Storage System (EES)	Prescriptive Measure The ESS will be maintained in accordance with the manufacturer's instructions and SDSs.	Operation
Hazards	Potential impacts to the Energy Storage System (EES)	Prescriptive Measure ESS maintenance will only be performed by authorised personnel.	Operation
Hazards	Potential impacts to the Energy Storage System (EES)	Mitigation Measure Maintenance procedures will form part of the ESS System Manual, and may include: • Cleaning battery system terminals of dirt and electrolyte. • Ensuring electrical terminals are set to correct torque settings. • Ensuring battery accommodation integrity is maintained (e.g. not damaged, free from debris/ rubbish; and, access is not obstructed).	Operation

Impact	Potential Impact	Approach		Phase
		• Ensure proper functioning of overcurrent and isolation devices. • Check charge and discharge parameters are correctly set. • Ensure correct ventilation has been provided and is maintained. • Check cable mechanical support, protection and penetration is maintained.		
Historic Heritage				
Historic Heritage	Potential impact on historic heritage site.	Prescriptive Measure If an item of potential historic heritage is uncovered during the works, works would cease and the Heritage Division (OEH) would be contacted for advice.	Minimal impact on any potential historic heritage item uncovered during the project.	Construction
Hydrology and water quality				
Flooding of Project site	Risk to property and life	Management Measure Overall the risk to life is low and manageable, since, a) the flood warning time is significant; b) flood modelling has confirmed a suitable refuge area close to the centre of the Project site; and, c) the Operational Environmental Management Plan for the Project will include a Flood Management Plan.		Construction Operation
Water quality	Water quality	Management Measure Since the existing site is essentially flat there are very low rates of erosion and sediment transport from site. No broad scale earthworks or soil disturbance are proposed, and any localised soil disturbance will be progressively revegetated such that the total area of denuded soil is minimised. If any water quality issues become evident through monitoring, then localised erosion control measures will be intensified – such as hydromulching, contour berms and localised sediment sumps. Preparation of a Construction Environment Management Plan will further detail requirements and procedures for erosion and sediment control, water quality monitoring, bunding of hydrocarbon storages (if relevant), and spill response.		Construction
Water quality	Water quality	Management Measure		Operation

Impact	Potential Impact	Approach	Phase
		An Operational Environmental Management Plan will be prepared to detail requirements and procedures for water management. Although some areas of the site do not drain to the farm dam, the water quality in the farm dam will be representative of the whole site, and will be monitored during initial stages of development. Water quality controls will be adapted if monitoring indicates changes in water quality beyond ANZECC 2000 trigger values. Any changes will be documented in revisions to the Construction and Operational Environmental Management Plans as appropriate.	
Landscape and visual amenity			
Landscape & visual amenity	Visual impact to neighbouring private properties.	Whilst screening of the proposed works around the site boundary has not been considered necessary form a public receptor view point, specific localised screen initiatives may be considered by the proponent at their discretion to address the interface with neighbouring private properties.	Operation
Air quality			
Air quality	Dust generation	Water truck(s) will be used during construction for dust suppression along internal, unsealed access roads and disturbed areas;	
Air quality	Dust generation	Vehicle movements will be minimised where possible on unsealed roads.	
Air quality	Dust generation	All vehicles, plant and equipment will be cleaned on a regular basis.	
Air quality	Dust generation	All vehicles, plant and equipment will be switched off when not in continuous use;	
Air quality	Dust generation	All vehicles, plant and equipment will be regularly inspected and maintained to ensure that they operating efficiently.	
Air quality	Dust generation	A Construction Traffic Management Plan will be prepared and implemented to assist with the management of vehicle generated dust.	
Noise and vibration			

Impact	Potential Impact	Approach	Phase
Noise and vibration	Increase in noise levels at sensitive receivers from construction noise impacts	Mitigation Measure In order to minimise potential noise impacts on nearby sensitive receivers understood that the majority of construction works are proposed to be undertaken during the ICNG standard daytime construction hours (i.e. 7.00 am to 6.00 pm Monday to Friday and 8.00 am to 1.00 pm on Saturdays).	Construction
Noise and vibration	Increase in noise levels at sensitive receivers from construction noise impacts	Mitigation Measure Where it is necessary to undertake works outside of standard daytime hours, it is recommended that AS 2436-2010 "Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites" is used to assist in mitigating construction noise emissions	Construction
Noise and vibration	Construction noise impacts	Mitigation Measure **Adoption of Universal Work Practices** • Regular reinforcement (such as at toolbox talks) of the need to minimise noise. • Regular identification of noisy activities and adoption of improvement techniques. • Avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents. • Where possible, avoiding the use of equipment that generates impulsive noise. • Minimising the need for vehicle reversing for example (particularly at night), by arranging for one-way site traffic routes. • Use of broadband audible alarms on vehicles and elevating work platforms used on site. • Minimising the movement of materials and plant and unnecessary metal-on-metal contact. • Minimising truck movements.	Construction
Noise and vibration	Construction noise impacts	Mitigation Measure **Plant and Equipment** • Choosing quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks. • Selecting plant and equipment with low vibration generation characteristics. • Operating plant and equipment in the quietest and most efficient manner.	Construction

