Glenellen Solar Farm Environmental Impact Statement

Glenellen Solar Farm Pty Ltd

1300 646 131
www.ecoaus.com.au

DOCUMENT TRACKING

Project Name	Glenellen Solar Farm Environmental Impact Statement
Project Number	20ARM - 15523 (previously 18ARM – 10726)
Project Manager	Robert Cawley
Prepared by	Eliza Biggs, Andrew Butler, Bethany Lavers, Linden Burch, Mark Southwell and Robert Cawley
Reviewed by	Daniel Magdi and Robert Cawley
Approved by	Daniel Magdi
Status	**Final**
Version Number	**v3**
Last saved on	**16 October 2020**

This report should be cited as 'Eco Logical Australia. (2020). *Glenellen Solar Farm Environmental Impact Statement*. Prepared for Glenellen Solar Farm Pty Ltd.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from CWP Renewables and Trina Solar.

SUBMISSION OF AN ENVIRONMENTAL IMPACT STATEMENT (EIS)

State Significant Development: Section 4.12 (8).

EIS Prepared by:

Name:	Daniel Magdi
Qualifications:	Bachelor of Landscape Management and Conservation
Address:	Level 3, 101 Sussex St. Sydney NSW 2000
In Respect of:	Eco Logical Australia Pty Ltd
Development Application:	SSD 9551
Applicant Name:	Glenellen Solar Farm Pty Ltd (ACN 54 619 967 636; ABN 54 619 967 636)
Applicant address:	c/- Addsum Accountants Pty Ltd 109 Pitt Street, Sydney NSW 2000
Lot No. DP No. **Land to be Developed:**	Glenellen Solar Farm, 4 km NE of Jindera NSW. The Project Site will also be taken to include any Council or Crown land, Crown waterways or any road reserves, contained within the Development Footprint. See Figure 4-1.

Lot	DP	Lot	DP	Lot	DP
3	411022	27	753342	1004	1033823
3	1190444	101	791421	1	588720

ENVIRONMENTAL IMPACT STATEMENT

This Environmental Impact Statement (EIS) assesses the potential environmental impacts associated with the proposed Glenellen Solar Farm in accordance with the Secretary's Environmental Assessment Requirements, issued to the proponent on 14 September 2018.

I certify that I have overseen the preparation of the contents of this Statement and to the best of my knowledge:

- It has been prepared in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*
- It contains all available information that is relevant to the environmental assessment of the development to which the statement relates
- The information contained in this Statement is neither false nor misleading.

Signature:	D. Magdi
Name:	Daniel Magdi
Date:	16 October 2020

Contents

Appendices

List of Figures

List of Tables

Abbreviations

Abbreviation	Description
µT	Microtesla
AC	Alternating Current
ACHA	Aboriginal Cultural Heritage Assessment
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
ANZECC	Australian and New Zealand Environment Conservation Council
ARPANSA	Australian Radiation Projection and Nuclear Safety Agency
APZ	Asset Protection Zone
ASRIS	Australian Soil Resource Information System
BAM	Biodiversity Assessment Method
BAMC	Biodiversity Assessment Method Credit Calculator
BESS	Battery Energy Storage System
BC Act	*Biodiversity Conservation Act 2016*
BC Regulation	*Biodiversity Conservation Regulation 2017*
BDAR	Biodiversity Development Assessment Report
BFSA	Bush Fire Safety Authority
Biosecurity Act	*Biosecurity Act 2015*
BoM	Bureau of Meteorology
BOS	Biodiversity Offset Strategy
BPL	Bushfire Prone Land
BSAL	Biophysical Strategic Agricultural Land
C	Construction
CCTV	Closed-circuit Television
CEEC	Critically Endangered Ecological Community
CHL	Commonwealth Heritage List
CLM Act	*Crown Lands Management Act 2016*
CMA	Catchment Management Authority
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSP	Community Strategic Plan
CWPR	CWP Renewables Pty Ltd
D	Decommissioning

Abbreviation	Description
DA	Development Application
DAWE	Department of Agriculture, Water and the Environment
DC	Direct Current
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DoEE	Department of the Environment and Energy
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment
Draft ISP	Draft 2020 Integrated System Plan
DTM	Digital Terrain Model
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
ELA	Eco Logical Australia Pty Ltd
ELF	Extremely Low Frequency
EMF	Electromagnetic Field
EPA	Environmental Protection Agency
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection Licence
ERP	Emergency Response Plan
ESD	Ecologically Sustainable Development
ESP	Exchangeable Sodium Percentage
FDI	Fire Danger Index
FM Act	*Fisheries Management Act 1994*
GDE	Groundwater Dependent Ecosystems
GSF	Glenellen Solar Farm
GSG	Great Soil Group
Hazardous Waste Act	*Hazardous Waste (Regulation of Exports and Imports) Act 1989*
HEC-RAS	Hydrologic Engineering Center's River Analysis System
Heritage Act	*Heritage Act 1977*
HGL	Hydrogeological Landscapes
HV	High Voltage
Hz	Hertz

Abbreviation	Description
IAL	Important Agricultural Land
ICNG	DEEC Interim Construction Noise Guideline
INP	*NSW Industrial Noise Policy for Industry 2017*
IPC	Independent Planning Commission
IPCC	Intergovernmental Panel on Climate Change
ISEPP	*Infrastructure State Environmental Planning Policy 2007*
JSF	Jindera Solar Farm
KFH	Key Fish Habitat
Koala SEPP	*State Environmental Planning Policy (Koala Habitat Protection) 2019*
kV	Kilovolt
LCU	Landscape Character Unit
LEP	Local Environment Plan
LGA	Local Government Area
LLS Act	*Local Land Services Act 2013*
LSC	Land and soil capability
LSPS	Local Strategic Planning Statement
mbgl	metres below ground level
MNES	Matters of National Environmental Significance
MV	Medium Voltage
MVPS	Medium Voltage Power Station
MW	Megawatt
NDC	Nationally Determined Contribution
NEM	National Electricity Market
NHL	National Heritage List
NHMRC	National Health and Medical Research Council
NPW Act	*National Parks and Wildlife Act 1974*
NRAR	Natural Resources Access Regulator
NSR	Noise Sensitive Receiver
NSW	New South Wales
O	Operation
O&M	Operation and maintenance
OEH	Office of Environment and Heritage
PBP	*Planning for Bush Fire Protection*
PCT	Plant Community Type
PCU	Power Conversion Unit

Abbreviation	Description
PEA	Preliminary Environmental Assessment
PHA	Preliminary Hazard Analysis
POEO Act	*Protection of the Environment Operations Act 1997*
The Proponent	Trina Solar Pty Ltd
PTNL	Project Target Noise Levels
PV	Photovoltaic
PVHI	Photo-Voltaic Heat Island
RAP	Registered Aboriginal Parties
RBL	Rating Background Level
RE Act	*Renewable Energy (Electricity) Act 2000*
RET	Renewable Energy Target
REZ	Renewable Energy Zones
RFFE	Regional Flood Frequency Estimation Model
RFS	Rural Fire Service
RMS	Roads and Maritime Services
Roads Act	*Roads Act 1993*
RSWMP	Regional Strategic Weed Management Plans
SAII	Serious and Irreversible Impacts
SAT	Single Axis Tracking
SDGs	Sustainable Development Goals
SDS	Safety Data Sheet
SEARs	Secretary Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SEPP(SRD)	*State Environmental Planning Policy (State and Regional Development) 2011*
SEPP 33	*State Environmental Planning Policy No. 33 – Hazardous and Offensive Development*
SEPP 55	*State Environmental Planning Policy No. 55 – Remediation of Land*
SSD	State Significant Development
SU	Survey Units
TEC	Threatened Ecological Community
UNEP	United Nations Environment Programme
VRZ	Vegetated Riparian Zone
WARR Act	*Waste Avoidance and Resource Recovery Act 2001*
WM Act	*Water Management Act 2000*
ZVI	Zone of Visual Impact

Executive Summary

INTRODUCTION

This Environmental Impact Statement (EIS) has been prepared for Trina Solar (Australia) Pty Ltd (Trina Solar) on behalf of Glenellen Solar Farm Pty Ltd (the 'Proponent') to support a Development Application to build and operate a utility-scale photovoltaic (PV) solar farm near Jindera. Glenellen Solar Farm (GSF) is located within the Greater Hume Shire Local Government Area (LGA) 20 km north of Albury in the south western slopes part of the New South Wales (NSW) Murray Region.

GSF was originally proposed by CWP Renewables Pty Ltd (CWPR) on behalf of Glenellen Solar Farm Pty Ltd. The concept was sold to Trina Solar in early 2020. Trina Solar are a long-established worldwide provider of photovoltaic systems and solutions. The company has over two decades of renewable energy development experience and offices in NSW, with key development activities coordinated from the NSW base in Sydney.

THE PROPOSAL

Fully constructed, the GSF (the 'Proposed Development') is expected to have an electricity generation capacity of approximately 200 megawatts (MW_{AC}) at the point of connection, producing enough renewable energy (400 GWh) to power the equivalent of 94,899 average NSW households each year (based on a representative household consumption of 4,215 kilowatt hour (kWh) per annum: Australian Energy Market Commission, 2019).

In addition, the electricity generated by the Proposal would result in significant carbon savings due to the electricity displaced from the current National Electricity Market (NEM) generation mix, which is heavily reliant on coal powered generation. Based on 2019-20 Scope 2 emission figures for the NEM of 0.82 kilograms (kg) of CO_2-equivalent per kWh, approximately 328,000 tonnes of CO_2 would be displaced by the Proposed Development annually (Department of Environment and Energy, 2019), providing progress towards the State's, as well as national and international environmental commitments.

The Proposed Development would include, but not necessarily be limited to, the following elements:

- Solar arrays: solar PV panels supported by a mounting system[1] with a maximum height of 5 m above natural ground at maximum tilt installed on piles driven, screwed, drilled and stabilised with a cement mix or ballasted to the ground
- Power Conversion Units (PCU's) inclusive of Inverters/Rectifiers, Ring Main Units, Medium Voltage (MV) and/or High Voltage (HV) step-up Transformers located throughout the Proposed Development

[1] The mounting system will be a SAT arranged north-south. A SAT system tracks the daily movement of the sun and motorised linkages rotate the modules from the east in the morning to the west in the afternoon, constantly aligning towards the sun to maximise energy output performance. The modules are laid out in rows, typically referred to as arrays, approximately 4 to 16 m apart depending on the technology used. The racking system will be supported by steel piles, typically comprised of C-section or I-section beams which are driven into the ground or otherwise placed in bored holes and secured in place with concrete, stabilised sand or other backfill material.

- Collector systems: above and/or below ground onsite cabling and electrical connections between the grid connection substation and collector substations and between the substations and the respective PCU's
- Road safety upgrades
- Operation and maintenance (O&M) building including workshop, warehouse, offices, ablutions, and carpark
- Site access and onsite access tracks
- Fencing and security system
- Meteorological stations
- Vegetation buffers for visual screening
- Asset Protection Zones (APZ) containing category 1 fire track.

In addition to the key components outlined above, there would be a temporary construction compound and material laydown areas required to facilitate the construction, upgrading and decommissioning phases of the Proposed Development.

The final scale and capacity of the Proposed Development would be optimised within the Development Footprint during post-consent studies based on a combination of the most suitable technology at the time of procurement, along with detailed geotechnical and grid connection studies.

It is anticipated that the Proposed Development would take approximately 12 to 18 months to construct and would be operational over an initial term for approximately 30 years. It is anticipated that the Proposed Development could extend for a further term depending on market and commercial circumstances.

It is expected that upgrading or repowering of the PV modules and ancillary equipment may be required throughout, or to extend, the operational life of the project. This will be a commercial decision made at the time based on the relative economics of solar PV generation compared to alternatives. Decommissioning and restoration would occur at the end of the operational life of the Proposed Development. As such, initial planning consent for the Proposed Development is sought for 30 years to cover two full terms of operation and associated construction, upgrading and decommissioning periods.

STATUTORY POSITION

The Proposed Development has a capital investment value estimated to be approximately $250 million and is classified as State Significant Development (SSD) under Clause 20 of Schedule 1 of the *State Environmental Planning Policy (State and Regional Development) 2011*.

The Proposed Development is sited on land zoned as RU1 Primary Production under the *Greater Hume Shire Local Environmental Plan 2012* (Greater Hume Shire LEP). Pursuant to clause 34(7) of the *State Environmental Planning Policy (Infrastructure) 2007*, development for the purpose of a solar energy system may be carried out by any person with consent on any land (except land in a prescribed rural residential zone).

Solar farms are considered an appropriate development within the region as solar farming does not permanently remove the land from future agricultural uses and supports employment in rural areas.

Additionally, the proposed development also fits with the Council's vision to introduce sustainable new industries to the region that directly respond to the threat of climate change. At the same time, the development will not prejudice surrounding rural productive activities which are considered an asset to the area.

Therefore, the Proposed Development is permissible with consent.

The NSW Minister for Planning is the consent authority for SSD applications. This Environmental Impact Statement has been prepared in accordance with the requirements of Division 4.7 of the *Environmental Planning & Assessment Act 1979* (EP&A Act), Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* and the Secretary's Environmental Assessment Requirements, dated 14th September 2018.

COMMUNITY AND STAKEHOLDER CONSULTATION

Trina Solar has revisited and expanded upon the extensive consultation CWPR carried out with the local community, stakeholders from the wider area and relevant Government Agencies in order to understand and respond to community concerns during the design and assessment process leading to this Development Application.

- Activities that have taken place are listed below:
- Identification and consultation (ongoing) with host landholders and neighbouring residents
- Community newsletter distributions
- Consultation with the Aboriginal community through the preparation of a Cultural Heritage Assessment
- TransGrid consultation
- 2 to 5 km radius Neighbour engagement meetings
- Local Government consultation – including information workshop for elected Councillors
- State Government consultation
- Meetings with Regional Rural Fire Service Command
- Website information (www.glenellensolarfarm.com.au)
- Media coverage at the local, regional and national scale.

Consultation activities remain ongoing at the time of preparing this EIS.

ENVIRONMENTAL ASSESSMENT

In designing the Proposed Development, the following hierarchy has been adopted in order to manage potential environmental impacts:

1. Avoid – in the first instance, all efforts will be made to avoid potential environmental impacts

2. Minimise – where potential impacts cannot be avoided, design principles shall seek to minimise environmental impacts, as far as feasibly possible

3. Mitigate – mitigation strategies will be implemented to manage the extent and severity of remaining environmental impacts

4. Offset – environmental offsets shall be used only as applicable, following all efforts to first avoid, minimise and mitigate environmental impacts.

This EIS has been undertaken to assess potential environmental impacts for a range of issues identified through the consultation process and site investigations. All potential environmental constraints associated with the Site have been identified and are responded to within this Environmental Impact Statement.

Biodiversity

As the Proposed Development is a SSD, the impacts of the Proposed Development on biodiversity must be assessed according to the Biodiversity Assessment Method (BAM) established under section 6.7 of the NSW BC Act. Therefore, a Biodiversity Development Assessment Report has been prepared to assess the impacts to biodiversity, propose mitigating and ameliorating options, and calculate offsets for residual unavoidable impacts.

The current GSF Development Footprint has considered the biodiversity values known to occur within the Site, and has where possible avoided areas of native vegetation, threatened species, and their habitats. In particular, the project has avoided (where possible) areas of Threatened Ecological Communities (TECs) and known threatened species habitats. The GSF Development Footprint has reduced through each iteration of design to provide a final footprint that:

- Co-locates with the grid connection point infrastructure;
- Locates panel arrays within areas of cultivation
- As far as practicable avoids drainage lines, high quality vegetation, and known threatened species records.

The Development Footprint is currently used for agricultural purposes and has been substantially cultivated. There are patches of retained native woodland scattered throughout, as well as scattered remnant paddock trees. Approximately 96.71% of the Development Footprint is considered cleared agricultural land, with only 3.29% of the Development Footprint occupied by poor condition native vegetation. The Proponent is committed to leaving existing boundary tree and minimising removal of trees within the solar farm footprint, as far as practicable.

There are native remnant trees throughout the Development Footprint within pasture improved and cultivated paddocks. There are two plant community types (PCTs) were identified within the Development Footprint which occur in varying condition states / vegetation zones:

- PCT 277: Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion. This PCT was stratified into three vegetation zones based on three condition classes (grazing / exotic pasture, planted vegetation and low condition). PCT 277 has also been selected as the likely PCT for the mapped paddock trees (vegetation zone 5)
- PCT 9: River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion. This PCT contained one condition class and has been stratified into a single vegetation zone

Targeted threatened flora surveys were conducted for *Pilularia novae-hollandiae* (Austral Pillwort) and targeted threatened fauna surveys were conducted for the *Callocephalon fimbriatum* (Gang-gang Cockatoo), *Crinia sloanei* (Sloane's Froglet), *Petaurus norfolcensis* (Squirrel Glider), *Phascolarctos cinereus* (Koala), *Polytelis swainsonii* (Superb Parrot), *Hieraaetus morphnoides* (Little Eagle), *Lophoictinia isura* (Square-tailed Kite) and *Haliaeetus leucogaster* (White-bellied Sea-eagle).

Avoidance measures to minimise impacts to biodiversity have been proposed, including siting of the project, alternative options, as well as methodologies to minimise impacts during construction and operation of the project. Following consideration of minimisation methods, the offsetting requirement for the residual unavoidable impacts of the Proposed Development were calculated using the Biodiversity Assessment Method Credit Calculator (BAMC) in accordance with the BAM.

A total of 138 ecosystem credits are required to offset the unavoidable impacts of the project. This included 129 credits of PCT 227 and 9 credits of PCT 9. A total of 25 species credits are required to offset the unavoidable impacts to *Myotis Macropus* (Southern Myotis) and *Pilularis novae-hollandiae* (Austral Pillwort).

A Biodiversity Offset Strategy (BOS) will be developed to acquire and retire the full quantum of credits as required by the BAMC.

Heritage

The process of Aboriginal community consultation has been undertaken in accordance with the Heritage NSW, Department of Premier and Cabinet's (Heritage NSW) *Aboriginal Cultural Heritage Consultation Requirements for Proponents*. The study has sought to identify and record Aboriginal cultural areas, objects or places, assess the archaeological potential of the Site and formulate management recommendations based on the results of the community consultation, background research, field survey and a significance assessment.

A search of the Heritage NSW Aboriginal Heritage Management Information System (AHIMS) was conducted on 3 August 2018, yielding ten Aboriginal sites for a broad search area that included the Site. A second AHIMS database search was undertaken on 20 May 2020, yielding a total of 47 Aboriginal sites for the same search area. A field assessment was conducted on 25, 26 and 27 September 2018. The Site was found to contain three discrete distributions of stone artefacts.

Most heritage evidence is highly valued by Aboriginal people given its symbolic embodiment and physical relationship with their ancestral past. The archaeological significance of the recorded Aboriginal artefacts in the Site were determined to be of low local significance.

Due to the low cultural and archaeological significance of the Site, no further archaeological investigations are required. However, mitigation against impacts to the three stone artefact sites in the form of community collection with the Aboriginal community is recommended, in order to avoid unmitigated impact to the artefacts present across the Site.

The historic heritage assessment was undertaken in accordance with the *NSW Heritage Manual*, specifically the guidelines *Assessing Significance for Historical Archaeological Sites and 'Relics'*, and with reference to the Burra Charter (the Australian ICOMOS Charter for Places of Cultural Significance).

Database searches identified 16 registered heritage items within 5 km from the Proposed Development. The Proposed Development will not have any direct or indirect impacts on known historic heritage items. It is unlikely any items of historic significance remain unidentified within the Site, however, an unexpected archaeological finds procedure will be adopted and included in site induction processes and toolbox talks.

Land

The Site is located in a predominantly flat landscape, where elevation ranges between 200 – 220 m Australian Height Datum (AHD), with a small rise in the centre of the Site. The gradient of the slopes within the Site range from broad sloping plains to gently undulating hills. The Site has been historically cleared for livestock grazing and cropping production and is typical of farmland in the region. A number of stock dams have been developed across the Site. A considerable portion of the Site has been cultivated for improved pasture and cropping (these areas are prioritised for the solar farm development). Surrounding land uses include agriculture, residential and utilities. There are no mining leases or exploration licences over the Site.

The Development Footprint contains Important Agricultural Land (IAL) under the Draft Riverina-Murray Important Agricultural Land Mapping Program. No areas of high agricultural value have been mapped as Biophysical Strategic Agricultural Land (BSAL) within or in vicinity of the Site. No critical industry clusters have been mapped in the region.

The Proposed Development would have a life span of up to 30 years and would not involve permanent changes to the landscape. The scale of the Proposed Development would not compromise or significantly diminish the availability of land for primary production purposes within the LGA. Furthermore, the Proposed Development would not compromise the capacity for immediate neighbours to conduct existing or proposed primary production and, following the end of the Proposed Development's life span, the land can be returned to its pre-development use.

This Environmental Impact Assessment identifies a series of environmental controls and measures to ensure that land resources are protected from adverse impacts.

Visual

The Proposed Development has a relatively confined area of visibility due to level topography and areas of remaining woody vegetation. The Site is generally most visible from the cleared paddocks to the north east and elevated areas to the south east. Views from these locations are generally buffered by distance and vegetation. The Site has approximately 3 km of direct road frontage to Ortlipp Road and the Drumwood Road. Topography and vegetation in adjoining public areas naturally obscures potential views of the Site. Distant views and glimpses of the Site are possible from Blight Road East, Walla-Walla-Jindera Road, Dights Forest Road, Urana Road, Lindner Road, Glenellen Road, and Gerogery Road.

The overall impact of the Proposed Development on the rural landscape character is assessed as Low.