Impact	Potential Impact	Approach	Phase
Noise and vibration	Construction noise impacts	Mitigation Measure **On Site Noise Mitigation** • Maximising the distance between noise activities and noise sensitive land uses. • Installing purpose built noise barriers, acoustic sheds and enclosures.	Construction
Noise and vibration	Construction noise impacts	Mitigation Measure **Work Scheduling** • Providing respite periods which could include restricting very noisy activities (e.g. piling) to the daytime, restricting the number of nights that after-hours work is conducted near residences or by determining any specific requirements. • Scheduling work to coincide with non-sensitive periods. • Planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from the sensitive receivers. • Optimising the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours. • Including contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.	Construction
Noise and vibration	Construction noise impacts	Mitigation Measure **Source Noise Control Strategies** Some ways of controlling noise at the source are: • Where reasonably practical, noisy plant or processes should be replaced by less noisy alternatives. • Modify existing equipment: Engines and exhausts are typically the dominant noise sources on mobile plant such as cranes, graders, excavators, trucks, etc. In order to minimise noise emissions, residential grade mufflers should be fitted on all mobile plant utilised on site. • Use of siting of equipment: Siting noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise. • Regular and effective maintenance.	Construction

Impact	Potential Impact	Approach	Phase
Noise and vibration	Construction noise impacts	Mitigation Measure **Noise Barrier Control Strategies** • Temporary noise barriers are recommended where feasible, between the noise sources and all nearby potentially affected noise sensitive receivers, wherever possible. Typically, 7 dBA to 15 dBA of attenuation can be achieved with a well-constructed barrier. Specific strategies include: • Orientation of the noisy equipment whereby the least noisy side of the equipment is facing the closest receiver. • The positioning of any site huts/maintenance sheds adjacent to the noisy equipment, in the direction of the closest receiver.	Construction
Socio-economic			
Socio-economic	Community members and Stakeholders unaware of key project activities and business opportunities.	Management Plan Preparation of a Community Consultation & Stakeholder Engagement Management Plan which includes: • Providing regular project updates to the community and businesses • Providing a schedule of activities when there may be heavy vehicles accessing the site or when noisy work may occur. • Establishment of a complaint handling procedure and a response protocol. • Preparation of regular project factsheets for distribution to surrounding residents.	Construction Operation Decommissioning
Socio-economic		Ongoing liaison with local community and business representatives to ensure the use of local contractors, labour, materials, and services during construction and operations.	Construction Operation Decommissioning
Socio-economic		Liaison with local businesses and services to determine accommodation options and availability so as local tourism is not affected, particularly during the construction phase.	Construction
Socio-economic		Liaison with tourism representatives to ensure local events are not impacted by accommodation short falls.	Pre-construction Construction
Socio-economic		Continued engagement with Narrandera Shire Council to discuss community and business concerns.	All phases

Impact	Potential Impact	Approach	Phase
Agricultural land and soils			
Soil	Soil erosion potential	Prescriptive Measure Construction will proceed in stages, and within each stage the construction activities will be sequenced, such that the construction zone at any one time will only be a small proportion of the overall Project site area.	Construction
Soil	Soil erosion potential	Prescriptive Measure The Project will utilise the existing landform and no broad-scale re-contouring of the existing ground levels is to be undertaken. Existing vegetative cover and soil structure will be maintained intact across much of the Project site.	Construction
Soil	Soil erosion potential	Prescriptive Measure Solar arrays will be pole mounted, with the poles being supported on a driven or screw pile, so that there is no excavation required other than for electrical cabling.	Construction
Soil	Soil erosion potential	Prescriptive Measure Construction areas will be progressively revegetated as installation of solar panel proceeds across the site.	Construction
Soil	Soil erosion potential	Management Measures At locations where earthworks are necessary, such as for construction of access roads, sub-station pads, or site facilities, localised erosion and sediment controls will be places in accordance with the Landcom (2004) guidelines.	Construction
Soil	Soil erosion potential	Prescriptive Measure Preservation and stabilisation of drainageways and minimisation of the extent and duration of any surface disturbance it to be adopted.	Construction
Soil	Soil erosion potential	Prescriptive Measure Where potential erosive impacts have been identified due to disturbance of sodic topsoil or subsoil gysum will be applied for any remediation earthworks where sodic soils (with exchangeable sodium percentage is greater than 5). The application of gypsum will minimise the potential for sheet, rill and tunnel erosion to occur on areas of disturbed soil. The recommended application rate provided in Table 22 of Appendix D.	Decommissioning
Soil	Soil erosion potential	Management Measure	Decommissioning