Zone of Visual Impact analysis using a digital surface model that incorporated screening effects of the existing vegetation and built structures outside of the Development Footprint indicates that some part of the Proposed Development is potentially visible from 52 of the 277 identified receptors within 5 km of the Proposed Development. Of these 52, seven are located within 2 km of the Proposed Development and 45 between 2 km and 5 km of the Proposed Development.

Public viewpoints within 5 km of the Site are restricted to public roads.

There is currently one other proposed commercial scale PV solar farm in the planning stages of development to be located 490 m north west from the GSF Development Footprint. Based on the low levels of visual impact associated with GSF and the proponents ongoing commitment to consult with significantly impacted landholders, it is anticipated that there is limited potential for significant views of the Proposed Development and any other solar farm development.

Mitigation measures including ongoing stakeholder consultation and potential landscaping strategies have been developed, where necessary, to provide low or insignificant visual impacts at all identified receptors. The proponent's visual screening commitments are modelled to reduce the number of potentially impacted residences and greatly reduce visual impacts to the receptors adjacent to the Proposed Development by using locally native vegetation plantings. Post-decommissioning, the continuation of agricultural production and removal of all above-ground infrastructure results in an insignificant residual visual impact.

Noise

The Proposed Development is located within a rural landscape and, background noise sources and levels are considered to be low, typical of the rural setting. Twenty-two residences, including two involved residences, are located within 1 km of the Development Footprint.

Acoustic modelling uses a worst-case prediction scenario to assess the maximum possible noise impact where it is assumed that all noise-generating construction machinery are being operated concurrently at the nearest part of the Development Footprint to each respective receiver. While maximum impact will only be for a short duration until the activities move to a different location, assessing the maximum impact ensures the right mitigation methods are implemented. The worst-case modelling indicates that the ICNG Noise Management Level of 50 dB(A) would be exceeded during the noisiest construction tasks (under worst-case atmospheric, meteorological and ground attenuation conditions) for 8 non-associated residences all located within 550 m of the Development Footprint. The period of time during which the exceedance could occur at any particular receiver will be a very small proportion of the overall 18-month construction period and occur only during unfavourable climatic conditions when the construction activities are at the edge of the Development Footprint closest to that particular receiver. The ICNG highly noise affected limit of 75 dB(A) is not exceeded at any residences even during the noisiest construction tasks because there are no receivers located less than 40 m from the boundary of the Development Footprint.

Noise impact from operational activities is predicted to be insignificant.

Mitigation measures are provided to further reduce potential impacts during all project phases.

Transport

The Proposed Development is located 7 km west of the Hume Highway (M31) and the main general access to the Site will be via the existing Ortlipp Road (upgraded as outlined). The proposed haulage from the Hume Highway to the Site during construction is via the Olympic Highway, Gerogery Road, Glenellen Road, Walla Walla Jindera Road (Southbound), Lindner Road and Ortlipp Road from the south. This route avoids heavy vehicle traffic through Jindera. The proposed main Site access point will be located along where Ortlipp Road flanks the western boundary of the Site, near the existing access point adjacent to the substation.

Drumwood Road on the south eastern boundary of the Site and Lindner Road to the south western boundary is not planned for use by heavy construction plant and vehicles, however may be used for light vehicles and utilities used for daily transport by site workers, as well as an emergency egress route for the project – subject to the final drafting of the project emergency management plan. Along the proposed haulage route, the intersection between Hume Highway and Olympic Highway is a seagull intersection and the intersection of Olympic Highway and Main Street (Gerogery Road) is a T-intersection with Olympic Highway as the major road. All other intersections within the vicinity of the Site are priority controlled.

Daily traffic flows recorded on the Hume Highway are well within the capacity of the road, leaving ample spare capacity to accommodate additional traffic. Existing traffic flows on the local roads within the vicinity of the Site are negligible in comparison to the Hume Highway.

Material deliveries will depend on day to day operational requirements. Heavy vehicles into the site are estimated to be up to 50 vehicles per day during construction activities (during a timeframe of up to 18 months). There is potential that peak truck movements could be as high as 60 to 100 vehicles in some situations such as due to weather delays, logistical delays, where the construction schedule pace is increased, or where a particular campaign or workfront requires a higher frequency of truck movements for a shorter duration. The construction traffic will consist of low loader trailers, truck and dog, A-double trucks, B-double trucks and waste collection trucks. Overall non-material delivery related construction traffic movements during construction will be up to 40 light vehicles and 13 buses daily. It is expected that two construction personnel would share a single light vehicle, however car-pooling and use of buses will further reduce these daily movements. Additional vehicle movements associated with the operational phase (up to 10 vehicles per day) are considered negligible.

Water

The Proposed Development is located within the upper alluvial area of the Murray River, part of the Upper Murray River Catchment. The Proposed Development occurs in the area covered by the *Water Sharing Plan for the Murray Unregulated and Alluvial Water Sources*. The Site is located within the Murray River above Hume Weir Water Source.

All channels in the vicinity and within the Site are heavily influenced by in-channel farm dams and significantly modified riparian vegetation. The channels were dry during field investigations and appear to be largely ephemeral with minimal bank delineation and limited riparian vegetation. As such they resemble broader watercourses in grass-covered paddocks, rather than streams with defined bed and banks.

Permanent water within the Site is dominated by farm dams. Riparian vegetation and the riparian zone generally throughout the study area are degraded, having been cleared, grazed, sown and modified to support agricultural activities. The streams lack aquatic vegetation and are dominated by terrestrial grasses. Habitat within the Site is generally unsuitable for threatened aquatic species.

Surrounding groundwater levels within the fractured rock aquifer are moderately deep, and range between approximately 54.8 metres below ground level (mbgl) north east of the Site, and 21.9 mbgl south of the Site.

While some portions of the Site are flood prone, hydrological modelling indicates that the Proposed Development is unlikely to significantly influence flood risks under existing conditions and future climate change scenarios.

The Proposed Development has been designed to minimise impacts to water resources, and the following environmental protections apply:

- Exclusion of 3rd order streams from the Development Footprint (except internal access across Kilnacroft and Dead Horse Creeks)
- Application of a 20 m (from stream thalweg) buffer zone for 3rd order and higher riparian zones
- Minimisation of creek crossings for within site access and electrical cabling
- Localised scour protection around building pads
- Sourcing of non-potable water from existing onsite farm dams, rainwater tanks, or Kilnacroft and Dead Horse creeks, under existing Greater Hume Shire Council licence conditions
- Sourcing from offsite all potable water requirements.

The Proposed Development could potentially result in impacts to surface water quality. A suite of mitigation measures shall be incorporated into Environmental Management Plans for each of the construction, operational and decommissioning phases of the project. These mitigation strategies include:

- Sediment and erosion controls in accordance with *Managing Urban Stormwater: Soils and Construction, Volume 1, 4th edition*, known as 'the Blue Book'
- Pollution controls
- Material storage and handling protocols
- Accidental spill response strategies
- Adherence to best practice for creek crossings.

Hazards and Risks

Hazards and risk assessments considered, bushfire and electrical fire and electromagnetic interference.

Potential fire risk associated with the Proposed Development would include:

- Machinery movement in long grass
- Hot work activities, including welders and grinders
- The storage of waste and combustible materials onsite
- Storage of flammable liquids
- Electrical faults
- Lightning strikes

- Cigarette butts disposed of carelessly on-site and from cars travelling along roads.

Mitigation measures, in accordance with the revised draft *Planning for Bushfire Protection 2019* guidelines, are proposed to reduce and manage the risk of fire, and to reduce the impact of any fires within or surrounding the Proposed Development. The mitigation measures encompass the following considerations:

- Design principles
- Access and Firebreaks
- Fuel reduction
- Fire Management and Emergency Response Plan
- Safety protocols.

Existing potential sources of electromagnetic interference within the vicinity of the Site include two 330 kV and two 132 kV TransGrid transmission lines and one 22 kV distribution line. There is also an existing TransGrid 330/132/22 kV substation located on the Site.

Electromagnetic fields generated during operation of the Proposed Development would depend on the type and size of electrical equipment on site and whether potential sources of electromagnetic fields are overhead or buried. However, predicted electromagnetic levels are such that potential exposure on site would be below the NHMRC's Interim Guidelines on limits of exposure. In limiting exposure to electromagnetic fields, following advice from the International Commission on Non-Ionizing Radiation Protection, priority would be given to engineering and access controls so that:

- The final design of the Proposed Development would be undertaken by qualified and competent persons
- Design would meet relevant Australian standards, ensuring electromagnetic fields would be minimised as far as possible
- Access to electrical equipment would be limited to qualified personal only.

To reduce the potential for chronic or acute exposure to electromagnetic fields, no unsupervised public access to the Proposed Development would be permitted. Electromagnetic fields are considered likely to be indistinguishable from background levels at the boundary of the Proposed Development so pose no risk to the general public and would not impact on any electrical devices.

Waste

Key resources required for the Proposed Development include gravel, sand, metal, glass, silicon and water. The supply of these materials is not currently limited or restricted, and the likely quantities required by the Proposed Development are unlikely to place significant pressure on necessary resources.

In order to encourage the efficient use of resources and reduce environmental impacts, resources and waste would be managed according to the following hierarchy:

1. Reduce waste production
2. Recover resources (including reuse, reprocessing, recycling and energy recovery)
3. Dispose of waste appropriately.

Waste would be classified in accordance with the NSW EPA *Waste Classification Guidelines – Part 1: classifying waste* and *addendum*, and if required disposed of lawfully at a licensed waste facility. A Waste Management Plan would be prepared in consultation with local Councils and other stakeholders, in order to meet the hierarchy set out above. The objectives, protocols and responsibilities within it would be communicated to all staff and contractors through a Site induction process and ongoing training. Specific waste management measures would be incorporated into a Waste Management Plan for each phase of development.

Socio-economic

The socio-economic and environmental benefits of developing renewable energy sources, and transitioning to a low carbon future are large, providing potential benefits to entire communities and helping to maintain quality of life in the longer term. Increased adoption of renewable energy sources will assist Australia and NSW to transition away from traditional carbon intensive energy production which is linked to atmospheric pollution and changes to climatic conditions with the potential to increase risks of drought, fire and floods. Reduced carbon emissions have the potential to reverse or slow the effects of climate change, benefitting current and future generations – particularly those in farming regions.

Glenellen Solar Farm will help NSW achieve its target of net zero carbon emissions by 2050 by increasing the amount of clean energy available in the State's electricity grid.

Electricity produced from the Site provides a clean power source for local and regional consumers in a cost-effective manner. The Proposed Development would produce clean renewable energy to the local electricity transmission network, providing enough energy to power up to 94,899 average NSW homes each year. This would reduce up to 328,000 tonnes of CO_2 per annum through the displacement of conventional electricity supply.

Solar provides opportunity to 'value-add' to the existing Greater Hume economy by creating higher earning employment opportunities, offering opportunity for local skills development and enabling agricultural practices to continue on the site, even during operations.

This is particularly the case during the construction period. Construction will take 12 to 18 months and up to 200 staff will be required. The construction and decommissioning stages of the Proposed Development will generate the largest economic gain for the greatest number of people and businesses in adjoining Local Government Areas. This is due to the hiring of a large temporary work force over these periods. Employment opportunities would involve surveying, engineering, concreting, earthworks, steel works and electrical cabling during construction, with demolition and removal during decommissioning. Other supplementary services, like fencing, telecommunications, vegetation management, meals, fuel, security, transport and cleaning will also be required – and are best sourced locally to improve the economics of the project.

Where local services cannot be obtained – or supported in their development - additional workers from outside the region would stimulate the local economy through demand for accommodation, hospitality and retail services. A temporary influx of staff may lead to a small, but temporary, increase in pressure on local services, including accommodation. The relatively long lead up to construction from the point of project approval however, would allow the Proponent to work with key stakeholders such as Council and other providers to ensure the local economy is geared to supporting this temporary influx.

Landowners directly involved in hosting the Project will experience a temporary reduction in agricultural production and therefore incomes from agricultural activities during construction and operation of the GSF. This loss of income will be appropriately offset by the rental income generated from the land lease arrangements for all associated landowners and therefore localised negative economic impacts will be avoided. Additionally, diversification of farm income will provide the host landholders with a long-term, secure alternative income stream as well as the opportunity to further invest in agricultural production activities of the remaining portions of the farms not leased for renewable energy purposes.

It is not anticipated that GSF would have any adverse impacts on tourism given its limited visibility and the general positive attitude of Australians towards renewable energy and solar developments. Elsewhere, solar farms, as well as other renewable energy projects are being used as a tourism drawcard.

When operations of the GSF cease, it is required the site is returned to agricultural use. During Operations the site will be managed to ensure the quality of the land is preserved for farming to resume at some point in the future.

Cumulative Impacts

Other major and renewable energy projects within the vicinity include:

- Jindera Solar Farm (130 MW) – NSW DIPE decision pending
- Walla Walla Solar Farm (300 MW) – 21 km N. More information required for DPIE assessment
- Hume Battery Energy Storage System (capacity of 20 MW / 40 MWh) – 22 km SE. Preparing EIS
- Howlong Sand and Quarry Expansion –25 km W. Response to Submissions
- Wodonga Solar Farm, Victoria (54 MW) – 26 km SW. Approved
- Culcairn Solar Farm (400 MW) – 27 km NNE. NSW DIPE decision pending
- Corowa Solar Farm (27 MW) – 45 km W. Approved
- Wangaratta Solar Farm, Victoria (20 MW) – 66 km SW. Approved.

For all other identified projects, besides Jindera Solar Farm, the combined effect of temporal and spatial separation between GSF and other developments occurring, or proposed to occur, in conjunction with project specific mitigation measures are considered appropriate to satisfactorily mitigate most potential cumulative impacts. In addition to the subject-specific mitigation measures established that prevent and minimise potential impacts from the GSF, measures to further mitigate potential cumulative impacts with Jindera Solar Farm if approval of both solar farm projects is granted may also be employed. These include consultation with Jindera Solar Farm Pty Ltd and contractors to ensure potential cumulative impacts relating to traffic volumes and accommodation availability are managed accordingly and to ensure adequate temporal and/or spatial separation of noise impacts if the construction periods for GSF and Jindera Solar Farm overlap.

ENVIRONMENTAL MANAGEMENT

Environmental Management Plans would be prepared to provide an overall framework for the management of environmental impacts that could potentially arise during each stage of the Proposed Development.

The Proposed Development would be designed, constructed, operated and decommissioned in accordance with the requirements of:

- Relevant legislation
- Conditions of consent
- Commitments provided in this EIS.

PROJECT JUSTIFICATION

Residual risks following the application of mitigation strategies identified in this EIS are shown to be generally low or medium, and can be reasonably managed. The reasons for justifying the Proposed Development are demonstrated within this EIS and accord with environmental, social and economic considerations, as well as the principles of Ecologically Sustainable Development.

CONCLUSION

Environmental impacts associated the construction, operation and decommissioning of the Proposed Development are compliant with the requirements for SSD under the EP&A Act and other relevant State and Commonwealth legislation. Potential environmental impacts are relatively minor and can be appropriately managed through the application of identified mitigation strategies and ongoing stakeholder consultation. Potential benefits associated with the Proposed Development are a substantial reduction in greenhouse gas emissions, reduced reliance on non-renewable energy sources diversification of agricultural enterprise within the district, and positive socio-economic outcomes for the community and Local Government Region. On this basis the Proposed Development is strongly justified.

1. Introduction

1.1 Purpose of this document

This Environmental Impact Statement (EIS) has been prepared for Trina Solar (Australia) Pty Ltd (Trina Solar) on behalf of Glenellen Solar Farm Pty Ltd (the 'Proponent') to support a Development Application (DA) to build and operate a utility-scale photovoltaic (PV) solar farm at Glenellen, near Jindera. The proposed Glenellen Solar Farm (GSF) is located within the Greater Hume Shire Local Government Area (LGA) 20 km north of Albury in southern New South Wales (NSW). The proposal is expected to have an electricity generation capacity of approximately 200 megawatts (MW_{AC}), producing enough renewable energy to power the equivalent of 94,899 average NSW households each year.

The Proposed Development has an estimated capital value of c. $250 million. Under the *State Environmental Planning Policy (State and Regional Development) 2011* (SEPP(SRD)), electricity generating works (including solar) that have a capital investment value of more than $30 million are classified as "State Significant Development" (SSD) and require approval under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) through the preparation of an EIS.

As such, this EIS has been prepared under Part 4 of the EP&A Act, in accordance with the Secretary's Environmental Assessment Requirements (SEARs), dated 14 September 2018 (Appendix A), and the requirements of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation).

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Matters of National Environmental Significance (MNES) are protected. The EPBC Act requires approval for significant impacts upon MNES to be approved by the Commonwealth Minister for the Environment. The potential for impacts to MNES are considered throughout this EIS, in accordance with the SEARs, and the likely significance of potential impacts are presented in Section 6.2.1.

1.2 Project Overview

The Proposed Development would generate electricity through the conversion of solar radiation to electricity using PV panels laid out across the Site in a series of modules, mounted on steel racking with piled, screwed or ballasted supports. Other infrastructure on Site would include electrical power conversion units, underground and/or above ground electrical cabling, telecommunications equipment, operations/maintenance building (including amenities and storage facilities), vehicular access and parking areas, along with perimeter security fencing and gates.

The Proposed Development will connect to the existing TransGrid Substation located at Ortlipp Road.

1.3 Project Setting

The Proposed Development is located on land within the Greater Hume Shire LGA, 4 km north east of Jindera in the south western slopes part of the NSW Murray Region (Figure 1-1). It is located within the Murray River catchment and drains to Hume Weir. The Proposed Development is situated on a Site that contains 398.4 ha of largely cleared agricultural land currently used mostly for grazing with some cultivation. Critical electricity infrastructure – in the form of an electrical substation – already exists on the Site. Land agreements have been negotiated with the two host landowners (excluding the TransGrid substation, whereby connection agreements are underway). In addition, access arrangements are in progress with Crown and Council in relation to unformed road parcels located within the Site and a Crown lands permit under the *Crown Lands Management Act 2016* (CLM Act) has been sought from the NSW Department of Industry – Crown Lands.

Development Approval is sought for 30 years, with post operational activities to include the decommissioning of the GSF and returning of the Site to a suitable condition to allow the resumption of agricultural activities.

Surrounding land use is primarily agricultural, with associated rural dwellings comprising two involved residences and non-involved residences, totalling 110 within a 2 km radius of the Site. Consultation with adjoining residents and land holders for the purposes of the Proposed Development has been ongoing from inception of the proposed solar development.

Through the extensive and ongoing consultation process, the Proponent has agreed to a number of commitments developed in response to direct feedback from adjoining landholders and aimed at reducing potential impacts on social amenity. These commitments include an increased setback of the Development Footprint from the homes along Lindner Road and Drumwood Road, the commitment to not use Drumwood Road and the eastern part of Lindner Road for construction traffic, the retention of existing perimeter vegetation and visual screening along parts of the Site boundary, and are addressed within Section 7 and Section 8.6.

The inclusion of the existing TransGrid Jindera substation within the central western part of the Site provides the immediate opportunity to co-locate electricity generation with the point of connection to the TransGrid 330 kV network. This connection option will minimise the overall impact of the Proposed Development, while maximising the use of an existing connection asset.

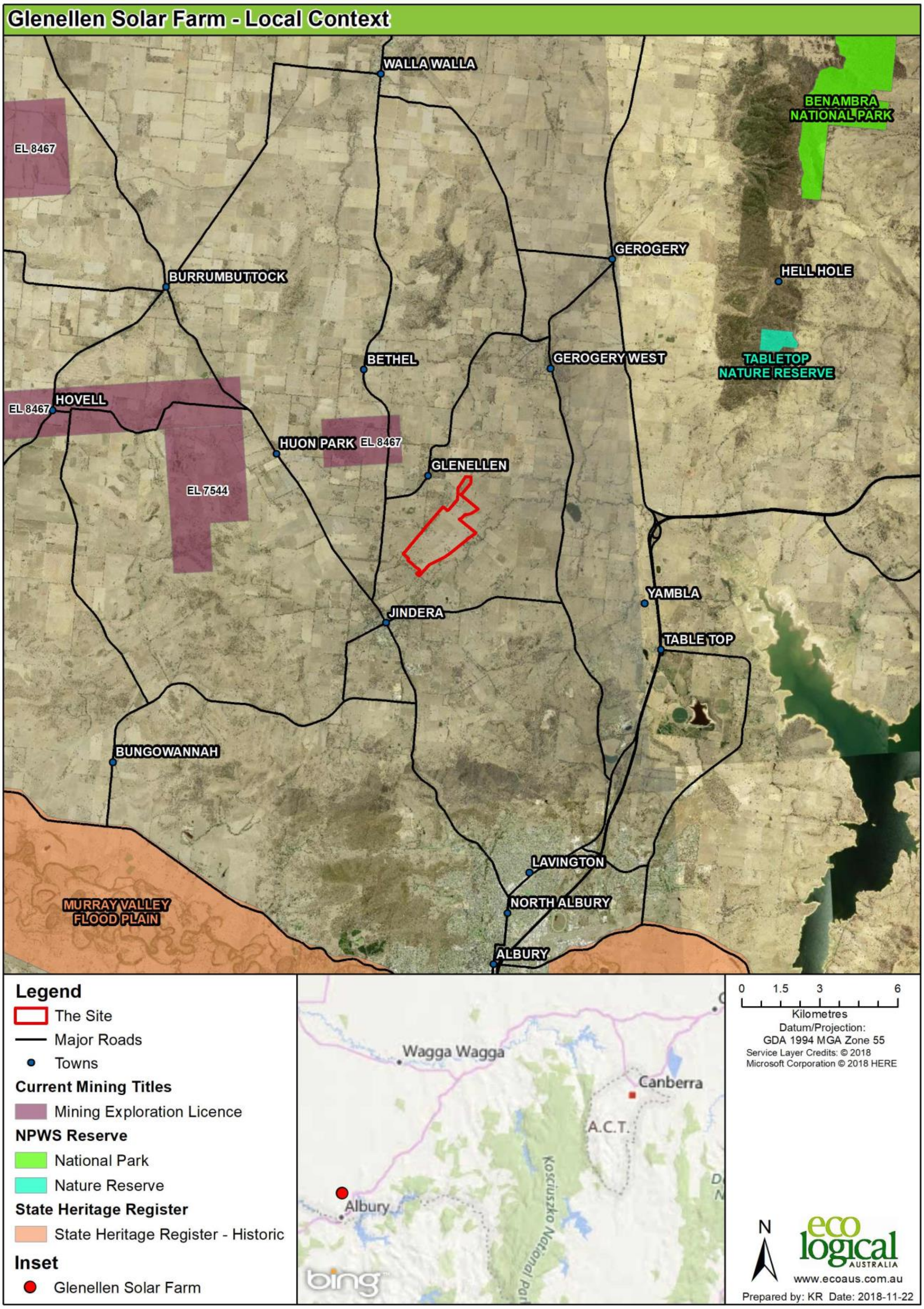

Figure 1-1: Regional Context

1.4 The Proponent

GSF was originally proposed by CWP Renewables Pty Ltd (CWPR) on behalf of Glenellen Solar Farm Pty Ltd. The concept was sold to Trina Solar (Australia) in early 2020.

Trina Solar is one of the world's leading photovoltaic providers and has a strong track record for product innovation and reliability as well as project delivery. Many people know of Trina Solar for its work in installing rooftop solar panels across thousands of homes in Australia.

Trina Solar purchased Glenellen Solar Farm Pty Ltd as a means of acquiring and developing its second solar development in Australia.

Trina Solar's Australian Team is based in Sydney and responsible for the development of utility scale PV Projects through Australia, Asia, New Zealand and the Pacific. Trina Solar brings considerable experience to the development of large-scale solar farms, having managed the delivery of other projects in Europe, the United Kingdom, Asia and South America.

Should it proceed, the GSF will be part of Trina Solar's wider, global portfolio of solar farms at the same time as helping to boost renewable energy output domestically.

2. Alternatives considered

2.1 Do Nothing Scenario

Under the Do-Nothing Scenario, the Proposed Development would not take place, which would negate all potential environmental impacts associated with the Proposed Development, but would forgo all environmental benefits associated with the project, such as:

- Access to renewable energy sources
- Progress towards Renewable Energy Targets (RET) and national and international carbon reduction commitments
- Economic and social benefits to the community
- Biodiversity offsets protected in perpetuity.

Environmental impacts would continue to be consistent with those associated with the current agricultural land use.

2.2 Alternative Locations

In defining GSF as a development opportunity, the Proponent

has evaluated a range of other sites across the National Electricity Market (NEM) for both wind and solar generation opportunities, which may be considered as alternatives to the Proposed Development. Some of these sites are being progressed as they are deemed appropriate developments; other prospective sites have been considered but discarded owing to a range of reasons. The GSF Site is a unique circumstance where the consideration of alternative locations is marginalised by the opportunity to co-locate solar electricity generation with an existing connection asset.

To be effective, solar must be developed close to areas where there is customer demand for energy. This location provides ready access to the growing regional population of Greater Hume, as well as business and industry in Sydney and Melbourne. The option to connect directly into the local electricity transmission system accentuates this benefit.

Land north of Jindera was initially chosen as the preferred location for the Proposed Development due to the opportunity to co-locate the development with the existing TransGrid substation and connection point. The outcomes of the environmental assessment indicate the suitability of the Site for the Proposed Development.

Further decisions around alternative design with regard to the GSF will be made post-approval during detailed design, with a view to minimising environmental and social impacts while maintaining investment viability; however, this decision-making will occur within the approved Site, rather than at a macro scale (i.e. site identification/selection).

Developing an alternative site may potentially have greater environmental impacts than the current proposal and would forgo connection to the existing capacity within the NEM.

2.2.1 Alternative land use

The current proposal has been developed through a thorough concept development process aimed at maximising potential benefits while minimising environmental impacts. Examples of this approach include:

- Co-locating solar electricity generation with an existing network connection asset
- Designing and locating the Proposed Development in order to minimise impacts on biodiversity, native vegetation and the need for clearing
- Identifying environmental constraints associated with the Development Footprint and developing mitigation strategies to avoid or minimise impacts.

Alternative land uses would potentially forego this environmentally responsible approach to project development and impact minimisation.

2.3 Project Design Principles

While a solar PV project can occupy a large area of land, the on-ground impacts upon that land are relatively minor by comparison to most developments. This aspect is relevant when evaluating potential impacts to land resources and biodiversity through the lens of permanent versus temporary disturbance. The vast majority of the land which is utilised for a solar PV project will only be subject to a temporary disturbance that is returned to its previous condition at the end of construction and then, for the balance of the land, at the end of the operational life of the Proposed Development. This is illustrated through Table 2-1 below.

2.4 Permanent Impacts

A typical 6 MW_{AC} rectangular block of modules on a single-axis tracking (SAT) system would occupy an area of approximately 13.2 ha. Within this area the following materials would typically be installed:

Table 2-1: Permanent Impacts

Item	Quantity	Notes	Permanent on-ground impact (ha)
Tracker row	207	*(Above ground)*	*n/a*
6 MW_{AC} PCU	1	12 m x 2.4 m	0.003
Access track	310 m	4 m wide	0.124
PV module	18,165	*(Above ground)*	*n/a*
Tracker DC cable	207	*(Above ground)*	*n/a*
Combiner box	30	*(Above ground)*	*n/a*
LV and MV Trenches to PCS	620	4m wide	0.25
Piers	2,517	$0.09m^2$ pier	0.03
Total Area			**0.41 ha**

The materials list above shows that of the 13.2 ha of land used to install 6 MW_{AC} of solar PV, only 0.41 ha or ~ 3% of the total land area would be permanently impacted over the life of the project.

Design considerations made throughout this EIS will refine this example 6 MW_{AC} estimation to project-specific circumstances, and moreover include other associated permanent impacts such as vehicular access tracks and operational facilities. Minor augmentation to the existing Substation is also required to accommodate a new switch room and associated connection arrangement, this will occur within the existing enclosed substation compound.

2.5 Temporary Impacts

Temporary impacts which will occur through construction may include the stripping and storage of top-soil for construction of temporary construction roads and trenches, laydown areas for components adjacent to each work front, and the construction compound and amenities buildings facility.

2.6 Agricultural Use (Agrivoltaics / Agri-solar)

Development of the GSF will not permanently remove land from conventional agricultural use, as it will be possible to both produce a clean energy output and operate the Site as an agricultural enterprise. Post construction (i.e. during the operational phase), it is proposed that the balance of land would continue to be used for agricultural purposes such as sheep grazing or even cropping (Figure 2-1), with grasses sown for ground cover and grazing fodder in disturbed areas, resulting in only a minor net change to the existing land-use.

'Agri-solar' is a concept increasingly being used on may sites to maximise output and value of agricultural lands without significant environmental modifications or impacts. To enable this to occur, space allocated between rows of panels will be maximised to allow the coexistence of cropping or grazing of sheep on a rotation basis. Expected panel heights (see Section 4.1.6.1) are sufficient to allow animals to pass freely underneath.

Negotiated arrangements will be established with host Landholders to enable them to have safe access and passage into the solar facility to manage grazing or cropping activity. Dams will be retained onsite to provide water sources for livestock.

An ancillary benefit of utilising agri-solar is the reduction in dry groundcovers and grasses through grazing. Without sheep, weed and pest management would need to be done via alternative means, most likely chemical spraying or more costly mechanical mowing. Fuel reduction through grazing is an added benefit from the perspective of good practice bushfire prevention.

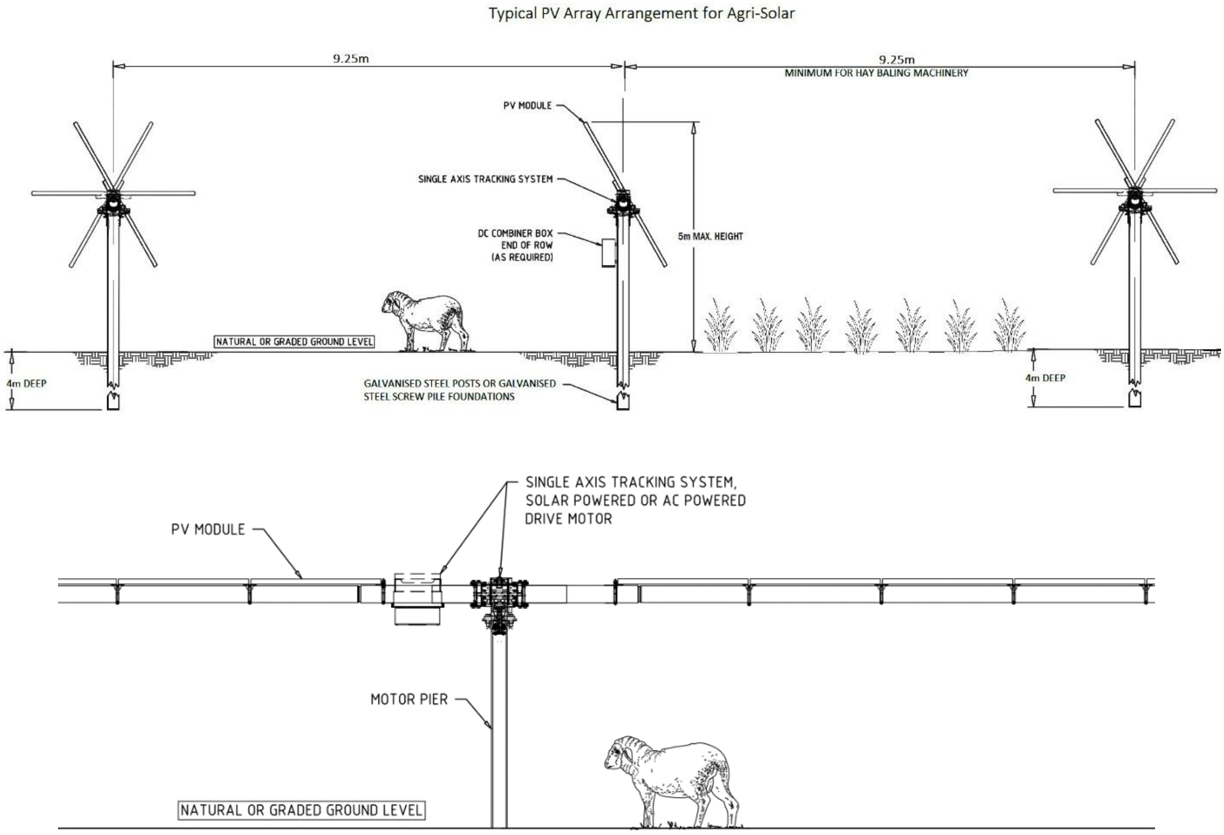

Figure 2-1: Generic Tracking System SAT elevation view showing approximate dimensions (Images courtesy of Zenviron)

2.7 Site Selection

Solar farming is considered a suitable land use for the project's proposed site as it creates a sustainable, long term industry that can operate in harmony with existing agricultural farming practices.

The proposed Site was selected due to its suitability for a solar farm and the limited environmental and social constraints identified. In designing and assessing the potential impacts of the Proposed Development, the following design hierarchy was adopted:

- **Avoid** – in the first instance, all efforts will be made to avoid potential environmental impacts
- **Minimise** – where potential impacts cannot be avoided, design principles shall seek to minimise environmental impacts, as far as feasibly possible
- **Mitigate** – mitigation strategies will be implemented to manage the extent and severity of remaining environmental impacts
- **Offset** – environmental offsets shall be used only as applicable, following all efforts to first avoid, minimise and mitigate environmental impacts.

In addition, the following specific principles were adopted:

- **Minimise vegetation clearing** – areas of high conservation value and/or native vegetation shall be strategically avoided
- **Minimise land disturbance** – solar arrays shall be attached using piles either driven, screwed or ballasted to the ground. Ground disturbance shall be limited to the area of contact between

the pile and the ground. Design footprints for tracks, cable trenches, support buildings, and the substation upgrades shall be limited to the minimum area required

- **Protect functional riparian zones** – higher order (as per Strahler stream ordering) and higher value functional riparian zones shall be excluded from the developable area
- **Use previously disturbed land** – as much as possible the Proposed Development shall be located on land previously modified by agricultural development
- **Protect cultural heritage values** – through the identification and evaluation of cultural heritage assets at the Site
- **Protect agricultural values** – existing agricultural values shall be preserved, and a negotiated lease shall offset forgone landholder income while diversifying income streams for the duration of the project life
- **Minimise direct and indirect impacts** – as far as practicable, infrastructure shall be located away from nearby residences and adjoining properties
- **Adopt a flexible approach to design** – the final project design shall respond to identified environmental impacts and constraints.

2.8 Design Evolution and Constraints

From the outset, the Proposed Development has adopted a methodology to, in the first instance, avoid possible environmental impacts. This design ethic is central to the current proposal and has been adopted at all stages of design. The evolution of the Site and Development Footprint is shown in Figure 2-2 and summarised in Table 2-2 below. The CWPR Development Footprint is shown in Figure 2-3. Figure 2-4 shows the residual constraints and the Proposed Development layout.

Table 2-2: Site and Development Footprint evolution

Footprint	Area (ha)	Comments	Map
Scoping Area	8,722	Land north of Jindera was initially chosen as the preferred location for the Proposed Development due to the opportunity to co-locate the development with the existing TransGrid substation and connection point.	-
Preliminary Study Area	426	The Preliminary Study Area reflected initial site inspections and landholder negotiations.	Figure 2-2
Refined Study Area and	405	The Study Area and the Site were refined further to reduce the development area, reflecting findings made during detailed environmental assessments and in response to community consultations.	
The Site	398.5		
Preliminary Development Footprint	354	Within the Site, a preliminary Development Footprint was proposed which accommodated avoidance areas identified through environmental studies and community consultation.	
CWPR Development Footprint	350	The CWPR Development Footprint excluded areas of avoidance identified during the assessment process. In particular, this Development Footprint included an additional setback of the Project from a neighbouring residence.	
Final Development Footprint	334.2	The Development Footprint represents the final extent of this DA and was formed following further consultation activities undertaken by Trina Solar (Australia). Notable adjustments include allowance for light vehicle and emergency access from Drumwood Road, retaining the existing 22kV line (originally to be re-routed underground), and no longer proposing a Battery Energy Storage System.	Figure 2-3

Footprint	Area (ha)	Comments	Map
Constraints Layer	-	Identifies further constraints within the Development Footprint for consideration during construction and operational phases of the GSF. These additional constraints typically relate to further minimisation of impacts and associated mitigation measures.	Figure 2-4