Impact	Potential Impact	Approach	Phase
		There are only minor soil stripping and stockpiling activities proposed within the Project site as part of the Project. Soil should preferably be stripped in a slightly moist condition, where possible. Material should not be stripped in either an excessively dry or wet condition. Stripping operations will not be undertaken during excessive dry periods to prevent pulverisation of the natural soil aggregates. Similarly, stripping during wet periods will not be undertaken to prevent damage through compaction	
Traffic, transport and road safety			
Traffic, transport and road safety	Impacts to traffic, transport and road safety	Management Plan It is recommended that a Road Management Plan (RMP) or equivalent document be prepared following award of the construction contract and prior to the substantial commencement of construction.	Pre-construction
Traffic, transport and road safety	Impacts to traffic, transport and road safety	Management Plan The purpose of the RMP will be to: • Summarise and update (where appropriate) the latest condition of the road network and estimates of the Project's traffic generation potential considering the finalised workforce, procurement and logistics arrangements; • Update (if appropriate) the analysis presented herein where either the underlying road conditions or assumed traffic generating characteristics of the Project have changed; • Detail proposed/negotiated impact mitigation strategies, both "soft" strategies (for example, bussing workers, variable message signs/ media notices about increased project traffic and road-use management strategies such as avoiding peak hour traffic, fatigue management) and "hard" infrastructure strategies (for example, upgrading an intersection or contributing to maintenance).	Pre-construction/ Construction
Traffic, transport and road safety	Impacts to traffic, transport and road safety	Management Plan A Traffic Management Plan (TMP) will also be required for construction activities, and is a separate document to the RMP. The TMP should be prepared using the relevant template prepared by RMS.	Construction
Traffic, transport and road safety	Impacts to traffic, transport and road safety	Management Plan The TMP shall apply to all works and activities in or near a State-controlled road corridor for each stage of the Project, namely planning/ pre-construction, construction, operation, decommissioning (establishment, implementation, commissioning and decommissioning).	Construction/ Operation
Waste management			

Impact	Potential Impact	Approach	Phase
Waste management	Generation of construction waste	Prescriptive Measure No staff will be living on-site during the construction phase of the Project.	Construction
Waste management	Generation of construction waste	Prescriptive Measure All waste that cannot be, or is not, recovered or recycled will be placed in bins and collected by a licenced contractor for disposal at a site lawfully able to accept it.	Construction
Waste management	Generation of construction waste	Prescriptive Measure Any clinical waste generated will be stored safely by medical or first-aid staff and disposed of at Narrandera District Hospital or another suitable facility as required	Construction
Waste management	Generation of construction waste	Prescriptive Measure All trades people and contractors engaged for construction work will be required to take any waste generated from their activities off-site for appropriate disposal. This condition will be included in the construction contractor and sub-contractors' agreements.	Construction
Waste management	Generation of construction waste	Prescriptive Measure Stockpiled timber will be chipped and the chipped material used on-site, including for walkway surfaces and Landscaping.	Construction
Waste management	Generation of construction waste	Mitigation Measure When building materials such as timber are delivered and the packaged panels are unwrapped, the constituent materials of the packaging, including timber will be separated. Timber will be stockpiled until there is enough for a chipping contractor to be brought to site. Stockpiled timber will be chipped and the chipped material used on-site, including for walkway surfaces and landscaping.	Construction
Waste management	Generation of construction waste	Mitigation Measure When building materials such as cardboard are delivered and the packaged panels are unwrapped, the constituent materials of the packaging, including cardboard will be separated. Cardboard will be baled using a baler, kept on-site during construction for this purpose, and stockpiled until there is enough for a contractor to come to site to remove.	Construction
Waste management	Generation of construction waste	Mitigation Measure	Construction

Impact	Potential Impact	Approach	Phase
		When building materials such as plastic film is delivered and the packaged panels are unwrapped, the constituent materials of the packaging, including plastic film will be separated. Plastic film will be baled using a baler kept on-site for this purpose during construction and stockpiled. Bales will be stored on site until there are enough for a recycler to come to site and collect them. Bales will be moved and stacked using a forklift.	
Waste management	Generation of construction waste	Prescriptive Measure Cables will be laid on the original soil and excavated soil replaced as infill. No waste soil will be generated. Any other excavated soil will be used for any necessary backfilling activities or stockpiled to be available for use during the rehabilitation phase of the Project. No soil will leave the site.	Construction
Waste management	Generation of waste during operation	Prescriptive Measure General waste will be placed in bags and taken as required by staff to Narrandera Shire Council's waste disposal facility at 16 Red Hill Road, Narrandera.	Operation
Waste management	Generation of waste during operation	Prescriptive Measure Food waste will be separated by staff and placed in a worm farm or compost bin located in a landscaped area.	Operation
Waste management	Generation of waste during operation	Prescriptive Measure Office paper and any other paper and cardboard waste will be placed into recycling bags or bins, bearing appropriate labels and signs, and taken as required by staff to Narrandera Shire Council's waste disposal facility at 16 Red Hill Road, Narrandera where there are paper and cardboard recycling facilities.	Operation
Waste management	Generation of waste during operation	Management Plan Any hydrocarbons, chemicals and hazardous materials that may be required on-site during the operational phase of the project will be managed in accordance with a yet-to-be-written Operational Environmental Management Plan (OEMP) and all relevant EPA and OEH guidelines. The OEMP will provide guidance in this regard, specifically in relation to the potential use of herbicides and storage of chemicals.	Operation
Reflective and illumination glare			
Reflective and illumination glare	Potential impacts to receivers from glare and illumination	Prescriptive Measure The project will use single-axis tracking arrays which tilt to follow the sun as the sun tracks east to west through the day to maximise the amount of sunlight available to the panels.	Operation