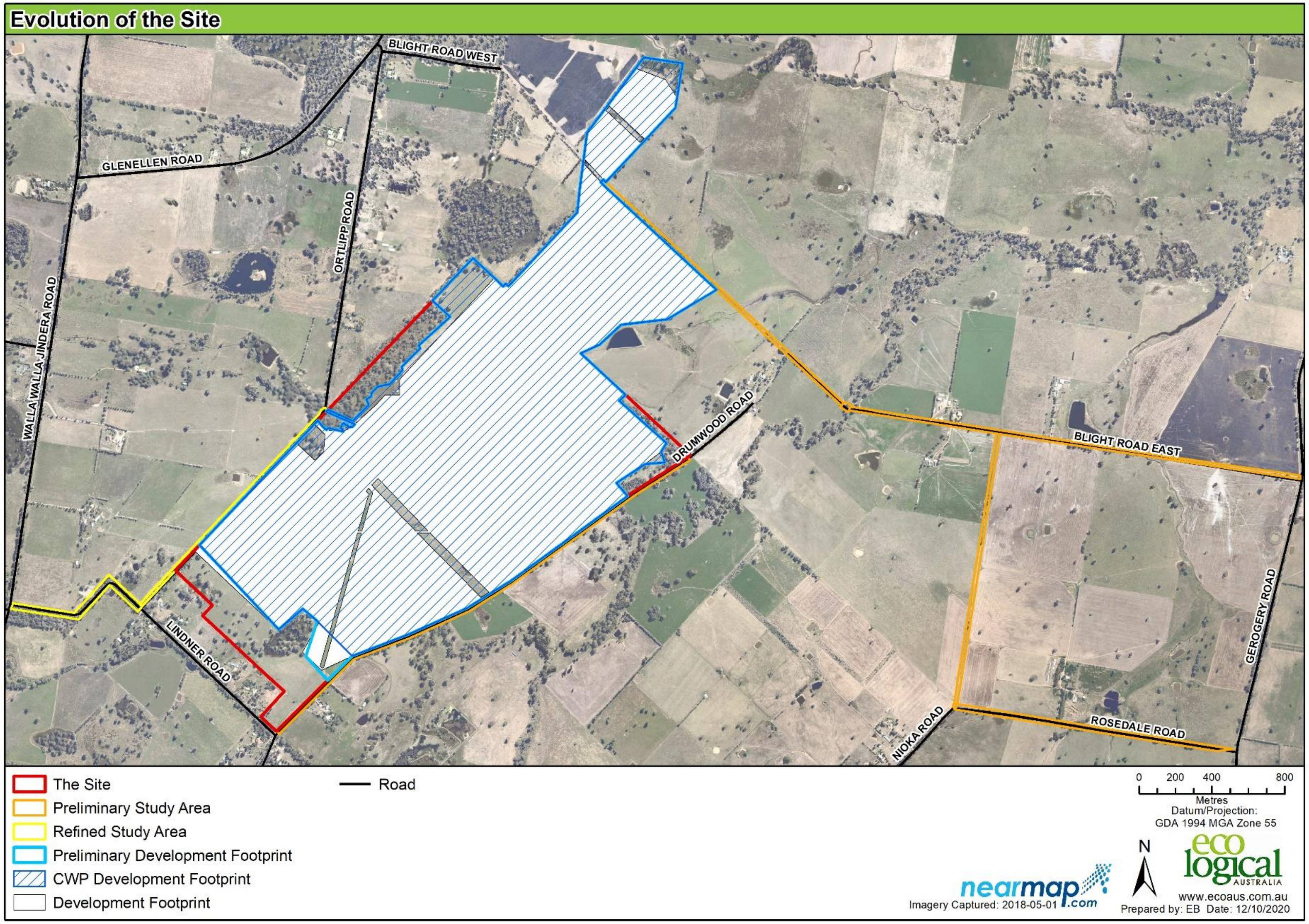

Figure 2-2: Evolution of the Site

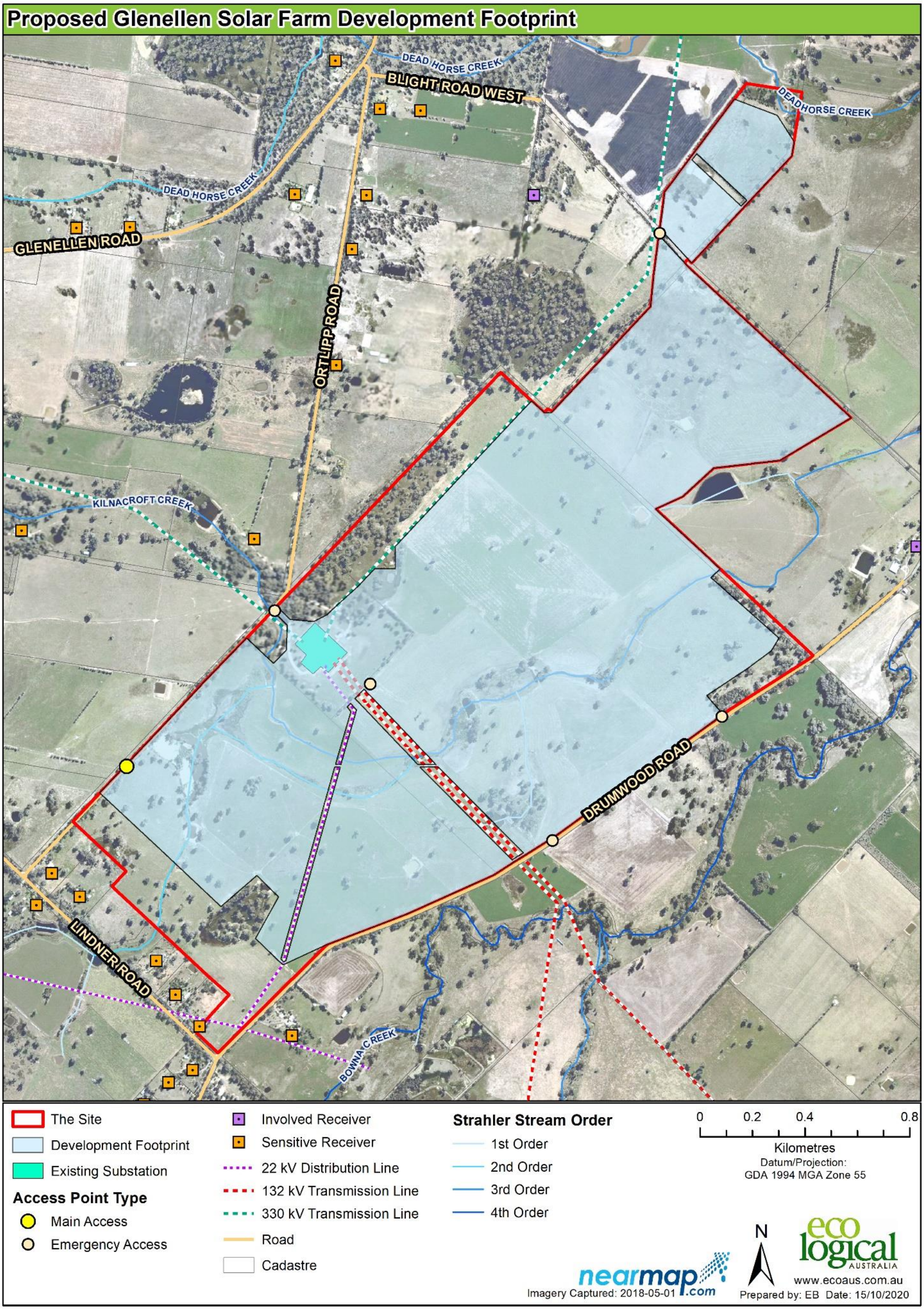

Figure 2-3: The Site and Development Footprint

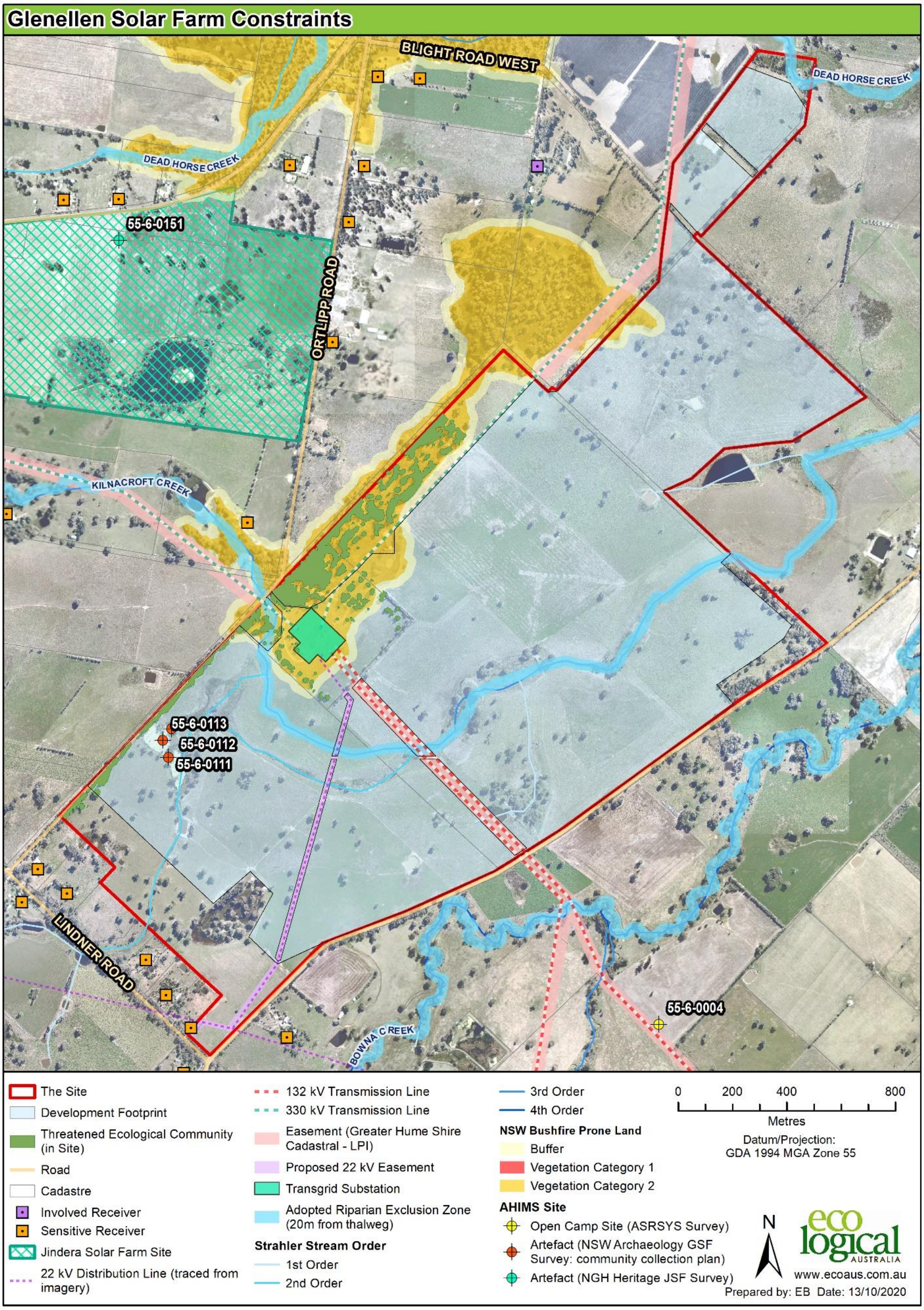

Figure 2-4: Glenellen Solar Farm Site Plan and Constraints Layer

3. Project Justification

3.1 Socio-economic

The construction and ongoing operation of the Proposed Development will provide significant social and economic benefits to the community and wider LGA and provide environmental benefits to populations across NSW.

3.1.1 Economic

The Proposed Development provides direct employment opportunities for up to 200 personnel during the construction period, sourcing workers from a wide range of fields and expertise, including engineers, construction workers and labourers with further employment opportunities associated with supply chains and local goods and services.

The Proposed Development will provide income for the region through capital expenditure and the provision of contracts for ongoing maintenance activities.

It is the intention during operations that grazing could occur underneath and around the solar panel array, allowing a co-use of the land and therefore achieving associated agricultural outputs.

3.1.2 Environmental

Over eighty percent of NSW emissions come from the extraction, processing and burning of fossil fuels, primarily coal. Almost seventy percent of emissions are in the form of carbon dioxide, with methane emissions the next largest form of emissions[2]

Recently, the NSW Government committed to a target of net zero emissions by 2050 to address the impacts of climate change. This reduction target has been set to mitigate or avoid more extreme weather conditions and to reduce the impacts of climate change.[3]

The Proposed Development would reduce carbon emissions by displacing approximately 328,000 tonnes of CO_2 annually (based on current NSW emission figures of 0.82 kg of CO_2-equivilent per kWh), providing progress towards the State's, as well as national and international environmental commitments. Support for developments that deliverable measurable reductions in greenhouse gas emissions now will mitigate risks associated with climate warming and reduce the public cost of transitioning to a net zero emissions economy in the future.

The commitment to decommission the Proposed Development at the conclusion of its operational period and return of the Site to its current state protects the long-term agricultural value of the region.

---

[2] https://climatechange.environment.nsw.gov.au/About-climate-change-in-NSW/NSW-emissions

[3] https://www.smh.com.au/politics/nsw/nsw-to-commit-to-new-emission-reduction-targets-for-2030-20191211-p53izc.html

3.2 Demand for products

Access to electricity is essential for the maintenance and improvement of living standards. Demand for clean, renewable energy sources will continue to grow for the foreseeable future as governments and consumers respond to the threat of climate change and act to actively reduce carbon emissions.

Electricity supply from renewable sources currently provides 21% of the Australian electricity market (Department of Industry, Science, Energy and Resources (DISER), 2020 - https://www.energy.gov.au/government-priorities/energy-supply), and at current, there are sufficient projects approved to meet and exceed the 2020 target for additional renewable electricity under the Australian Government's RET scheme (DISER, 2020 - hthttps://www.industry.gov.au/funding-and-incentives/renewable-energy-target-scheme).

3.3 Mandate

The social, economic and environmental benefits of developing renewable energy projects, and transitioning to a low carbon future are unequivocal, providing potential benefits to entire communities and helping to maintain quality of life. Indeed, increased adoption of renewable energy sources will assist Australia to transition away from traditional carbon intensive energy production which is linked to atmospheric pollution and carbon emissions associated with climate change (Intergovernmental Panel on Climate Change (IPCC), 2018). Reduced carbon emissions have the potential to halt or slow the effects of climate change, benefitting current and future generations.

There is a growing realisation that the environmental impacts associated with the generation of energy through the use of fossil fuels requires serious and urgent mitigation. This realisation has established into international, national and state-wide commitments to support sustainable energy developments. Australia is a signatory to international agreements, conventions and protocols regarding climate change and the reduction of greenhouse gas emissions, including the 2015 Paris Agreement to reduce CO_2 emissions to 26% - 28% below 2005 levels by 2030 (DoEE, 2017). In addition, NSW has committed to an aspirational target of achieving net-zero emissions by 2050 and is following an Electricity Strategy (Department of Planning, Industry and Environment (DPIE), 2019) that recognises the importance of encouraging the deployment of renewables to help replace the States' ageing coal generators. There is a particular focus on solar and wind technologies as these are the cheapest forms of new generation.

The Proposed Development will therefore play an important role in meeting State, national and international commitments, addressing the need for affordable renewable energy projects to assist during the phasing out of centrally located fossil fuel generators, as well as to mitigate impacts associated with global warming and climate change.

3.3.1 Greenhouse Gas Emissions and Climate Change Science

There is global recognition of climate change and global warming due to human activities and the need to mitigate the environmental effects associated with fossil fuel energy generation. The consensus of scientific opinion as presented to world governments by the IPCC is that there is a link between humankind's actions and a variety of climate related issues. Industrialisation and the resultant emissions of greenhouse gases from the burning of fossil fuels have created, and continue to exacerbate, global environmental problems including climate change and global warming.

The most recent IPCC report on Global Warming (IPCC, 2018) has estimated that global surface temperatures are likely to increase by 1.5°C above pre-industrial levels between 2030 and 2052 if it the current rate of global warming is sustained. Human-induced global warming reached approximately 1°C above pre-industrial levels in 2017 (IPCC, 2018) and we are already experiencing the impacts to the climate system such as sustained drought, floods, coral bleaching, extreme weather events, biodiversity loss and sea level rise.

Fossil fuel consumption and industrial processes are the primary drivers behind the rate of carbon dioxide equivalent emissions (Figure 3-1). Central to this is a heavy reliance on coal for electricity production, which is also recognised as having the highest output of carbon dioxide equivalent emissions (Garnaut, 2008).

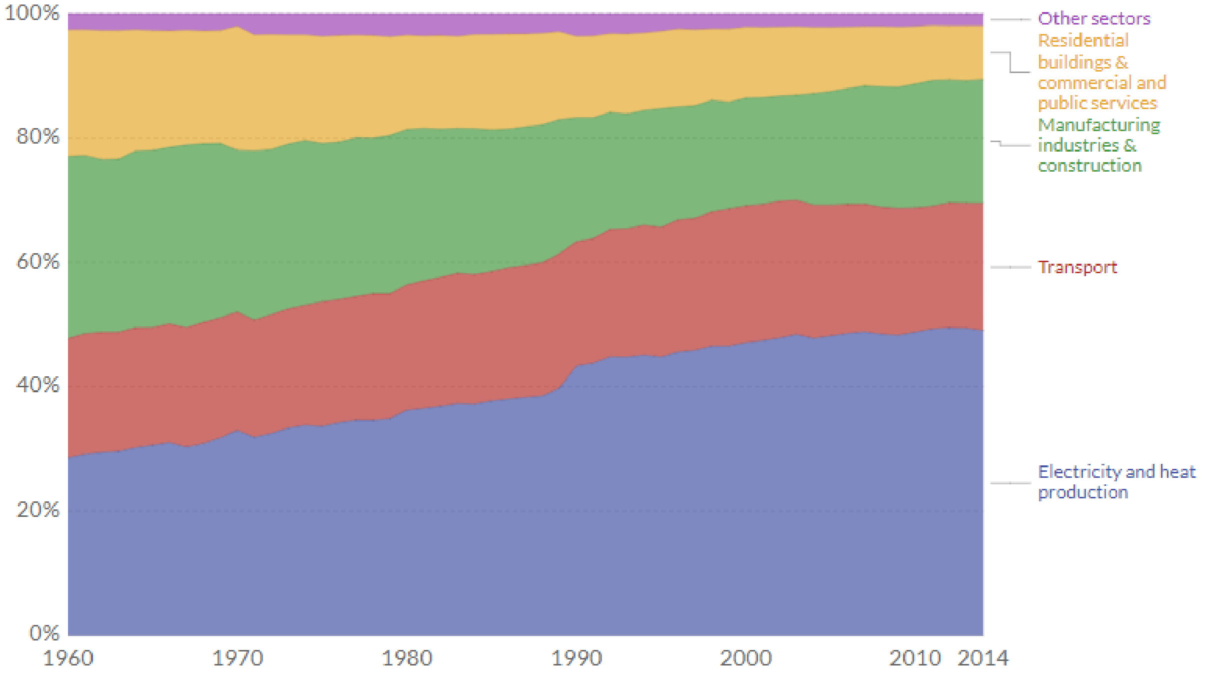

Figure 3-1: Global carbon dioxide (CO_2) emissions by sector or source (OWID, 2019)

Continued and unrestricted emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. Limiting climate change will require substantial and sustained reductions in greenhouse gas emissions which, together with adaptation, can limit climate change risks (IPCC, 2018). The IPCC notes that there are multiple mitigation pathways that are likely to limit warming to below 1.5°C relative to pre-industrial levels. Since the energy sector is the highest emitting, reductions in this sector should be a high priority globally. The IPCC's 'Below 1.5°C mitigation pathways' include a strong increase in primary energy production from renewable sources by 2050 (52-67% supply share), improvements in energy efficiency, as well as a reduction in energy generation from coal (1-7% decrease) (IPCC, 2018).

3.3.2 Current Global Response – The Paris Agreement

The Paris Agreement brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort.

The Paris Agreement central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change. To reach these ambitious goals, appropriate financial flows, a new technology framework and an enhanced capacity building framework is being put in place, thus supporting action by developing countries and the most vulnerable countries, in line with their own national objectives. The Agreement also provides for enhanced transparency of action and support through a more robust transparency framework.

3.3.3 United Nations Sustainable Development Goals

The United Nations 2030 Agenda for Sustainable Development includes a set of 17 interdependent global Sustainable Development Goals (SDGs) to help build a more sustainable and resilient future for all (Figure 3-2). The SDGs are broken down into 169 individual targets to stimulate and measure action towards improving economic, social and environmental sustainability. All countries of the world have agreed to work towards achieving the SDGs by 2030.

Figure 3-2: Interdependent global Sustainable Development Goals (United Nations)

The Project will respond positively to Goal 7 Affordable and Clean Energy and will contribute towards Target 7.2: 'By 2030, increase substantially the share of renewable energy in the global energy mix'. The UN explains:

"Transitioning the global economy towards clean and sustainable sources of energy is one of our greatest challenges in the coming decades. Sustainable energy is an opportunity – it transforms lives, economies and the planet."

The primary function of the Project is to generate renewable energy and increase the amount of renewable energy in Australia's energy mix the project will improve affordability for all. The Project will also contribute towards *Goal 11 Sustainable Cities and Communities* (Target 11.6) by helping to reduce Australia's reliance on power from fossil fuels which will improve air quality and have positive impacts on health and wellbeing.

3.4 Australian Emissions and Response

Australia is one of the highest emitters of greenhouse gas emissions in the world at 16.5 metric tonnes of carbon dioxide equivalent per capita in 2016 (OWID, 2019) (Figure 3-3). Australia's emissions are continuing to increase and for the year to September 2018 emissions increased by 0.9 per cent on the previous year, primarily due to increases in LNG exports and steel and aluminium production (DoEE, 2018).

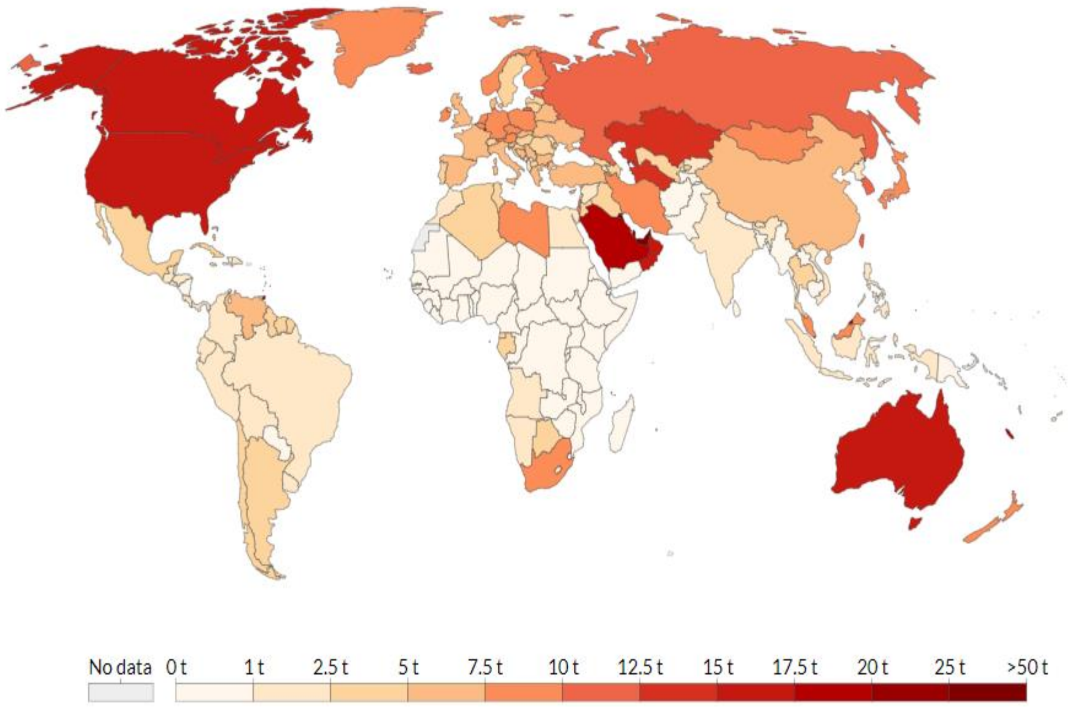

Figure 3-3: Average CO_2 emissions per capita measured in tonnes per year in 2016 (OWID, 2019)

Electricity generation is the largest source of Australia's emissions, accounting for 33.7 % of emissions in the year to September 2018 (DoEE, 2018) (Figure 3-4). Emissions from electricity decreased by 3.2 % on the previous year to September 2018 (DoEE, 2018). Greenhouse gas emissions from the NEM account for around 83% of national electricity emissions (DoEE, 2018).

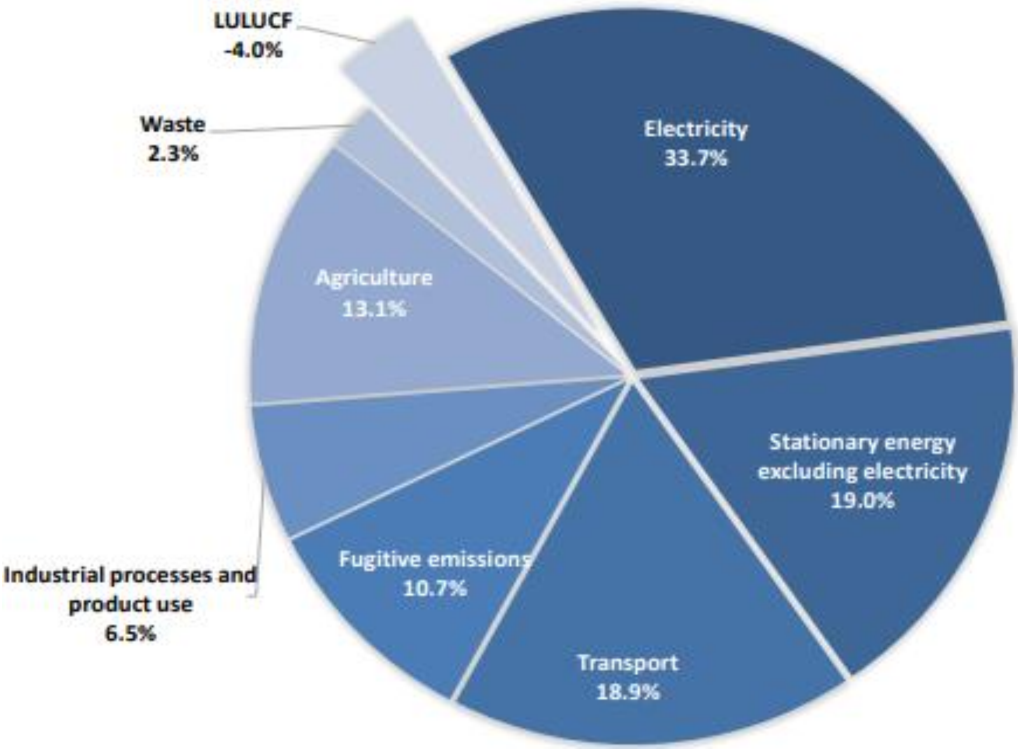

Figure 3-4: Emissions contribution by sector in Australia (DoEE, 2018)

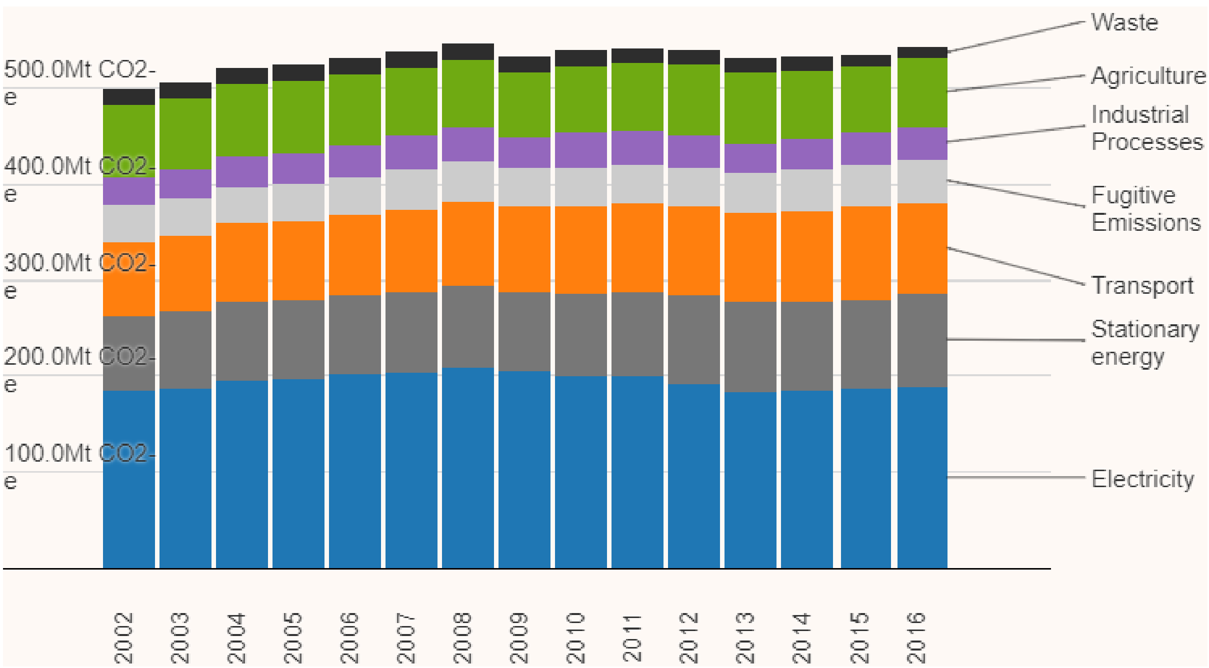

Figure 3-5: Australia's annual greenhouse gas emissions by sector

The State of the Climate 2018 report, published by Bureau of Meteorology (BoM) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), provides the most up-to-date scientific assessment of observed Australian climate changes and causes, and projections for the 21st century. Key studies / projections include (CSIRO & BoM, 2018):

- Australia's climate has warmed by just over 1°C since 1910, leading to an increase in the frequency of extreme heat events and more frequent marine heatwaves
- Sea levels are rising around Australia, increasing the risk of inundation
- The oceans around Australia are acidifying (the pH is decreasing)
- April to October rainfall has decreased in the southwest of Australia. Across the same region May–July rainfall has seen the largest decrease, by around 20 per cent since 1970
- There has been a decline of around 11 per cent in April–October rainfall in the southeast of Australia since the late 1990s
- Rainfall has increased across parts of northern Australia since the 1970s
- Streamflow has decreased across southern Australia. Streamflow has increased in northern Australia where rainfall has increased
- There has been a long-term increase in extreme fire weather, and in the length of the fire season, across large parts of Australia
- Australia is projected to experience:
    - Further increases in sea and air temperatures, with more hot days and marine heatwaves, and fewer cool extremes
    - Further sea level rise and ocean acidification
    - Decreases in rainfall across southern Australia with more time in drought, but an increase in intense heavy rainfall throughout Australia.