Impact	Potential Impact	Approach	Phase
Reflective and illumination glare	Potential impacts to receivers from glare and illumination	Prescriptive Measure The maximum height of the panels will be approximately 4 m above the natural ground level and arrays will likely be spaced either 5 m apart for the portrait system or 10 m apart for the landscape system.	Operation
Reflective and illumination glare	Potential impacts to receivers from glare and illumination	Mitigation Measure Light spill from the Project onto the facades of the surrounding residential dwellings should be kept below 1 lux during curfew hours.	Operation
Reflective and illumination glare	Potential impacts to receivers from glare and illumination	Mitigation Measure *AS4282-1997 Control of the Obtrusive Effect of Outdoor Lighting* sets out general principles that should be applied when designing outdoor light to minimise any adverse effect of the light installation, including: • Direct lights downward as much as possible and use luminaires that are designed to minimise light spill, eg full cut off luminaires where no light is emitted above the horizontal plane, ideally keeping the main beam angle less than 70°. Less spill light means that more of the light output can be used to illuminate the area and a lower power output can be used, with corresponding energy consumption benefits, but without reducing the illuminance of the area; • Do not waste energy and increase light pollution by over-lighting; and • Wherever possible use floodlights with asymmetric beams that permit the front glazing to be kept at or near parallel to the surface being lit.	Operation
Cumulative impacts			
Cumulative Impacts		Develop an informed employment strategy that identifies local opportunities in terms of construction as well as operation employment opportunities.	Project planning Pre-construction
Cumulative Impacts		A project specific accommodation strategy would be developed to identify suitable local accommodation options available to support a percentage of the workforce that would need to be sourced from outside the Narrandera LGA.	Project planning Pre-construction
Cumulative Impacts		Reach will liaise with the appropriate local community representatives to reduce the potential for adverse impacts on local services or events due to the accommodation of the construction workforce.	Pre-construction Construction

Impact	Potential Impact	Approach	Phase
Cumulative Impacts		As part of Reach's commitment to the Project, it will be consulting with key stakeholders including the Narrandera Shire Council and other neighbouring Shire Councils, local businesses including accommodation services and car and bus hire, as well as the local community to ensure that all long-term support business opportunities are identified early.	Construction Operation Decommissioning

Reach SOLAR ENERGY

SECTION 9

Evaluation and Conclusion

9 EVALUATION AND CONCLUSION

The SEARS for the Project state that the EIS must provide the reasons why the Project should be approved having regard to:

- Relevant matters for consideration under the EP&A Act, including the objects of the Act and how the principles of ecologically sustainable development (ESD) have been incorporated into design, construction and ongoing operations of the development – these matters are considered in **Section 9.2.** and **9.3**;
- The suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses this is considered in **Section 9.1**; and
- Feasible alternatives to the development (and its key components) including the consequences of not carrying out the development. A discussion of the alternative locations, technologies and design, including the 'do nothing' option is provided in **Section 4.3**.

9.1 Site Suitability

Selecting the best site for the Project reduces the environmental impacts and risks and maximises benefits in terms of electricity generation performance and carbon emission reduction, and reduces construction and operational costs. The location for the Project was selected after an extensive review of:

- Land availability and access;
- Land ownership and existing use;
- Topography;
- Geological formation;
- Transmission grid access and capacity; and
- Solar irradiation;

Reach considered these issues in detail when assessing the suitability for numerous sites for the Project and determined that the most suitable site is Yarrabee Park.

The Project Site allows for flexibility in design, enabling Reach Solar to avoid or effectively mitigate the (modest) archaeological, ecological and flooding constraints that have been identified during the EIS process. The use of a large site provides advantages over smaller fragmented sites as it allows of exploitation of economies of scale with procurement, construction activities and infrastructure required to support the Project. This ultimately reduces the overall environmental impacts of the Project.

The Project would be permissible under the Infrastructure SEPP (refer **Section 5**). The Project would not affect long term agricultural capability or future use or land use planning options for the property. Based on the above Reach Solar has determined that the Yarrabee site is the optimal location for this project.

9.2 Matters for Consideration

The consent authority for SSD applications is required to take into consideration matters listed in the objects of the EP&A Act and Section 4.15, when determining a project. An evaluation of the Project against the relevant these matters is provided below.