These changes have significant impacts many Australians, particularly those in regional communities more susceptible to changing climate conditions. To combat these recorded and potential impacts and affirm Australia's commitments to its international agreements, the Australian government and other agencies and participants in the climate change and energy sectors have come up with several responses in the form of Acts and policies, funds, programs and schemes.

3.4.1 Australian Government ratification of the Paris Agreement

The Australian Government ratified the Paris Agreement in November 2016, committing to an unconditional Nationally Determined Contribution (NDC) to reduce emissions by 26-28% below 2005 levels by 2030, which builds on the Cancun Pledge target of reducing emissions by 5% below 2000 levels by 2020.

Australia is on track to overachieve its Cancun pledge 2020 target by 166 $MtCO_2e$ (without the Kyoto Protocol carbon budget carry-over). However, under current policy, Australia is not on track to achieve its 2030 NDC target, with emissions levels projected to be well above the target by 2030 due to lack of climate policy (United Nations Environment Programme (UNEP), 2018).

3.4.2 Australian Government Energy Policies / Funding

Australia's response to climate change and energy policies were at the forefront of the most-recent 2019 Australian Federal election campaign.

On 25 February 2019, the Australian Government announced the Climate Solutions Package, a $3.5 billion investment to deliver on Australia's 2030 Paris climate commitments. The Climate Solutions Package aims to provide the following (Department of Agriculture, Water and the Environment (DAWE), 2019):

- A $2 billion **Climate Solutions Fund** to reduce greenhouse gases across the economy through the existing Emissions Reduction Fund
- Investments in high-tech expansion projects such as the Snowy Mountains Scheme and a second interconnector and the Marinus Link, between Victoria and Tasmania
- The development of a **National Electric Vehicle Strategy**.

3.5 NSW Government Emissions and Response

Although NSW does not have a specific renewable energy target, the state government has set a long-term target for NSW to have zero net emissions by 2050, including in its energy sector.

Ten of Australia's coal power stations in the NEM have closed since 2012. The majority of Australia's remaining coal power stations are aging, becoming unreliable, inefficient and costly. Of the 21 coal fired power stations currently operating in Australia, by 2030 three are set to close and six will be within five years of their total life (CEC, 2018). Extending the life of old coal power stations is extremely expensive and building a new coal power station is the most expensive form of new power generation.

In early 2019, a court ruling by the NSW Land and Environment Court rejected a new coal mine planned near the town of Gloucester on the NSW mid-north coast. Furthermore, in September 2019, the Independent Planning Commission (IPC) refused development consent for the Bylong Coal Project for numerous reasons, with the main being failure to address Scope 3 Greenhouse Gas emissions and the project being contrary to the principles of Ecologically Sustainable Development (ESD), specifically the principle of intergenerational equity, in that the predicted economic benefits would accrue to the present generation but the long-term environmental, heritage and agricultural costs would be borne by the future generations, therefore, not being in the public interest. These landmark court rulings, primarily based on social and environmental risks including the impact of greenhouse gas emissions at a global scale, affirms the widespread view to transition away from coal.

3.5.1 NSW Net Zero Plan Stage 1: 2020 – 2030

The Net Zero Plan Stage 1: 2020-2030 is the foundation for NSW's action on climate change and goal to reach net zero emissions by 2050. It outlines the NSW Government's plan to grow the economy, create jobs and reduce emissions over the next decade.

The plan aims to enhance the prosperity and quality of life of the people of NSW, while helping the state to deliver a 35% cut in emissions by 2030 compared to 2005 levels (Figure 3 6). Currently the majority of emissions in NSW are derived from electricity generation (Figure 3 7). The plan will support a range of initiatives targeting electricity and energy efficiency, electric vehicles, hydrogen, primary industries, coal innovation, organic waste and carbon financing.

The implementation of the Net Zero Plan, together with the NSW Electricity Strategy, will result in more than $11.6 billion of new investment for NSW, including $7 billion in regional NSW. This will support the creation of almost 2400 new jobs, including 1700 jobs located in the regions.

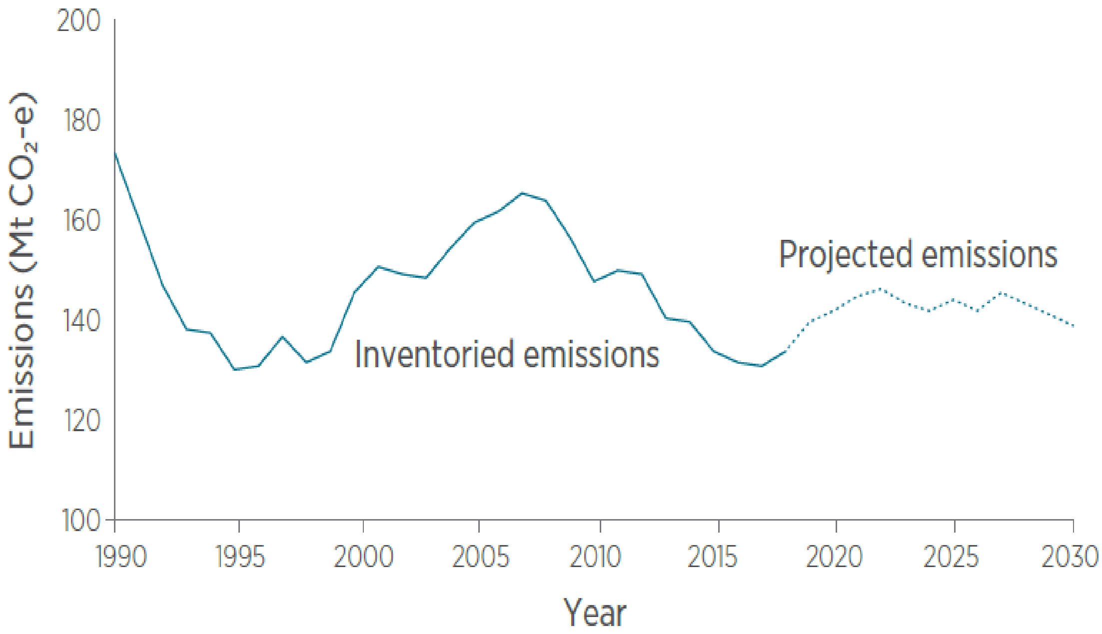

Figure 3-6: NSW total annual emissions to 2030 (DPIE, 2020). Note MtCO2-e = Megatonnes of carbon dioxide equivalent

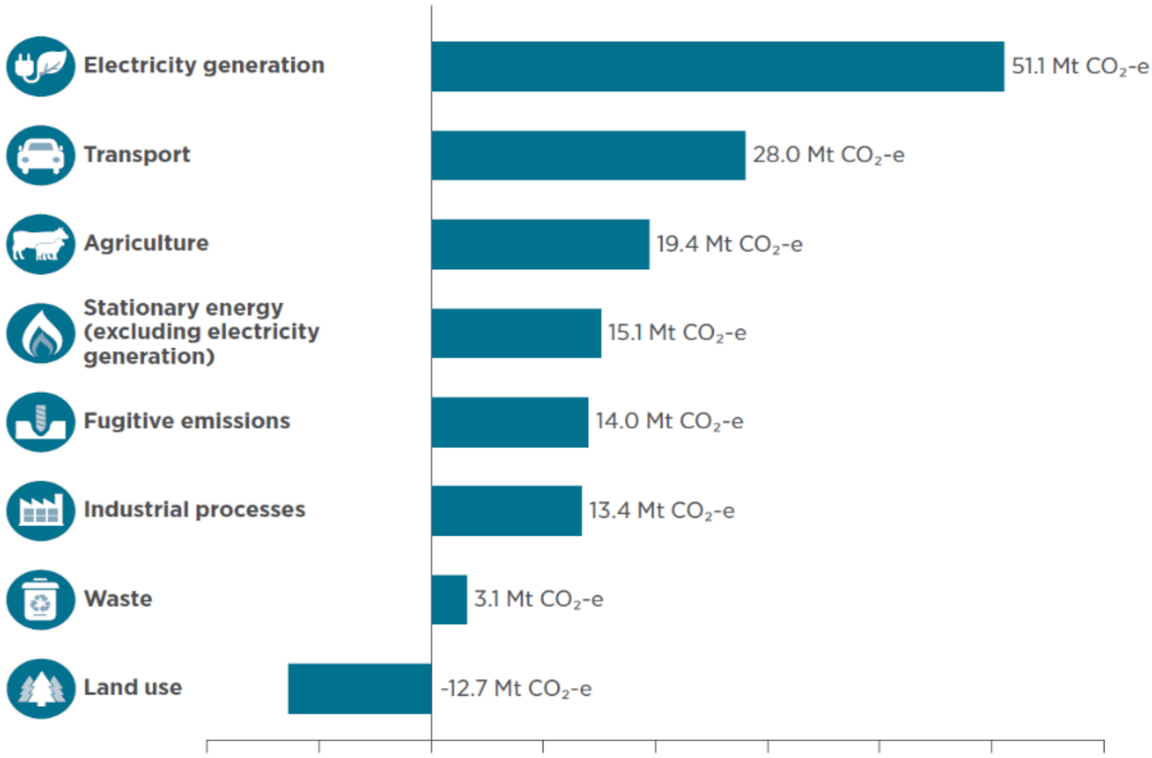

Figure 3-7: NSW emissions by sector in 2017 (DPIE, 2020)

3.5.2 NSW Electricity Strategy

The NSW Electricity Strategy is the NSW Government's plan for a reliable, affordable and sustainable electricity future that supports a growing economy. The strategy encourages an estimated $8 billion of new private investment in NSW's electricity system over the next decade, including $5.6 billion in regional NSW. It will also support an estimated 1,200 jobs, mostly in regional NSW. The strategy aligns closely with the NSW Government's Net Zero Plan Stage 1: 2020 – 2030.

Significantly for the Proposed Development, the strategy supports the development of new transmission infrastructure to connect low-cost generation to the electricity system by developing Renewable Energy Zones (REZ). The REZs will play a vital role in delivering affordable energy to help replace the state's existing power stations as they retire over the coming decades. The NSW Government's Electricity Strategy sets out a plan to deliver three REZs in the State's Central-West, New England and South-West regions to aid in unlocking a significant amount of large-scale renewable energy and storage projects.

The NSW Government is in the early stages of feasibility and planning for the state's first pilot REZ, which is set to be built in the Central-West due to existing investment and interest.

The Draft 2020 Integrated System Plan (Draft ISP) produced by the Australian Energy Market Operator (AMEO, 2019) indicates the Proposed Development would be within a potential REZ, "N7" identified as encompassing a wide area of land covering from north of Wagga Wagga to just south of the NSW border.

3.5.1 Greater Hume Shire Council Strategic Plan

Greater Hume Council's Local Strategic Planning Statement (LSPS) sets out the land use framework for this region's economic, social and environmental land use needs until 2040. Two key Planning Priorities within this Strategy consider means of bolstering use of the region's resources and Agricultural *Value Adding* – as a means of attracting higher earning employment opportunities for local residents and to provide contributions to the Council's gross domestic product.

The Proposed Development supports Greater Hume Council's intent to consider large-scale renewable energy generation as a complementary land use option for the area – given its access to transmission infrastructure, land availability and favourable climate conditions.

4. The Proposal

4.1 Proposal Description

4.1.1 Site Description

The Proposed Development is a c.200 MW_{AC} utility scale electricity generation works comprised of solar PV modules, steel racking and piled supports, electrical power conversion units, underground and/or above ground electrical cabling, telecommunications equipment, operations/maintenance building (including amenities and storage facilities), vehicular access and parking areas, along with security fencing and gates (Appendix B).

The Proposed Development is located on land within the Greater Hume Shire LGA near Jindera, 20 km north of Albury in southern NSW (Figure 1-1). The GSF Site main access will be via Lindner Road and Ortlipp Road as outlined in Section 8.8.

The existing TransGrid Jindera substation located within the Site provides the opportunity to co-locate electricity generation and connection to the TransGrid 330 kV network, minimising potential impacts of the Proposed Development and maximising the use of an existing asset.

The Site is mapped as Important Agricultural Land (IAL) and is currently used mostly for grazing and some cultivation (see Section 8.5 for further detail). No part of the Site is mapped as Biophysical Strategic Agricultural Land (BSAL), however some parts are mapped as Bushfire Prone Land (BPL).

The Site is located within freehold land owned by three separate landholders. The Site also includes Crown Roads and unformed Council roads (Figure 4-1). Figure 4-1 provides details of freehold landholdings comprising the Proposed Development Footprint and current land-use.

Table 4-1: Proposed Development landholdings and characteristics

Landowner	Lot	DP	Land use	Total Area of Affected Lots (ha)	Site within Lot (ha)	Development Footprint within Lot (ha)[1]
Landowner 1	3	411022	Grazing Cultivation Residence	58.7	18.5	15.7
	3	1190444		1.6	1.6	1.2
Landowner 2	27	753342	Grazing Cultivation Residence	125.9	52.9	53
	101	791421		185.9	185.9	160.4
	1004	1033823		115.9	115.9	87.6
Landowner 3	1	588720	Grazing Electricity transmission	20.1	20.1	14.1

[1] Note, the Development Footprint is inclusive of where solar PV modules may be located and subject to further assessment through the EIS process. Facilities such as the operations building, construction compound are located within this area.

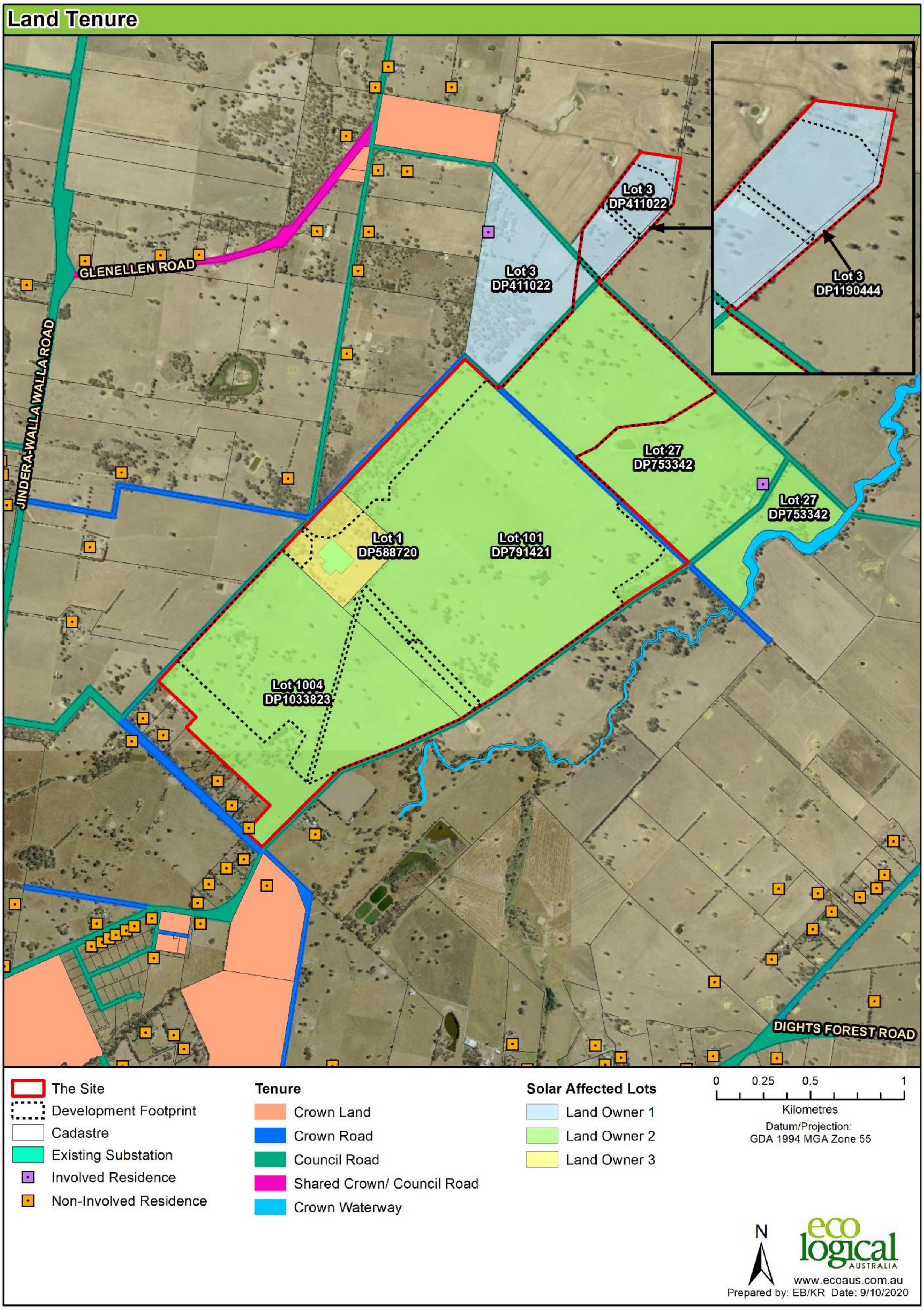

Figure 4-1: Land Tenure

4.1.2 Subdivision for Lease Purposes

As the Proposed Development extends over several adjoining properties, the Proponent requires separate long-term leases (with durations in excess of five years) to be granted by each of the registered proprietors over parts of existing lots where the Proposed Development will be constructed.

Since the leases will extend for a term greater than five years, the Proposed Development will be deemed ‘subdivision’ of land pursuant to section 6.2(1)(b) of the EP&A Act. It is noted that this is not an actual subdivision of the land which creates a new allotment and deposited plan, and that the current DPIE approach is that a formal request for a subdivision certificate compliant with the requirements of clause 157 of the EP&A Regulation is not required.

Under section 23F of the *Conveyancing Act 1919* (Conveyancing Act), the Registrar-General can refuse to register a transaction in relation to the lease of part of an existing lot unless the boundaries of each part into which the land is divided follows the boundaries of an existing lot. There is an exception for a lease where the term does not exceed 5 years.

As the long-term leases arising as a result of the landowner agreements to secure the land for the Proposed Development will be over parts of existing lots and will exceed five years, the Registrar-General will not register the leases unless development consent is obtained for the subdivision of the relevant lots for leasing purposes so that the leases are for the whole of each ‘lot’. The reason that the long-term leases are not registered over the whole of the existing lots is to allow the current registered proprietors to continue to maintain full control over the majority of their land.

Section 88B of the Conveyancing Act also provides for the creation of easements which benefit the land and its intended uses. Once the land is subdivided and the deposited plans registered, easements for access tracks, right of carriageway, transmission lines and power cabling may need to be sought and registered with NSW Land Registry Services where these land carriageway rights are required.

Once the leases are granted, they will be registered on title with NSW Land Registry Services (LRS). Following the expiry or earlier termination of the leases, a landowner may request that LRS remove the lease from their title.

The intent of a Lease Subdivision is administrative in nature. It is merely the legal mechanism to enable the Project to be carried out. It does not change the nature or scope of the Project. There will be no actual subdivision of the relevant titles to create new freehold lots or which could give rise to any new dwelling entitlements. Therefore, a Lease Subdivision does not result in any fragmentation of agricultural land and/or create potential land use conflicts.

4.1.2.1 Proposed Indicative Subdivision for Leasing Purposes

Development consent is sought for the indicative subdivision layout for leasing purposes described in Table 4-2 below and Figure 4-2.

subdivisions inclusive of minor lot boundary variations should adjustment be required at the detailed design stage. Figure 4-2 shows the proposed lots to be created as part of the subdivision for leasing purposes, inclusive of minor lot boundary variations should adjustment be required at the detailed design stage. Indicative lot sizes are described in Table 4-2 below. These lots will be subject to final survey.

Table 4-2: Proposed lots to be created for leasing purposes

Existing Lot	Existing DP	Current Lot Area (ha)	Proposed Lot No.	Type	Proposed Indicative Area (ha)
3	411022	58.7	1	Development Footprint Area	15.7
3	411022	58.7	2	Residual	43
3	1190444	1.6	1	Development Footprint Area	1.2
3	1190444	1.6	2	Residual	0.4
27	753342	125.9	1	Development Footprint Area	52.9
27	753342	125.9	2	Residual	73
101	791421	185.9	1	Development Footprint Area	160.4
101	791421	185.9	2	Residual	25.5
1004	1033823	115.9	1	Development Footprint Area	87.6
1004	1033823	115.9	2	Residual	28.3
1	588720	20.1	1	Development Footprint Area	14.1
1	588720	20.1	2	Residual	6.9
Council Road (Blight Road West)		-	-	Development Footprint Area	0.03
Council Road (paper road north)		-	-	Development Footprint Area	0.39
Crown Road (paper road south)		-	-	Development Footprint Area	1.78

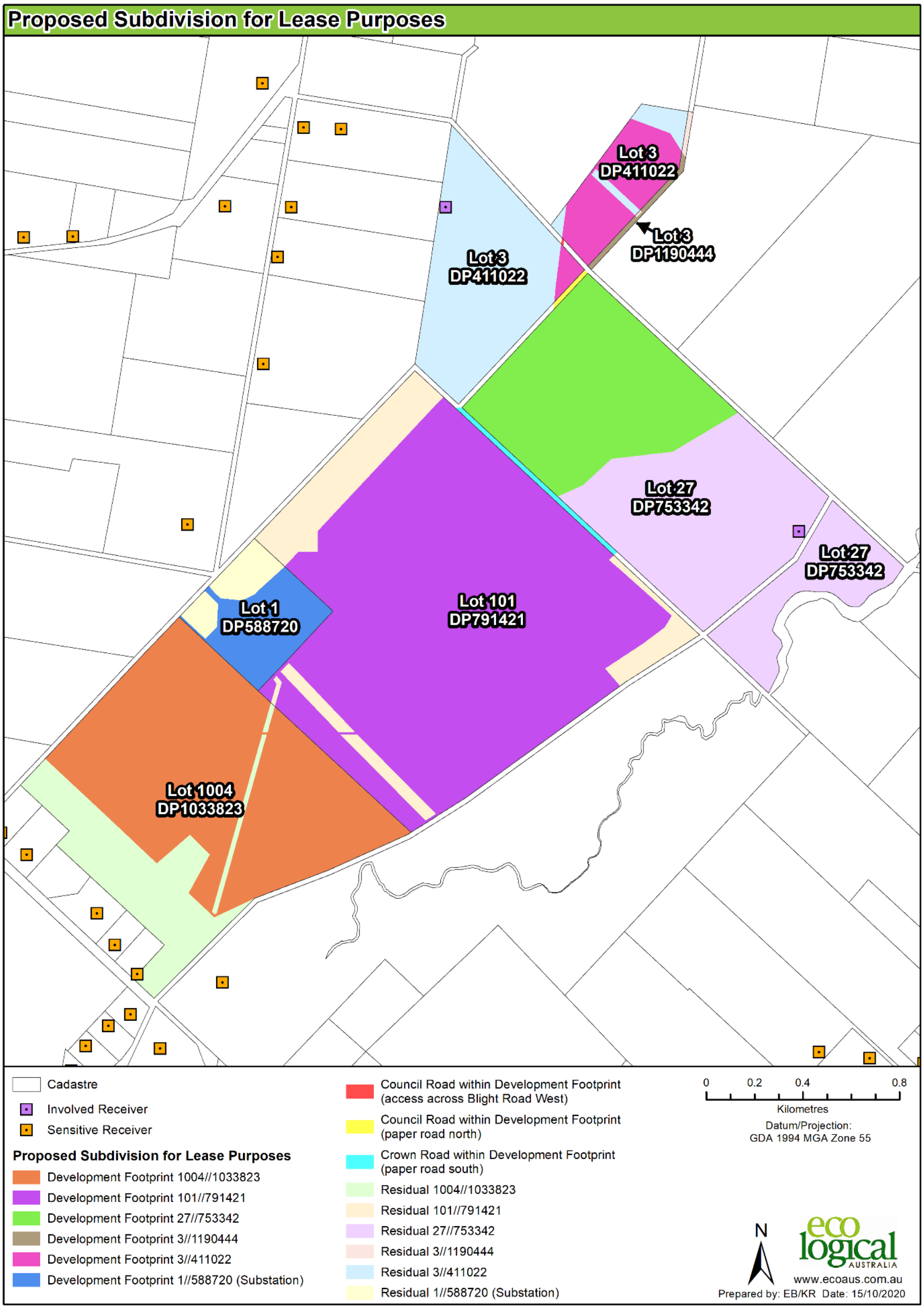

Figure 4-2: Proposed Subdivision for Lease Purposes

4.1.2.2 Permissibility of subdivision

The Proposed Development includes the subdivision of land for lease purposes to define the Site, which coincides with the leasing boundaries. As previously described, this is because a lease of five years or more cannot be registered over part of a lot. The Registrar-General's Guidelines for Lease of Land explains that a lease of part of an existing lot of land for greater than five years creates a subdivision under the Conveyancing Act 1919.

Development consent is required for the subdivision of land for lease purposes. "Development" for the purposes of the EP&A Act includes the "subdivision of land" (section 1.5(1)(b) EP&A Act). The definition of "subdivision of land" in section 6.2(1)(b) of the EP&A Act means the "division of land into two or more parts that after the division would be obviously adapted for separate occupation, use or disposition". The division may be affected by any agreement, dealing, plan or instrument rendering different parts of the land available for separate occupation, use or disposition. This includes the grant of a lease of a part of a lot. The definition of "subdivision of land" also includes the procuring of registration in the office of the Registrar-General of a plan of subdivision within the meaning of section 195 of the Conveyancing Act. Section 195 of the Conveyancing Act specifies that "plan of subdivision" includes any plan that shows the division of land.

The Proponent has set out below an assessment of permissibility of the Lease Subdivision within the planning framework. The consent authority can take comfort that the Lease Subdivision is permissible and will not create any fragmentation of agricultural land.

The Greater Hume LEP provides that land may be subdivided with development consent (clause 2.6) but any resulting lot must not be less than the identified minimum lot size (clause 4.1(3)). As the Site is zoned RU1 Primary Production, the applicable minimum lot size for the area of the Proposed Development is 100 ha. Therefore, the creation of a lot for lease purposes which is less than 100 ha is prohibited under the Greater Hume LEP. This prohibition applies to all Proposed Lots. Despite this prohibition, section 4.38(3) of the EP&A Act allows the consent authority to grant development consent to a SSD which is partly prohibited by an environmental planning instrument (which includes an LEP). Accordingly, under the applicable statutory framework, regardless of the controls set out in the LEP, development consent may be granted, inclusive of this subdivision. It is the intention of this EIS (specifically described in Section 4.1.2 and Table 4-2) to form the application for 'deemed subdivision'.

The objectives of clause 4.1 of the Greater Hume LEP are "to ensure land use and development is undertaken on appropriately sized parcels of land consistent with the objectives of the relevant zone". The Proposed Development is assessed against the objectives of RU1 Primary Production in Section 8.5.3.1.

4.1.3 Key Components of the Proposed Development

The Proposed Development involves the installation of solar PV panels with a generation capacity of approximately 200 MW_{AC}.

The Proposed Development would include, but not necessarily be limited to, the following elements:

- Solar arrays: solar PV panels supported by a mounting system[4] with a maximum height of 5 m above natural ground at maximum tilt installed on piles driven, screwed, drilled and stabilised with a cement mix or ballasted to the ground
- Power Conversion Units (PCU's) inclusive of Inverters/Rectifiers, Ring Main Units, Medium Voltage (MV) and/or High Voltage (HV) step-up Transformers located throughout the Proposed Development
- Collector systems: above and/or below ground onsite cabling and electrical connections between the grid connection substation and collector substations and between the substations and the respective PCU's
- Road safety upgrades as identified within Section 8.8.4 of this EIS
- Operation and maintenance (O&M) building including workshop, warehouse, offices, ablutions, and carpark
- Site access and onsite access tracks
- Fencing and security system
- Meteorological stations
- Vegetation buffers for visual screening
- Asset Protection Zones (APZ) containing category 1 fire track.

In addition to the key components outlined above, there would be a temporary construction compound and material laydown areas required to facilitate the construction, upgrading and decommissioning phases of the Proposed Development.

The construction compound would include:

- Temporary construction offices
- Car and bus parking areas (the transport assessment has considered car transport only as a worst-case scenario)
- Staff amenity block including portable toilets, showers and a kitchen) designed for peak staff numbers during the construction period
- Laydown areas
- Enclosed secure areas with security fencing.

---

[4] The mounting system will be a SAT arranged north-south. A SAT system tracks the daily movement of the sun and motorised linkages rotate the modules from the east in the morning to the west in the afternoon, constantly aligning towards the sun to maximise energy output performance. The modules are laid out in rows, typically referred to as arrays, approximately 4 to 16 m apart depending on the technology used. The racking system will be supported by steel piles, typically comprised of C-section or I-section beams which are driven into the ground or otherwise placed in bored holes and secured in place with concrete, stabilised sand or other backfill material.

The material laydown areas would include:

- Temporary facilities
- Plant and equipment storage areas
- Unloading areas
- Enclosed secure areas with security fencing.

All land required for the temporary construction activities will be rehabilitated for agricultural use following completion of construction.

4.1.4 Scale of Development

The Study Area has been assessed and, through avoidance, a Development Footprint has been defined that incorporates impact minimisation and mitigation measures. Within the Development Footprint (and subject to the aforementioned impact minimisation and mitigation measures which are outlined within this EIS) flexibility is sought for internal infrastructure such as associated permanent and temporary infrastructure. This flexibility is to allow for detailed design to derive an optimal layout for financing, construction and operation; ultimately driving the cost of energy produced from the project down while remaining considerate of overarching impact minimisation and mitigation measures.

The final scale and capacity of the Proposed Development will be optimised within the Development Footprint during post-consent design based on a combination of the most suitable technology at the time of procurement along with detailed geotechnical and grid connection studies. The placement of the permanent and temporary compound-style infrastructure (such as the main construction Site compound(s), operations and maintenance facilities) will be driven by an impact avoidance and risk minimisation process during detailed design.

That process will consider the functional requirements for the infrastructure (such as ease of access, geotechnical suitability, constructability, proximity to required inputs) and any identified environmental features including (but not limited to):

- vegetated and functional riparian zones
- areas of higher biodiversity value (including Threatened Ecological Communities (TECs))
- heritage artefacts
- proximity to receivers (potential noise and visual impacts)
- separation distances from surrounding woodland vegetation.

This approach has been adopted in undertaking assessments for the EIS, therefore any placement of the compound-style infrastructure has been considered according to the relevant potential impacts. Therefore, this application seeks a flexible consent which will enable this optimisation to occur within the approved Development Footprint.

4.1.5 Indicative Timeline

It is anticipated that the Proposed Development would take approximately 12 to 18 months to construct. This time to construct could be reduced should the Proposed Development be granted approval for an out of hours works protocol. The Proposed Development would be operational over an initial term for approximately 30 years. Further, it is anticipated that the Proposed Development could extend for a further term should market and commercial circumstances dictate. It is expected that upgrading or repowering of the PV modules and ancillary equipment may be required throughout or to extend the operational life of the Proposed Development. This will be a commercial decision at the time based on the relative economics of solar PV generation compared to alternatives and would be subject to a separate Development Application. Decommissioning and restoration would occur at the end of the operational life of the Proposed Development. As such, planning consent for the Proposed Development is sought for 30 years to cover one full term of operation and associated construction, upgrading and decommissioning periods. Details of each project phase are provided below in Table 4-3.

Table 4-3: Indicative timeframe for project phases

Phase	Indicative Start	Indicative Period
Construction	Late 2021	18 months
Operation / Repowering	Mid 2022	28 years
Decommissioning	c. 2050	6 months

4.1.6 Description of Solar Farm Key Components

4.1.6.1 Solar array

The solar array refers to the area of the Development Footprint within which the PV panels will be located, along with the necessary infrastructure to support them; namely the SAT system, inverters, internal track network, and connecting underground cabling. These components and other supporting infrastructure are described in detail below.

The solar array would comprise of approximately 416,000 individual solar panels with a combined generation capacity of approximately 200 MW_{AC}. Regardless of the size of the individual solar panels selected, when attached to a tracking system, the maximum tilt height above natural ground would not exceed 5 m during operational daylight hours, which is the height used in the visual impact assessment to ensure the potential maximum visual effect of the Proposed Development has been assessed.

The solar panels would be fitted to a SAT system which would track the sun from east to west as it moves throughout the day. The tracking system is installed in rows orientated in a north south direction. The tracking system tracks the panels from 60 degrees towards the east in the morning, to face straight upwards at midday (0 degrees) and finally to face 60 degrees towards the west in the afternoon. Note, for the majority of the day, as explained above, the PV panels will be below the maximum tilt height of 5 m.

The minimum spacing between each of the rows of trackers would be 6 m, this enables vehicles to access the rows for maintenance and the management of vegetation across the Array Area.

The solar array will be supported by approximately 60,000 piles which would be mechanically driven, screwed into, drilled and concreted or ballasted to the ground. Depending on the tracking system deployed, piles are typically spaced between 5 m to 10 m apart. Figure 4-3 below shows an example of a solar farm during construction. Figure 4-4 illustrates an operational tracking solar farm.

Figure 4-3: Piles for the solar farm in place (image source Infinergy UK)

Figure 4-4: Fully assembled tracking array solar farm showing inverter housing (image courtesy Nextracker Australia, actual tracking system may differ)

The solar array would be wired in ‘blocks’ that would be connected to PCUs (likely to be approximately 2.5 MW to 10 MW each) located throughout the Proposed Development. Blocks would not necessarily appear as discrete entities but would appear as a series of continuous rows. The SAT system would be installed in rows that are oriented typically north to south. The solar array would connect to the

Substation through a series of 33 kV lines that would be above or below ground depending on local ground conditions, which would be internal to the Site and not interact with the public roads.

4.1.6.2 Substation

The proposed grid connection infrastructure is an expansion to the existing 330/132/22kV substation located on the Site. Proposed works to enable connection of the solar farm generally consist of expanding the fence line to accommodate installation of a transportable building and depending on the final design, installation of a new power transformer and outdoor switchyard equipment, which will be supported by concrete foundations and steelwork, depending on the requirements of the network service provider (TransGrid).

4.1.6.3 Power Conversion Units

PV panels produce Direct Current (DC) electricity which would be converted to Alternating Current (AC) at the many central PCUs. Depending of the final PCU selection, the project will have approximately 100 PCUs that would be installed throughout the Site. The PCUs will be approximately 2 MW to 10 MW each, though subject to procurement processes. PCUs are typically a containerised solution or a skid mounted solution located on a prefabricated transportable galvanised steel platform, either singularly the size of a 20 ft container, measuring approximately 6.1 m *(l)* x 2.9 m *(h)* x 2.5 m *(w)*, or doubly the size of a 40 ft container measuring approximately 12.2 m *(l)* x 2.9 m *(h)* x 2.5 m *(w)*. Each PCU would also have:

- Inverters (typically 2 per PCU)
- A 33 kV MV transformer
- Circuit breakers
- Communication equipment.

PCUs will be transported to Site ready-made and require little in the way of foundations, either attached to steel or concrete pilings depending on ground conditions or a raft concrete foundation approximately 300 mm thick, with structural edge thickening. Figure 4-5 and Figure 4-6 below illustrate a double and single PCUs respectively. Figure 4-7 illustrates the skid mounted medium voltage power station (MVPS).

Figure 4-5: Double PCU container (image courtesy of SMA)

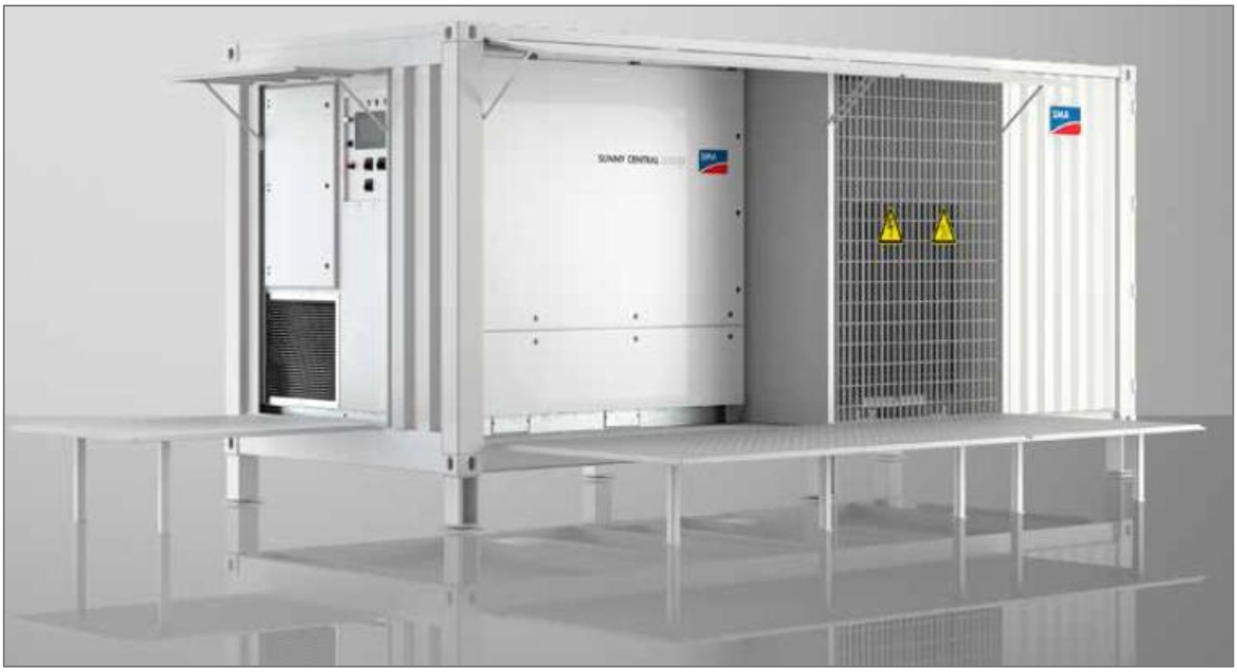

Figure 4-6: Single PCU container (image courtesy of SMA)

Figure 4-7: SMA MVPS Skid Mounted Solution (image courtesy of SMA)

4.1.6.4 Collector Systems

A typical collector system will include DC reticulation cabling run along each solar array (which may be mechanically protected as required to facilitate co-use of land for grazing purposes) and then below ground to the PCUs. Inverters will convert the DC to AC with MV and/or HV transformers increasing the voltage for export to the grid.

Collector cables will be of sufficient length to minimise wherever possible the use of cable joints between PCU's and the Substation. In-ground or above ground looped joint pits will be utilised to ensure recovery of joints for repairs if joints are required for underground cables. Where underground, single mode fibre and the radial earth conductor (where required) will be laid in parallel to other cables in a common trench.

All cables will be designed based on Site conditions in accordance with relevant Australian and international standards. Subject to final design, cable trenches will contain:

- Below ground warning tapes
- Below ground Polymeric cover strips (where required)
- Electrical cables to export power
- Electrical supply cables where necessary
- Earthing cable
- Communications and SCADA links
- Above ground warning signs (where required).

Where possible, trenches will be located alongside/underneath internal access tracks to minimise ground disturbance (Figure 4-8). MV/HV cables may be either laid underground or constructed overhead to connect sections of the Proposed Development to the Substations.

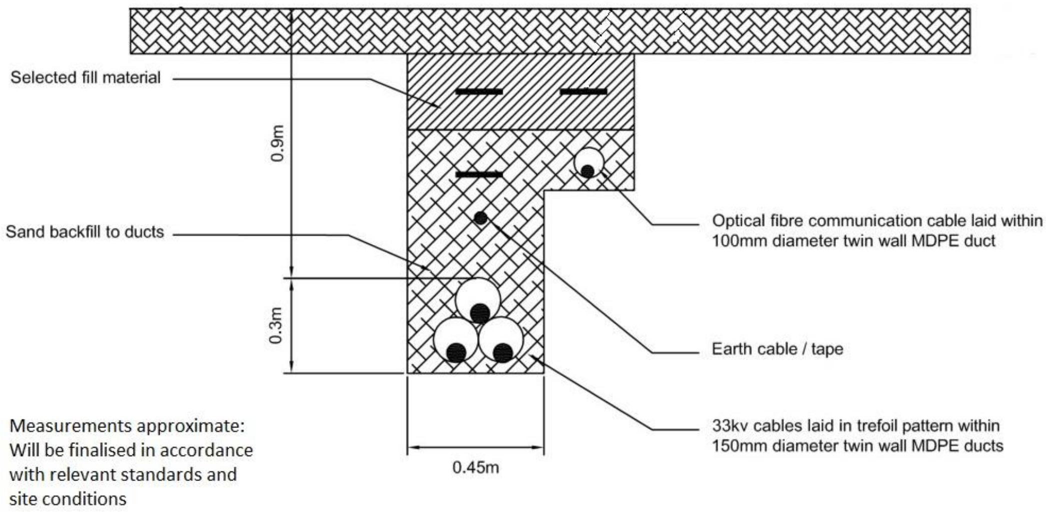

Figure 4-8: Indicative 33 kV cable trench design[5]

4.1.6.5 Operations and Maintenance Facility

A permanent O&M facility will be provided to meet the ongoing operational needs of the Proposed Development. A typical arrangement and design are shown in Figure 4-9 and Appendix B. Building fit-out will include power, lighting, air-conditioning, security, fire detection, and communication systems as required.