9.2.1 Relevant objects of the EP&A Act 1979

The relevant objects of the EP&A Act are:

- to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources,
- to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment,
- to promote the orderly and economic use and development of land,
- to promote the delivery and maintenance of affordable housing,
- to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats,
- to promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage),
- to promote good design and amenity of the built environment,
- to promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants,
- to provide increased opportunity for community participation in environmental planning and assessment.

The Project would not affect land use capability or reduce future land and resource use options. The Project demonstrates clear economic and social benefits for the community and negative impacts have been assessed as being localised, capable of being mitigated and largely confined to the construction phase. The Project design has been designed to minimise impacts to threatened species, populations, ecological communities, native vegetation and Aboriginal heritage sites through the use of buffer zones around these areas to ensure their protection. The Project is therefore considered to be consistent with the objects of the EP&A Act.

9.2.2 Environmental planning instruments

Environmental planning instruments relevant to the Project are identified in Section 5. The Project and this EIS are consistent the requirements of these instruments.

9.2.3 Likely impacts of the Project

The likely impacts of the Project, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality have been identified and quantified in Section 7 of this EIS. These assessments conclude that the Project would not result in significant impacts to the natural or built environment, or social or economic values of Narrandera or the broader Riverina region, subject to the application of relevant mitigation measures identified in Section 8 of this EIS.

9.2.4 Suitability of the site

The Project site as discussed in Section 9.1 above has been selected based on a number of criteria which makes the project feasible for the purposes of a 900MWac solar PV project.

9.2.5 Submissions

The outcomes of stakeholder and community consultation as discussed in Section 6 of this EIS, have been incorporated into the preparation of this EIS. Submissions received during the exhibition period of the EIS would be addressed through a submissions report.

9.2.6 The Public Interest

The Project need and alternatives including the social and economic needs and benefits of the Project are discussed in Section 4 of this EIS. The Project is considered to be in the public interest because it would:

- align with the "key strategic" aims of Narrandera Shire in particular to "target and attract new businesses" including "renewable energy", and diversify to reduce the dependency on agriculture;
- provide a renewable energy supply that would assist in reaching National, State and Local government energy targets;
- provide additional electricity generation and supply in the Australian grid.;
- enhance electricity network reliability and security benefits;
- increase demand to drive the upgrade of capacity within the Australian electricity grid, further enabling the growth of the renewable market, in turn reducing the demand for coal fired power stations;
- provide an opportunity to reduce greenhouse gas emissions and move towards cleaner electricity generation; and
- provide social and economic benefits generated through the direct and indirect employment opportunities during the construction and operational phases of the project.

9.3 Ecological Sustainable Development

ESD has emerged as a primary objective of environmental protection in NSW, being an objective of the EP&A Act. It is defined under Section 6(2) of the POEO Act as:

> *6(2) For the purposes of subsection (1)(a), ecologically sustainable development requires the effective integration of economic and environmental considerations in decision-making processes. Ecologically sustainable development can be achieved through the implementation of the following principles and programs:*
>
> *a. the **precautionary principle** - namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation...*

b. ***inter-generational equity*** *- namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations,*

c. ***conservation of biological diversity and ecological integrity*** *- namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration,*

d. ***improved valuation, pricing and incentive mechanisms*** *- namely, that environmental factors should be included in the valuation of assets and service, such as:*

   (i) Polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,

   (ii) The user of good and services should pay prices based on the full life cycles of costs providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,

   (iii) Environmental goals, having been establishes, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

The overall objectives of ESD are to use, conserve and enhance natural resources. This ensures that ecological processes are maintained facilitating improved quality of life, now and into the future.

Reach Solar has shown a commitment to the principles of ESD, through a pro-active constraints based approach. The proposed layout of the Project has been specifically designed to avoid areas of environmental, Aboriginal and cultural significance. The Project site comprises generally of isolated patches of relict (or regrowth) woodland and riparian vegetation along watercourses. Impacts of the proposed development on biodiversity values are minimal given that no native vegetation, threatened ecological communities or threatened species habitats will be removed or directly impacted. Identified sites of Aboriginal significance have also been avoided as a result of Project design changes that have been applied to ensure that no sites/areas of Aboriginal significance are impacted throughout the life of the Project.

Avoidance measures and mitigation measures have been presented to reduce the potential for indirect impacts on areas of environmental or Aboriginal and Cultural significance. These measures are relevant to the construction and operational phases of the Project.

9.4 The Precautionary Principle

The Precautionary Principle holds that where there are threats of serious or irreversible environmental damage, the lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

A detailed understanding of the issues and potential impacts associated with the Project has been obtained via consultation and assessment to a level of detail commensurate with the scale of the proposed work, the characteristics of the Project site and surrounds and the legislative framework under which the proposal is permitted.

Specialist studies have been undertaken to ensure careful evaluation of the Project and associated impacts in order to avoid, where possible, serious or irreversible damage to the environment. Specialist studies relating to noise, traffic, cultural heritage, biodiversity, hazard and risk, hydrology and flooding, landscape and visual amenity, waste management, bush fire management have been conducted. Additional issues including visual amenity, flooding and waste management have also been addressed.

The various consultation activities that have been undertaken (see **Section 6**) and the engagement of suitably qualified and experienced specialist consultants have ensured that the environmental impact assessment phase of the proposal has been transparent. The contents of this EIS (including appendices), combined with the consultation activities, has enabled Reach Solar to understand the potential implications of the Project, and therefore identify appropriate mitigation measures and management strategies.

9.5 Intergenerational Equity

Intergenerational Equity is centred on the concept that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations. There is a moral obligation to ensure that today's economic progress, which will benefit both current and future generations, is not offset by environmental deterioration.

The Project would not diminish long term ecological or agricultural productivity, biological resources or future land use options for the Yarrabee Park site. At the end of the operating life of the Project, the site would be decommissioned, and all above ground infrastructure would be removed to restore former land use potential, agricultural productivity, future land use and planning options at the site. Soil values would be maintained and restored where necessary to ensure that the Project does not impact the future soil capability at the site.

The Project would provide environmental benefit through the development of a renewable energy source that has the potential to reduce the reliance on fossil fuel energy sources such as coal fired power stations. The Project provides diversification of energy sources to the electricity grid, reducing the reliance on fossil fuel/non-renewable energy sources. Increasing the availability of renewable energy sources such as the Yarrabee Solar project supports the Federal and State government's policies and renewable energy targets in order to reduce the impact of climate change on future generations. Unlike non-renewable energy sources such as fossil fuels, the Project relies on a renewable energy source i.e. solar, which would not emit carbon dioxide, airbourne particulates or other pollutants.

The management measures outlined in **Section 8** of this EIS would effectively mitigate the environmental and social impacts of the Project, ensuring that current and future generations can enjoy equal and equitable access to social, environmental and economic resources.

At the end of its operational life, the Project would not leave a legacy of environmental issues such as contaminated waste, and the site would not require extensive site remediation to achieve its existing site capacity or land use.

9.6 Conservation of Biological Diversity and Ecological Integrity

The principle of Conservation of Biological Diversity and Ecological Integrity holds that the conservation of biological diversity and ecological integrity should be a fundamental consideration for development proposals.

The assessment undertaken and reported in this EIS includes a relevant evaluation of the existing environment and the likely impacts as a result of the Project. It has been concluded that the Project is highly unlikely to impact upon the current biological diversity and ecological integrity of the site and surrounding environment. Points to note in this regard include:

- Construction of the Project would not require the removal of native vegetation or threatened species habitat, and all woodland areas would be retained.
- Impacts on fauna habitat would be restricted to the removal of aquatic habitat at each of the dam sites and modification of agricultural land that provides low quality foraging habitat for a narrow selection of common fauna species. Given that resident fauna populations are likely to utilise these areas as part of a wider network of habitats, the Project is likely to have minimal adverse impacts on these species.
- Avoidance measures and mitigation measures have been presented in Section 7.2.1, to reduce the potential for indirect impacts to biodiversity values that will be retained within the Project site. These measures are relevant to both the construction and operational phases of the Project.

9.7 Improved Valuation, Pricing and Incentive Mechanisms

The principle of Improved Valuation, Pricing and Incentive Mechanisms requires that environmental factors be included in the valuation of assets and services. The cost associated with using or impacting upon an environmental resource is seen as a cost incurred to protect that resource.

To date there are few widely accepted methods by which monetary values are attributed to environmental factors. In terms of the Yarrabee Solar Project, the Project owner will bear the costs associated with the avoidance, minimisation, mitigation and management of potential environmental and social impacts. These costs have been incorporated into the capital investment and operating costs of the Project.

The Project optimises the valuation and pricing of natural resources by producing a source of power that is renewable, non-polluting, can off-set fossil fuel power generation and maintains the integrity of the site for future agricultural land use.

9.8 Analysis of Alternatives

An analysis of the alternatives is provided in **Section 4.3.** An analysis of possible alternatives and options for the Project has determined that the Project provides the best option for Reach's objective of achievement renewable energy generation and supply whilst avoiding and minimising environmental, social and economic impacts.

9.9 Summary of EIS findings

The key findings of this EIS are:

- The Project is permissible and meets planning requirements, including those pertaining to the EP&A Act and relevant planning instruments.

- The environmental impacts associated with the Project not expected to be significant, would be generally minor, highly localised, capable of mitigation or offsetting and mostly confined to the construction phase.
- Given the proximity to the existing 330 kV Wagga Wagga to Darlington transmission line, connection to the electricity grid will require minimal additional disturbance.
- The environmental impacts of the Project are expected to be reversible and would not result in any permanent loss of land use potential or reduce future land and resource use options.
- The Project will provide the existing Yarrabee farm operation with a "weather proof" income that is expected to significantly increase the long-term sustainability of the agricultural activities on the site;
- The Project will use technology best suited to the site and the network requirements. Solar PV technologies are continuously improving. The Project will look to utilise the best available technologies to enable greater efficiency and output.
- the Project potentially includes an energy storage facility which would regulate inputs in the electricity network and assist in reducing limitations associated with intermittent solar generation.
- The Project would offer a range of community benefits relating to electricity supply, economic activity, as well as local and regional employment opportunities.