[5] Indicative design only. Cables may be direct buried rather than trenched. Cables will be buried to a depth >500 mm in land with a cropping history or land with a capability of cropping. MDPE ducts may not be required and may not be used.

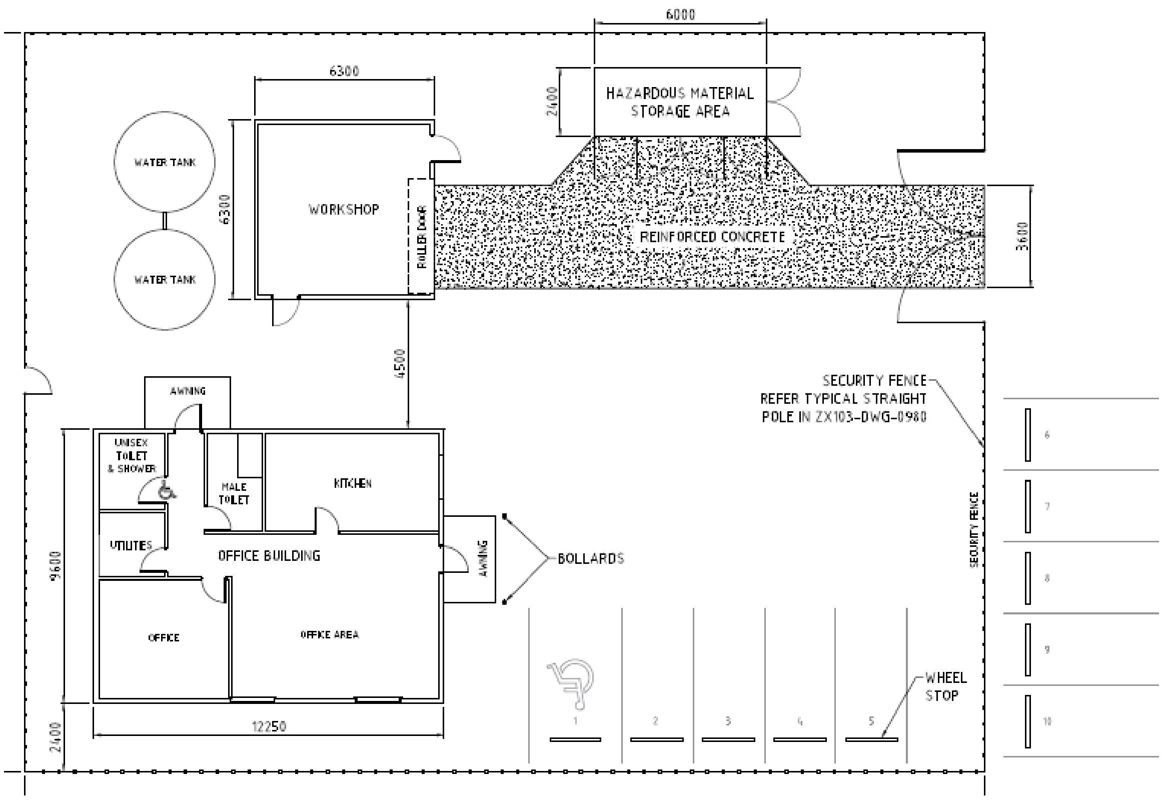

Figure 4-9: Typical O&M Facility

The O&M facility, including associated parking, would occupy an area of approximately 50 m by 50 m or 0.25 ha and may include the following:

- Office building, consisting of office, toilets, showers, staff room and kitchen
- Maintenance building
- Up to 3 storage buildings/sheds
- Parking
- Water storage
- A septic tank
- A workshop.

Onsite support buildings will comply with all relevant Australian building standards and regulations. They will be designed to accommodate the maximum number of staff that will be required during the operational life of the Proposed Development. Water for the support buildings will be supplied to site by commercial contractors and stored in onsite water tanks. In addition, there will be a requirement for a 20,000-litre water tank solely for the purposes of fire protection.

4.1.6.6 Site Access and Onsite Access Tracks

Ortlipp Road has both south and north access. The heavy vehicle haulage route to the Site will be via the Jindera-Walla-Walla Rd (Southbound), Lindner Road and the existing Ortlipp Road from the south. This route avoids heavy vehicle traffic through Jindera. The proposed main Site access point will be located near the existing access point, adjacent to the substation on Ortlipp Road (see Section 8.8).

Walla Walla-Jindera Road is a sealed road, whilst Lindner Road and Ortlipp Road are unsealed local roads that will require specific upgrades and periodic maintenance throughout the construction of the Proposed Development.

Drumwood Road on the south eastern boundary of the Site and Lindner Road to the south western boundary are not planned for use as main construction traffic routes, however these may be used as an emergency egress route for the project (subject to the final drafting of the project emergency management plan).

Internal tracks will be constructed of compacted gravel to an approximate depth of 150 mm depending on soil conditions (Figure 4-10). Internal access tracks would be approximately 4 m wide, with intermittent wider stretches for passing, parking, and at corners. Small culverts over identified stream crossings would also be constructed where required. Culverts will be designed in line with the following guidance:

- *Policy and Guidelines for Fish Habitat Conservation and Management* (Fairfull, 2013)
- *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003).

Approximately 15 km of internal access tracks will be installed on the project Site, which would require c. 9,000 m^3 of gravel material to be imported to the project or approximately 440 truck and dog aggregate deliveries over the duration of the project. It should be noted that the access track length is dependent on the manufacturer of the final SAT system and will be optimised during detailed project design.

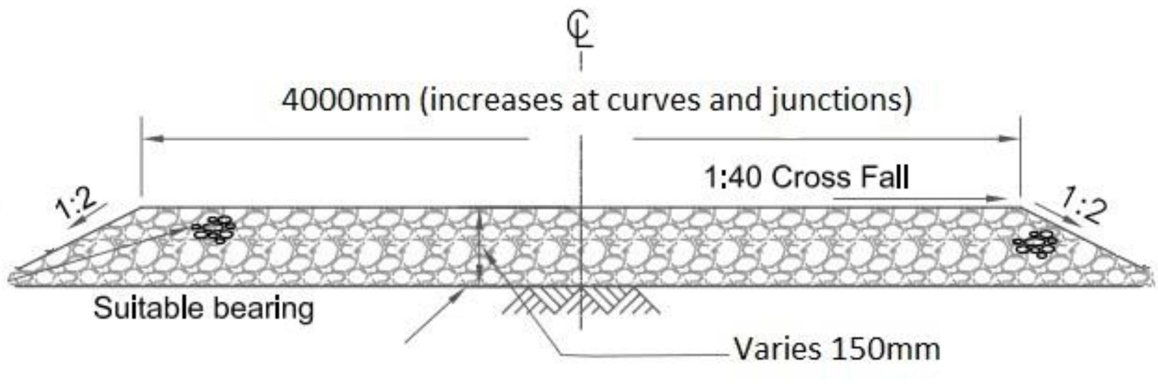

Figure 4-10: Typical track cross section

4.1.6.7 Fencing and Security System

To ensure safety and security at the Site, a perimeter fence up to 2.5 m will be installed around the perimeter of the Proposed Development in accordance with the Proponent's requirements to ensure entry into the Site is controlled. Once operational, all access points will be gated. The Site security system may also include sensor lighting and closed-circuit television (CCTV) at several locations around the Site.

4.1.6.8 Meteorological Station

A number of metrological stations will be located at locations determined as part of the final design, located in proximity to solar arrays and consisting of equipment to measure solar radiation (global and direct), temperature, pressure, rainfall, wind speed and direction. For wind speed, a mast approximately 10 m high would be installed. Ancillary power and optic fibre will be provided to each unit.

4.1.6.9 Vegetation Screen

The Site has been selected to minimise impacts to surrounding residences through a combination of consultation, consideration of existing vegetation and proximity to the Proposed Development. Substantial concessions have been made to adjacent residences in the creation of the Development Footprint. Vegetation screening will also be created along other parts of the Site perimeter in response to community feedback. If required, additional vegetation screening post construction may be planted in other areas of the Site or adjoining land (subject to landowner consent) (Section 8.6).

4.1.6.10 Asset Protection Zones (APZs)

APZs will be established and maintained around the perimeter, between the security fence and the solar panel array (and associated infrastructure), which allows for a defendable firefighting space that permits unobstructed vehicle access. The perimeter APZ will comprise a setback distance of all project infrastructure (excluding fence lines and access tracks) of:

- 20 m width from woodland areas
- 10 m width from grassland areas.

The APZ is to be ploughed, mowed or grazed, and maintained from the commencement of construction in perpetuity in accordance with the Bushfire Emergency Management and Operations Plan (see Section 8.10.4) and the NSW Rural Fire Service (RFS) (2019) APZ requirements for an Inner Protection Area. The APZ is to incorporate a 4 m Category 1 perimeter fire trail, established and maintained in accordance with NSW RFS requirements (NSW RFS, 2019) standards for fire trails (NSW RFS, 2019a) including provisions for passing bays and turn around points.

The APZs are to ensure, as far as possible, that a fire that originates within the Site does not escape into the wider landscape or, conversely, the APZs should reduce the potential of a fire that originates offsite encroaching onto the Site. Fire protection is discussed in more detail in Section 8.10.2 and Appendix E.

4.1.6.11 Grid Connection

The existing Jindera Substation will be the point of connection into the NEM. Augmentation within the Substation may be required inside the existing building, or on the land immediately surrounding the existing substation. For the avoidance of doubt, additional works associated with the Proposed

Development within (the inclusion of a new switch room and associated connection arrangement) and external to the Substation are included within this EIS.

4.1.6.12 Existing Overhead Lines

The existing 22 kV overhead line bisecting the southern section of the Site was originally proposed to be either relocated along the Site boundary or undergrounded as a part of the works to limit the shading on the solar array and improve safety during construction and operations. This is no longer proposed: instead, the existing22 kV line will be retained in place and an easement will be established as part of the Development Footprint that restricts disturbance to only three crossings (one where the line enters Lot 101 DP 791421 after exiting the TransGrid Lot, one where the line exists the Development Footprint in the south in Lot 1004 DP 1033823, and the third crossing will be decided upon during the detailed design phase for the GSF), but is generally expected to maintain the same shape as illustrated in Figure 2-3. The existing 132 kV overhead lines will be retained in place.

4.1.6.13 Waste

A waste management plan will be developed for the project to reduce the quantity of waste generated (by eliminating waste, returning waste to the equipment manufacturer for re-use where possible, through use of on-site recycling and other initiatives). Local waste recycling, reuse and disposal options will be explored during the development of the project design.

5. Typical Works Program

Construction will include all pre-operation activities associated with the Proposed Development other than survey, acquisitions, fencing, investigative drilling, excavation and structural pier pull tests or other preparatory activities that have minimal environmental impact such as Site mobilisation, minor adjustments to services/utilities, establishing temporary construction sites or minor clearing. Construction would typically comprise of the following activities:

5.1 Site Preparation

The Site will require Site specific preparation in advance of installing the PV modules as it is generally flat or of consistent slope, and largely clear of trees and dense vegetation. Site entrances will be opened, and Site gates secured in position. Temporary fencing and signage are to be installed prior to works, to delineate work zones, exclusion zones and clearing boundaries to protect retained vegetation and other sites of environmental significance.

Fencing will be upgraded or installed around the Site perimeter as required to match progress on work fronts. The Site will be cleared of internal fences, timber or rock debris as required. Trees within the Development Footprint where clearing has been approved will be removed and chipped.

It is possible low voltage distribution lines crossing the Site will need to be relocated to avoid impacting the layout. Any relocation will be undertaken in close cooperation with the network operator and other relevant stakeholders.

Site facilities and temporary laydown areas will be established within the Proposed Development Footprint and construction vehicles, plant and equipment will be mobilised to the Site. Site access tracks will be surveyed and established through scraping, grading, placement of suitable fill material and compacting. Some tracks may require road base to create an all-weather (unsealed) surface, however extensive track construction is not planned. Tracks will be treated to create a durable, dust-minimising surface.

Typically, construction of the site Substation will also commence at this phase. However, owing to the co-location of the Proposed Development with the existing TransGrid Jindera Substation, only minor works are required which will incur limited new impacts.

Site preparation and construction will require the use of plant such as bulldozers, water trucks, graders, flatbed trucks, skid steers, front end loaders, roller compactors, trenchers, backhoes, gravel trucks, cranes and aerial lifts.

5.2 Installation

Following construction preparation, the supporting structures (racking) and the solar modules will be installed. The Site will be surveyed and locations of all the equipment will be pegged. Topsoil will be left intact wherever possible. Circular hollow sections, flanged sectioned or ballasted steel piles which support the module support system will be driven into the ground by percussive specialist solar pile driving machines, screwed or alternatively ballasted in position.

Piles may be cut off to height in select areas where refusal is encountered and not predicted by geotechnical investigations and the steel assembly will be attached in accordance with the manufacturer's proprietary system. Solar PV modules are then installed on the racking and secured in position to withstand wind loading. Once the modules have been installed the DC collection cables are laid on the structure and terminated to the modules. If a tracking system is being used, the rotating mechanism and servo motors will be installed on the support structure.

This phase will require the use of equipment including pile drivers, augers, forklifts, welders, oxy acetylene, trenchers, excavators, pickup trucks, water trucks, flatbed trucks and cranes. Where pneumatic piling is to occur, a 100 m exclusion zone will be in place whereby hearing protection will be mandatory.

5.3 PCU Assemblies and Electrical Collection System

Once the PV modules have been installed, cable trenches will be excavated, and AC and DC cables will be laid. Trenches will be backfilled with excavated material and cables will be terminated to the modules. Foundations for the inverter assemblies will be constructed as either concrete slabs on the ground or piles. The inverter and transformer assemblies (PCUs) will be placed on the foundations and the cables will be terminated to them. Testing and quality assurance will be carried out as connections are made.

5.4 Substation Modification Works

The substation modification works will generally include the construction of additional equipment foundations within the existing substation area. Concrete equipment foundations will be formed and poured after cables, earthing, conductor, culverts, concrete cables pits and conduits (ducts) are installed below the ground.

5.5 Commissioning

Once all the PCU assemblies and electrical collection system has been installed, commissioning of equipment will commence systematically i.e. once a block has been installed and pre-commissioning finalised it will then be energised. Commissioning will include terminations, testing, calibration and troubleshooting. The inverters, transformers, collection system, solar PV array, Substation and storage system will be tested prior to commencement of commercial operations to ensure any system issues are rectified. Commissioning will involve Site crews and TransGrid personnel. Upon completion of successful testing, the Proposed Development can be connected to the TransGrid network and it will be ready to export electricity.

This phase of the construction process will require skid steers, pile drivers, trenchers, backhoes, cranes, aerial lifts, flatbed trucks and concrete trucks on site.

5.6 Restoration

During construction, additional infrastructure will be established including Site offices and amenities, vehicle parking and turning areas, equipment laydown and storage areas, safety fencing, and temporary power. This infrastructure will be removed at completion of commissioning and disturbed ground made good through re-topsoiling, re-profiling and establishing a groundcover.

5.7 Operation and Maintenance

Operational monitoring of the GSF will be undertaken remotely from an off-site location and apart from a routine maintenance program, operators will visit the GSF when responding to any performance issues (i.e. where actual output measured by the monitoring system deviates from generation forecasts and other key performance metrics).

Activities at the GSF that will be part of a routine maintenance program will generally include:

- Equipment, cabling, electrical connection and communications system inspection and maintenance
- Fence, access road and control room management
- Vegetation (fuel load), weed and pest management
- Solar PV module washing on an as-needed basis (see below)
- Security monitoring.

The solar PV modules may be periodically washed to remove excess dirt, dust or other matter (i.e. bird droppings) which can prevent sunlight from effectively reaching the solar cells and subsequently reducing the electricity production output. The frequency of any washing will depend on monitoring the actual performance of the GSF.

If required, washing will be carried out manually or mechanically. Clean water would be transported to Site by water trucks that would then be driven down the rows between the strings of modules and personnel or mechanical devices would use spray equipment to clean the surface of modules.

5.8 Upgrading, Repowering and/or Decommissioning

Upgrading or repowering of the PV modules and ancillary equipment may be required throughout the operational life of the project. This will be a commercial decision based on the relative economics of solar PV generation compared to alternatives at the time.

Upgrading and repowering would involve removal of any obsolete equipment such as modules and PCUs and disposing of these off-site in accordance with applicable waste laws and good practice, including recycling wherever possible. The technology available at that time would be installed using the existing structures and infrastructure to the extent possible and the GSF would be recommissioned.

If the decision at the time is to decommission the GSF, rather than apply for an additional operational term, the procedure would be to initially disconnect the solar farm from the TransGrid network. The interconnecting cable would be removed and disposed of off-site, reusing and recycling wherever possible. Foundations would be broken up and removed off-site.

Modules and the racking system would be removed and recycled, and it could be expected that a significant amount of the support structure could be reused or recycled off-site. Piles will be lifted out of the ground and recycled wherever possible. In general, cables are likely to be worth removing and recycling. However underground cables located more than 500 mm below ground level may be left buried to avoid excessive ground disturbance. The Site control room and facilities would be lifted off their foundations and transported off-site on flatbed trucks. Finally, the surface of the Site would be ripped and returned to agricultural use.

6. Statutory Framework

This chapter addresses Commonwealth, State and local legislation which is potentially relevant to the Proposed Development and discusses the applicability of each statute, including any additional approvals, licenses or permits which are required.

6.1 Permissibility

The Proposed Development is entirely situated on land zoned as RU1 Primary Production (Figure 6-1) under the *Greater Hume Local Environmental Plan 2012* (Greater Hume LEP). Solar energy systems are prohibited in the RU1 Zone. However, pursuant to clause 34(7) of the *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP), development for the purpose of a solar energy system may be carried out by any person with consent on any land (except land in a prescribed rural residential zone). Therefore, the Proposed Development is permissible with consent.

Under Schedule 1 (clause 20) of the SEPP(SRD), solar electricity generating works with a capital investment value of more than $30 million are classed as SSD and therefore the consent authority is DPIE.

As the activity is SSD, the assessment framework for the Proposed Development is Division 4.7 of the EP&A Act.

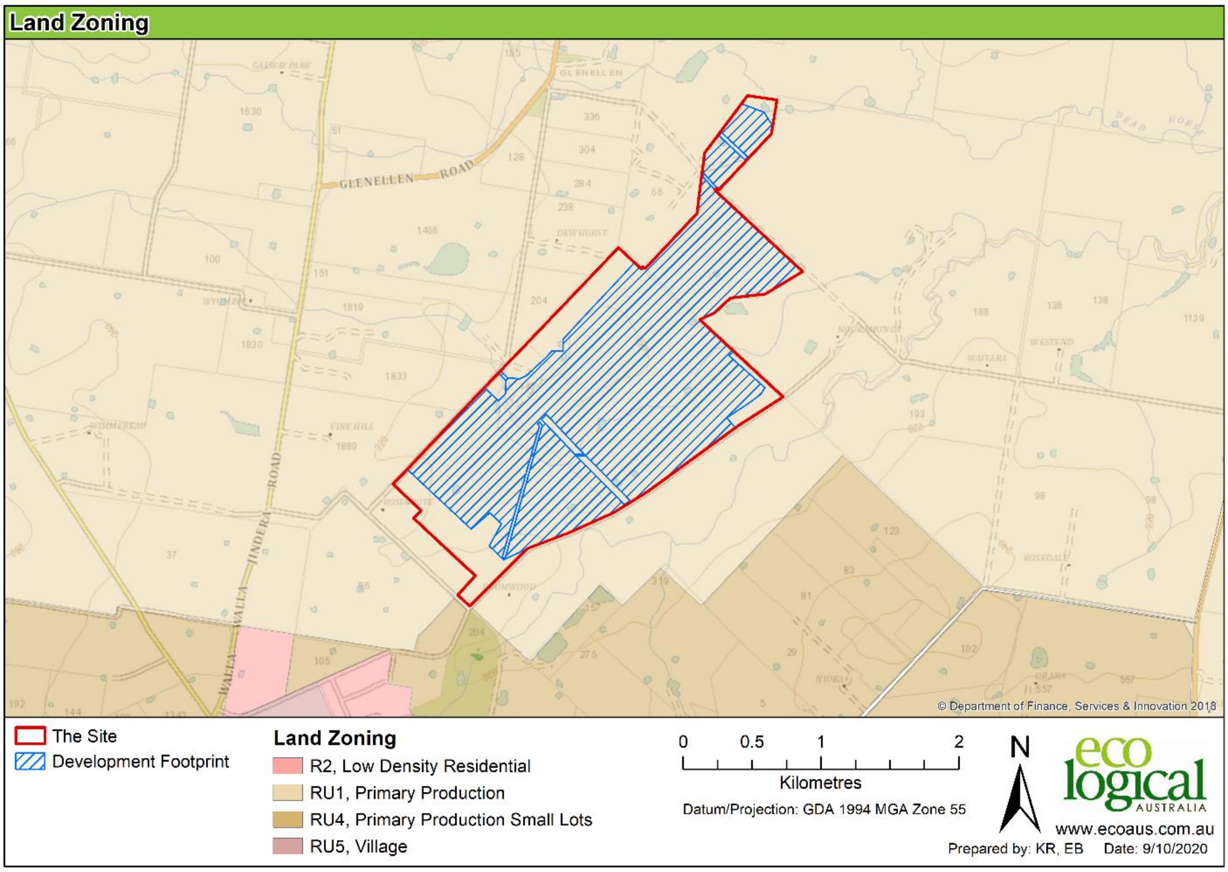

Figure 6-1: Land-use zones

6.2 Commonwealth Legislation

6.2.1 Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act protects MNES, such as threatened species and ecological communities, migratory species (protected under international agreements), and national heritage places (among others).