9.10 Conclusion

This EIS has been prepared to support a State SSD application by Reach Solar for the construction and operation of the Yarrabee Solar Project.

The purpose of this EIS is to assess, and propose mitigation measures for, the environmental and social implications of proceeding with the Project. This EIS has also been prepared in accordance with the SEARs and agency comments, issued by the DPE on 20 April 2018, and outcomes of community and stakeholder consultation.

The Project has been assessed as a permissible development for which consent is grants as an SSD under Section 89E of the EP&A Act. The Project comprises of 900 MWac solar photovoltaic renewable energy, potentially including energy storage, to be located approximately 23 kilometres (km) southwest of Narrandera in Western NSW. The 900MWac of renewable electricity would be generated through the conversion of solar energy (radiation) to electricity via photovoltaic modules.

The main impacts of the Project would include:

- Construction phases (18 months with a possible 6 month overlap between phases)
  - Intermittent construction noise and traffic from vehicles entering and existing the site, as well as machinery being used at the site, which may affect local resident and road users; and
  - Increased demand on social infrastructure, retail and services including accommodation, supermarkets and health services.
  - Of the twenty five Aboriginal heritage sites identified within the Project site, six are located on an existing access track and liable to be harmed by the Project (three totally impacted and three partially impacted). All remaining sites are outside the impact footprint but will require management measures to ensure that they are not inadvertently impacted.
- Operational Phase (30 – 50 years)

- Minor visual and landscape character impacts, which may affect the closest resident to the site.
- Temporary loss of agricultural cropping land at Yarrabee Park, which would be offset by an alternate income stream generated through the leasing of the Project site land.

The EIS presents a comprehensive assessment or the associated planning and environmental issues to a level that is commensurate with the scale of the Project, the characteristics and current agricultural use of the site, and the legislative framework under which the Project is to be assessed and determined.

The key benefits likely to result from the Project include:

- Income generation for the landholder of Yarrabee Park from the lease arrangements for the Project site. The Project site will occupy a maximum of 2,600 hectares of the 11,326 hectares of the Yarrabee Park property. This diversification of income for the landowner will provide them with the opportunity to further invest in the agricultural production for the remaining farm areas. Following decommissioning, agricultural activities including the existing cropping practices could recommence as the project is not expected to have any long term impacts on the existing land capability.
- Additional agricultural production opportunities may arise in terms of managing sheep during the solar project's operation.
- An increase in local employment opportunities for local and regional communities as the Project will require up to 450 staff during construction and between 10 to 15 permanent staff with a further 10 staff required on an ongoing (permanent) basis for specialist contract work, e.g. inverter maintenance, panel replacement, panel cleaning, vegetation management, fencing. Other operational and maintenance activities will be performed by contractors.
- The Project will bring more than $1Bn of direct investment into the NSW economy depending on the MW capacity constructed.

It has been demonstrated through this EIS that the proposal will not result in significant impacts to the environment through the implementation of management and mitigation strategies. Therefore the development is considered an appropriate use for the Project site, has positive social and economic benefits for the local and regional area, and is the interest of the public, environment and sustainability.

Reach SOLAR ENERGY

SECTION **10**

REFERENCES

10 REFERENCES

Aboriginal Cultural Heritage Consultation Requirements for proponents (DECCW 2010b) (ACHCRs).

AS/NZS 2676.1 *Guide to the installation, maintenance testing and replacement of secondary batteries in buildings – Vented cells.*

AS/NZS 3000 *Electrical installations (known as the Australian/New Zealand Wiring Rules)*

AS/NZS 4777.1 *Electrical Grid connection of energy systems via inverters –Installation requirements*

AS/NZS 4777.1 specifies the electrical and general safety requirements for inverter energy systems connected to the grid at low voltage. It covers the requirements for connection of an inverter to an energy source, including battery storage. Such requirements include connections, cabling, overcurrent protection and isolation devices.

A draft standard AS/NZS 5139 *Electrical installations – Safety of battery systems for use with power conversion equipment*, has been released for public comment/submissions – a final release date has not yet been announced

AS/NZS 5139 aims to cover any type of battery connected to an inverter system, with provisions for mitigating hazards associated with battery energy storage system installation and a classification of batteries based on their potential hazards (not simply their chemistry type).

Australian Soil Classification (ASC) System (Isbell, 2002).

Australian Rainfall and Runoff 2016 (ARR 2016) guideline, http://book.arr.org.au.s3-website-ap-southeast-2.amazonaws.com/#b1_ch6_e_fismf.

Austroads *Guidelines for Sealed Pavements*

Battery install guidelines for accredited installers (CEC 2017).

Battery Energy Storage Systems - A guide for Electrical Contractors (WA DoC 2017).

Code of Practice for the Investigation of Aboriginal Objects in New South Wales (Code of Practice; DECCW 2010).

Cook, Lauren and Richard McCuen, *Hydrologic Response Of Solar Farms* | Journal Of Hydrologic Engineering | Vol 18, No 5. 2013

ENA Policy Statement on Electric and Magnetic Fields, adopted by the ESAA Board in 1991 and reconfirmed by the ENA EMF Committee, March 2006.

FAA, *"Technical Guidance for Evaluating Selected Solar Technologies on Airports"*, Federal Aviation Administration, Washington, D.C., November 2010.

FAA, *"Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports"* Federal Register, Oct. 23, 2013

Flood Studies for the Towns of Urana, Morundah, Boree Creek, Oaklands and Rand, Jacobs, November 2017

Guidance Note 6, Community Stakeholder Engagement – Draft Environmental Impact Assessment Guidance Series June 2017

Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011).

IEC 62109-1 *Safety of Power Converters for use in Photovoltaic Power Systems – Part 1 General Requirements*

IEC 62109-2 *Safety of Power Converters for use in Photovoltaic Power Systems – Part 2 Particular Requirements for Inverters.*

Intergovernmental Panel on Climate Change (IPCC) *Fifth Assessment Report* (2013)

Large-scale solar the hottest ticket in town, Clean Energy Council, 27 February 2018. https://www.cleanenergycouncil.org.au/news/2018/February/large-scale-solar-hottest-ticket.html

Lyall & Associates, 2015, *Narrandera Flood Study Review and Levee Options Assessment*

Lyall and Associates 2015, *Sturt Highway Upgrade West of Narrandera, Flood Study Review and Impact Assessment of Highway Upgrade Options*, May 2015, prepared for NSW Roads and Maritime Services

Managing Urban Stormwater: Soils and Construction, Volume 1, 4th Edition (Landcom 2004), known as "The Blue Book", and Volume 2A Installation of Services (DECC 2008a).

Murrumbidgee River at Narrandera: *Narrandera Flood Study Review and Levee Options Assessment,* Lyall & Associates, October 2015

Narrandera Shire Economic Development Strategy 2017- 2020. Narrandera Shire Council, www.narrandera.nsw.gov.au

NSW Department of Planning and Environment, Guideline for the Preparation of Environmental Management Plans (2004).

NSW Department of Planning and Environment, Division of Resources & Geoscience's MinView application, https://minview.geoscience.nsw.gov.au/#/?bm=bm1&z=6&lat=148.9143431&lon=-32.6560775

NSW Government SEED database. https://datasets.seed.nsw.gov.au/dataset/acid-sulfate-soils-risk0196c

NSW Rural Fire Service (RFS) website in May 2018, https://www.rfs.nsw.gov.au/

NSW Rural Fire Service (RFS), *"Planning for Bush Fire Protection"* (2006)

NSW Rural Fire Service (RFS), *"Planning for Bush Fire Protection"*, Draft Issued April 2017.

NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft) (DEC 2004).

Nutall, K., Flanagan, P. and Melik, G., *"Prudent Avoidance Guidelines for Power Frequency Magnetic Fields"*, 23rd Annual Conference of the Australasian Radiation Protection Society, 1998;

Page, K, Kemp, J & Nanson, G 2009, *'Late Quaternary evolution of Riverine Plain paleochannels, southeastern Australia'*, Australian Journal of Earth Sciences, vol. 56, pp. S19-S33

State of Energy Report, May 2017. Australian Energy Regulator.

Tesla - refer https://www.tesla.com/en_AU/powerpack

The Blueprint for the Future Security of the National Electricity Market, commissioned by the Department of Energy and Resources (Cwth).

The Clean Energy Australia Report 2016, Clean Energy Council. www.cleanenergycouncil.org.au

Renewable energy employment hits new peak, and the best is yet to come, Ecogeneration.

http://www.ecogeneration.com.au/renewable-energy-employment-hits-new-peak-and-the-best-is-yet-to-come/. 21 May 2018.

The Reach Solar website (www.reachsolarenergy.com.au)

The Riverina Murray Regional Plan 2036, http://www.planning.nsw.gov.au/~/media/Files/DPE/Plans-and-policies/riverina-murray-regional-plan-2017.ashx, May 2018.

TransGrid 2017 Annual Report, https://www.transgrid.com.au/news-views/publications/transmission-annual-planning-report/Documents/Transmission%20Annual%20Planning%20Report%202017.pdf

Transmission Strategy and Use of Energy Zones, NSW Government.
https://www.energy.nsw.gov.au/legislation-and-policy/energy-zones

4631.0 – Employment in Renewable Energy in Activities, Australia, 2016-17. Australian Bureau of Statistics (ABS), 24 May 2018. http://www.abs.gov.au/ausstats/abs@.nsf/mf/4631.0.