Any actions that will, or are likely to, have a significant impact on MNES require referral to, and approval from, the Australian Government Environment Minister. Significant impacts are defined by the Commonwealth guidelines and policies (DoEE, 2013) for MNES.

Some MNES have been identified as potentially occurring on or near the Site, including TECs and threatened species. Potential MNES impacts are summarised in Table 6-1. It is concluded that the Proposed Development will not likely have a significant impact upon any MNES, therefore, a referral to the Commonwealth is not required.

Table 6-1: Impacts on Matters of National Environmental Significance

	Factor	Likely impact
a.	*Any impact on a World Heritage property?* The proposal would not impact any World Heritage property	Nil
b.	*Any impact on a National Heritage place?* The proposal would not impact any National Heritage place	Nil
c.	*Any impact on a wetland of international importance?* The proposal would not impact any wetland of international importance	Nil
d.	*Any impact on a listed threatened species or communities?* Detailed habitat assessments and targeted flora and fauna surveys addressed in Section 8.2 of this EIS and Appendix C, indicate that the proposal is unlikely to impact on EPBC listed threatened species or TECs.	Unlikely
e.	*Any impacts on listed migratory species?* Assessments in Section 8.2 of this EIS and Appendix C, indicate that the proposal is unlikely to impact on any Commonwealth-listed migratory species	Unlikely
f.	*Any impact on a Commonwealth marine area?* The proposal would not impact any Commonwealth marine area	Nil
g.	*Does the proposal involve a nuclear action (including uranium mining)?* The proposal does not involve a nuclear action	Nil
h.	*Additionally, any impact (direct or indirect) on Commonwealth land?* No Commonwealth land would be impacted by the proposal	Nil

6.2.2 Native Title Act 1993

The *Native Title Act 1993* recognises the rights and interests of Indigenous people to land and aims to provide for the recognition and protection of common law native title rights. Areas of land within the Site where native title may exist include public road reserves and other Crown land.

A search of the National Native Title Tribunal Register was undertaken in September 2018. There were no native title applications, determinations of native title, or Indigenous Land Use Agreements existing over the Site. As such, the Proposed Development is not subject to any native title claims at this time.

6.2.3 Renewable Energy (Electricity) Act 2000

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

(a) to encourage the additional generation of electricity from renewable sources
(b) to reduce emissions of greenhouse gases in the electricity sector
(c) to ensure that renewable energy sources are ecologically sustainable.

The objects of the RE Act are achieved through the issuing of certificates for the generation of electricity using eligible renewable energy sources. This requires certain purchasers (called liable entities) to surrender a specified number of certificates for the electricity that they acquire during a year.

Under section 17 of the RE Act, solar energy is a renewable energy source eligible under the Commonwealth Government's RET. The Proposed Development will need to be accredited as a Renewable Energy Generator to create Renewable Energy Certificates.

6.2.4 Hazardous Waste (Regulation of Exports and Imports) Act 1989

The *Hazardous Waste (Regulation of Exports and Imports) Act 1989* (Hazardous Waste Act) regulates the export, import and transit of hazardous waste to ensure human beings and the environment, both within and outside of Australia are protected from the harmful effects of hazardous wastes. Pursuant to section 40 of the Hazardous Waste Act, "*A person must not export hazardous waste unless:*

(a) the person is the holder of an export permit authorising the person to export the waste; or
(b) the person is the holder of a transit permit authorising the person to export the waste; or
(c) the export has been ordered under section 34 or 35A."

There will be no hazardous wastes produced by the Proposed Development.

6.3 State Legislation

6.3.1 Environmental Planning and Assessment Act 1979 (EP&A Act)

The EP&A Act is the principal planning legislation for NSW. It provides a framework for the overall environmental planning and assessment of development proposals. As the activity is SSD, the assessment framework for the Proposed Development is Division 4.7 of the EP&A Act.

The Site will be leased for the purposes of the Proposed Development. Since the lease will extend for a term greater than five years, the Proposed Development will be deemed 'subdivision' of land pursuant to section 6.2(1)(b) of the EP&A Act. It is noted that this is not an actual subdivision of the land which creates a new allotment and deposited plan, and that the current DPIE approach is that a formal request for a subdivision certificate compliant with the requirements of clause 157 of the EP&A Regulation is not required. Development consent is sought for these subdivisions inclusive of minor lot boundary variations should adjustment be required at the detailed design stage.

6.3.2 State Environmental Planning Policy (State and Regional Development) 2011 (SEPP(SRD))

Clause 20 of Schedule 1 of the SEPP(SRD) states that "*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 have a capital investment value of more than $30 million*" shall be classified as SSD under Division 4.7 of the EP&A Act.

The Proposed Development has a capital investment value estimated to be approximately $250 million, therefore is classified as a SSD. A formal quantity surveyor's report confirming the capital investment value of the Proposed Development is provided to DPIE separately to this EIS as part of the DA.

The Minister for Planning is the consent authority for SSD applications. SSD applications are assessed by DPIE, and in some cases the Minister may delegate decision making to Department staff. However, the Minister may also delegate the consent authority function to the IPC if the legislative triggers are met.

6.3.3 State Environmental Planning Policy (Infrastructure) 2007 (ISEPP)

The ISEPP was introduced to facilitate the effective delivery of infrastructure across NSW. In most cases, the ISEPP overrides the provisions of other Environmental Planning Instruments and provides permissibility and development assessment provisions which apply across the State for different infrastructure sectors.

Pursuant to clause 34(7), development for the purpose of a solar energy system may be carried out by any person with consent on any land (except land in a prescribed rural residential zone). Therefore, the Proposed Development is permissible with consent.

6.3.4 State Environmental Planning Policy (Primary Production and Rural Development) 2019

The aims of this Policy are as follows:

- *(a) to facilitate the orderly and economic use and development of lands for primary production*
- *(b) to reduce land use conflict and sterilisation of rural land by balancing primary production, residential development and the protection of native vegetation, biodiversity and water resources*
- *(c) to identify State significant agricultural land for the purpose of ensuring the ongoing viability of agriculture on that land, having regard to social, economic and environmental considerations*
- *(d) to simplify the regulatory process for smaller-scale low risk artificial waterbodies, and routine maintenance of artificial water supply or drainage, in irrigation areas and districts, and for routine and emergency work in irrigation areas and districts*
- *(e) to encourage sustainable agriculture, including sustainable aquaculture*
- *(f) to require consideration of the effects of all proposed development in the State on oyster aquaculture*
- *(g) to identify aquaculture that is to be treated as designated development using a well-defined and concise development assessment regime based on environment risks associated with site and operational factors.*

Pursuant to clause 11 land identified as being State significant agricultural land is listed in Schedule 1. Schedule 1 does not currently identify any land. Given its temporary nature and opportunities for ongoing grazing activities within and adjoining the Development Envelope, the Proposal does not compromise any of the above objectives nor impact any State significant agricultural land.

6.3.5 State Environmental Planning Policy (Koala Habitat Protection) (Koala SEPP)

The Koala SEPP replaces SEPP 44, which was repealed on 1 March 2020. The Koala SEPP aims to encourage the conservation and management of areas of natural vegetation that provide habitat for *Phascolarctos cinereus* (Koala). By supporting a permanent free-living population over their present range of habitats it is hoped that the current trend of Koala population decline would be reversed.

The Greater Hume LGA is listed in Schedule 1 of the Koala SEPP. There is no current Koala Plan of Management in Greater Hume LGA. The Project area is identified as Site Investigation Area for Koala Plans of Management.

The biodiversity impact assessment has assessed the Project in relation to potential for impacts on Koala habitat (Section 8.2 and Appendix C). Targeted surveys were undertaken for Koala and did not record this species.

6.3.6 State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33)

SEPP 33 defines and regulates the assessment and approval of potentially hazardous or offensive development. Under clause 3 of the SEPP 33, a 'potentially hazardous industry' is defined 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 in relation to the locality:*
>
> *(a) to human health, life or property, or*
> *(b) to the biophysical environment,*
>
> *and includes a hazardous industry and a hazardous storage establishment."*

Clause 3 also defines a 'potentially offensive industry' as

> *"… a development for the purposes 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."*

A preliminary hazard analysis (PHA) is required for development proposals classified as 'potentially hazardous industry' to determine the risks to people, property and the environment. Appendix 3 of the *Applying SEPP 33* guidelines list the industries that are considered to fall within SEPP 33. Solar farms and energy storage facilities are not listed in Appendix 3, however an assessment of hazardous activities associated with the Proposed Development is provided in Section 8.10.

6.3.7 State Environmental Planning Policy No. 55 – Remediation of Land (SEPP 55)

SEPP 55 aims to promote 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, a consent authority must not consent to the carrying out of any development on land unless:

(a) it has considered whether the land is contaminated, and
(b) if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and
(c) if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.

A review on 25 August 2020 of the Environmental Protection Authority (EPA) Contaminated Land Record under section 58 of the *Contaminated Land Management Act 1997* and the List of NSW contaminated sites notified to the NSW EPA under section 60 of *Contaminated Land Management Act 1997* did not reveal any registered contaminated land sites within or surrounding the Site.

A review on 25 August 2020 of premises currently regulated by an Environmental Protection Licence (EPL) under the *Protection of the Environment Operations Act 1997* (POEO Act) and premises that are no longer required to be licensed under the POEO Act did not identify any EPLs within or surrounding the Site.

There is a risk of contamination from agricultural activities such as pesticides could be present within the Site. However, the risk is considered low and no evidence of contamination was observed during the site assessments.

Pursuant to clause 7 of SEPP 55 there is no apparent reason to consider that land to be impacted by the Proposed Development would be contaminated.

6.3.8 Biodiversity Conservation Act 2016 (BC Act)

The purpose of the BC Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ESD. The BC Act contains provisions relating to; threatened species and ecological community listings and assessment; section 1.7 of the EP&A Act; and repealing the *Threatened Species Conservation Act 1995*. The BC Act provides for a biodiversity offsets scheme incorporating a single biodiversity assessment methodology (BAM), calculation and retirement of biodiversity credits and biodiversity assessment and approvals. The BC Act also contains measures for flora and fauna protection, repealing parts of the *National Parks and Wildlife Act 1974* (NPW Act).

Under section 7.9(2) of the BC Act, SSD development applications are to be accompanied by a biodiversity development assessment report (BDAR). Under section 7.14, the Minister for Planning must take into consideration the likely impact of the Proposed Development on biodiversity values as assessed in the BDAR. If the Minister is of the opinion that the Proposed Development will have serious and irreversible impacts on biodiversity values, the Minister may require the implementation of appropriate measures to minimise those impacts before granting consent. These impacts are described in detail in Section 8.2; Appendix C.

The *Biodiversity Conservation Regulation 2017* (BC Regulation) supports the BC Act and provides for the licensing and management of activities that affect biodiversity. It also defines additional biodiversity values which are relevant to the application of the BC Act. Impacts on biodiversity values as a result of actions outlined in section 6.1 must be assessed in the BDAR, but do not require additional offsets. Section 6.8 prescribes the content that must be included in a BDAR.

6.3.9 Fisheries Management Act 1994 (FM Act)

The FM Act provides for the protection, conservation, and recovery of threatened aquatic species defined under the Act. It also makes provision for the management of threats to threatened aquatic species, populations, and ecological communities defined under the Act, as well as the protection of fish and fish habitat in general.

Two waterbodies (Kilnacroft Creek and Dead Horse Creek) within the Site are mapped as Key Fish Habitat (KFH), and further KFH is identified downstream of the Site in Bowna Creek (NSW DPI, n.d. a). KFH is not defined under the FM Act, however the NSW Department of Primary Industries (DPI) provides a definition for KFH as generally including habitats that are crucial to the survival of native fish stock, excluding man-made habitats such as off-stream dams and ponds, and those natural waterways which are dry for the majority of the time or have limited habitat value.

A section 201 permit will not be required for any dredging or reclamation work associated with the Proposed Development as this requirement does not apply to SSD. Furthermore, there will be no harm to marine vegetation and no blocking of fish passage; therefore, permits under sections 205 and 219 of the FM Act are not required. Nevertheless, methods for minimising the impacts of vehicular and cable crossings (as detailed in Section 8.9) will be implemented to reduce impacts to all creeks identified as containing KFH.

Potential impacts to threatened aquatic fauna and ecological communities listed under Schedule 4 of the FM Act are assessed in Section 8.9.

6.3.10 Water Management Act 2000 (WM Act)

The objective of the WM Act is the sustainable and integrated management of the State's water for the benefit of both present and future generations. The WM Act recognises the need to allocate and provide water for the environmental health of the State's rivers and groundwater systems, while also providing licence holders with more secure access to water and greater opportunities to trade water through the separation of water licences from land.

The WM Act regulates controlled activities on waterfront land in NSW. Waterfront land is defined as the bed of any river, together with any land lying between the bed of the river and a line parallel to, and the prescribed distance (being 40 m) inland of, the highest bank of the river.

A controlled activity, within the meaning of the WM Act, includes the deposition or removal of material (whether or not by extractive methods) or vegetation from waterfront land, or the carrying out of any other activity that affects the quality or flow of water in a water source. Whilst vehicular crossings and the installation of cables are controlled activities undertaken on waterfront land, a permit under section 91 of the WM Act is not required by virtue of section 4.41 of the EP&A Act.

Vegetated Riparian Zones and riparian corridor widths have been planned in accordance with the *Guidelines for Controlled Activities on waterfront land—Riparian corridors* (NRAR, 2018). A detailed discussion of these matters is contained in Section 8.9.

6.3.11 Local Land Services Act 2013 (LLS Act)

The LLS Act provides the framework for clearing of native vegetation that does not require development consent on rural land in NSW. It is an offence under section 60N of the LLS Act for a person to clear native vegetation in a regulated rural area, unless the person establishes any of the following defences:

(a) that the clearing is for an allowable activity authorised under Division 4 and Schedule 5A,
(b) that the clearing is authorised by a land management (native vegetation) code under Division 5,
(c) that the clearing is authorised by an approval of the Panel under Division 6,
(d) that the clearing is authorised under section 60O (Clearing authorised under other legislation etc.).

The Proposed Development, including vegetation clearing, is being assessed under Part 4 of the EP&A Act, hence clearing of vegetation for the purpose of GSF is authorised under this Act but in accordance with the assessments undertaken by the BDAR under the BC Act, and does not require approval under Division 6 of Part 5A of the LLS Act.

6.3.12 National Parks and Wildlife Act 1974 (NPW Act)

The main aim of the NPW Act is to conserve the natural and cultural heritage of NSW. An initial 'due diligence' assessment has indicated that there is a low risk that Aboriginal objects and/or sites may occur within the Site. This was further corroborated through the preparation of an Aboriginal Cultural Heritage Assessment for the Site.

Pursuant to section 4.41 of the EP&A Act, an Aboriginal Heritage Impact Permit (AHIP) under section 90 of the NPW Act is not required for SSD, although the analyses in Section 8.3 and Appendix D include Aboriginal Cultural Heritage Assessment and recommendations for appropriate management measures.

6.3.13 Heritage Act 1977

Historic relics, buildings, structures and features are protected under the *Heritage Act 1977* (Heritage Act). The Heritage Act defines 'environmental heritage' as those places, buildings, works, relics, moveable objects and precincts of Local or State significance. Identified heritage items are listed in the heritage schedule of the local Council's LEP or listed on the State Heritage Register, or by an active Interim Heritage Order.

Under section 139 of the Heritage Act, a person must not disturb or excavate any land knowing or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damage or destroyed unless the disturbance or excavation is carried out in accordance with an excavation permit. A relic is any deposit, artefact, object or material that relates to the settlement of the area that comprises NSW, not being Aboriginal settlement, and is of State or local heritage significance. Section 139 does not apply to a relic that is subject to an interim heritage order made by the Minister or a listing on the State Heritage Order.

The potential impacts on historic heritage are addressed in Section 8.4 of this EIS. No heritage items or places have been identified within the Site. The Proposed Development would not have any direct or indirect impacts on any items of historic heritage significance and a section 139 permit is not required pursuant to section 4.41 of the EP&A Act.

6.3.14 Crown Land Management Act 2016

The CLM Act and the *Crown Land Legislation Amendment Act 2017* came into effect on 1 July 2018, repealing and consolidating seven pieces of legislation, including the *Crown Lands Act 1989*.

Crown land includes Crown reserves, state parks, land that is leased or licensed, minor ports, river entrances, caravan parks, places of cultural and community significance, submerged land of public waterways (except where under the ownership of NSW Maritime Authority) and Crown roads. It is an offence to reside, erect a structure, graze or drove livestock, clear, dig up, cultivate or enclose public land without lawful authority. Under Part 3 of the Act, prior to any allocation action of Crown land including lease, sale, reservation, dedication, licence or permit, the land must be assessed to consider capacities and suitable uses.

Crown roads are generally unformed ('paper roads') that provide lawful access to freehold or leasehold land where little or no subdivision has occurred since the original Crown subdivision of NSW in the early 19^{th} century. The Minister is the authority for all Crown roads.

The proponent has applied to the NSW Department of Industry – Lands & Water's crown land department for a crown road licence over the crown roads within the Site under Part 5 of the CLM Act.

6.3.15 Conveyancing Act 1919

Under section 23F of the Conveyancing Act, the Registrar-General can refuse to register a transaction in relation to the lease of part of an existing lot unless the boundaries of each part into which the land is divided follows the boundaries of an existing lot. There is an exception for a lease where the term does not exceed 5 years.

As such, because each lease required to secure the land for the Proposed Development will exceed five years, the Registrar-General will not register the leases unless development consent is obtained for the subdivision of the land for leasing purposes. An indicative subdivision plan is shown in Figure 4-2 and described in Section 4.1.2 of this EIS.

The Greater Hume LEP provides that land may be subdivided with development consent (clause 2.6) but any resulting lot must not be less than the identified minimum lot size (clause 4.1(3)). The applicable minimum lot size for the area of the Proposed Development is 100 ha. Therefore, the creation of a lot for lease purposes which is less than 100 ha is prohibited under the Greater Hume LEP. This prohibition applies to all Proposed Lots. Despite this prohibition, section 4.38(3) of the EP&A Act allows the consent authority to grant development consent to a SSD which is partly prohibited. Accordingly, development consent may be granted, inclusive of this subdivision. It is the intention of this EIS (specifically described in Section 4.1.2 and Table 4-2) to form the application for 'deemed subdivision'.

Section 88B of the *Conveyancing Act 1919* also provides for the creation of easements which benefit the land and its intended uses. Once the land is subdivided and the deposited plans registered, easements for access tracks, right of carriageway, transmission lines and power cabling may need to be sought and registered with NSW Land Registry Services where these land carriageway rights are required.

6.3.16 Roads Act 1993

Section 138 of the *Roads Act 1993* (Roads Act) sets out the requirement for approval to carry out certain works within the vicinity of a road. Under section 138 a person must not, without consent of the appropriate roads authority:

(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.

The Proposed Development will be accessed via the Walla Walla-Jindera Road (southbound), and Lindner Road, with immediate access to the Site via the existing Ortlipp Road. These are existing public roads. Therefore, approval to connect to a public road and to undertake work in, on or over a public road is required under section 138 of the Roads Act. Transport routes and traffic analyses for the Proposed Development are assessed in Section 8.8 and Appendix H, including recommended areas of road infrastructure upgrades. Formal applications for road upgrades under section 138 will be managed during the post-approvals agency liaison process.

6.3.17 Protection of the Environment Operations Act 1997 (POEO Act)

The objectives of the POEO Act are to protect, restore and enhance the quality of the environment, in recognition of the need to maintain ecologically sustainable development.

Pursuant to section 48 of the POEO Act, premises-based scheduled activities, as defined in schedule 1, require EPLs from the NSW EPA. Under clause 17 of Schedule 1, electricity generation is a scheduled activity requiring an EPL, however solar power is not included in this definition. Therefore, the Proposed Development is not a scheduled activity under the POEO Act, and an EPL is not required.

Part 5.7 of the POEO Act provides the duty to notify the relevant authority of pollution incidents, and under section 120 it is an offence to pollute waters. The Proposed Development will be managed to ensure pollution risks to soil, waterways and air quality are avoided or minimised. In the event of a pollution incident that causes or threatens material harm to the environment, the NSW EPA would be notified.

The legal requirements for waste management are also established under the POEO Act and the *Protection of the Environment Operation (Waste) Regulation 2005.* Under section 143 it is an offence to unlawfully transport and dispose of waste.

Waste minimisation and management is discussed in Section 8.11.

6.3.18 Biosecurity Act 2015 (Biosecurity Act)

The Biosecurity Act repealed the *Noxious Weeds Act 1993* and provides 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.

Part 3 of the Biosecurity Act applies a general biosecurity duty for any person who deals with biosecurity matter or a carrier to prevent, eliminate or minimise any biosecurity risk they may pose. Under section 23 of the Act, a person who fails to discharge a biosecurity duty is guilty of an offence.

Whilst the Act provides for all biosecurity risks, implementation of the Act for weeds is supported by Regional Strategic Weed Management Plans (RSWMP) developed for each region in NSW. Appendix 1 of each RSWMP identifies the priority weeds for control at a regional scale. However, landowners and managers must take appropriate actions to reduce the impact of problem weed species regardless of whether they are listed in Appendix 1 of the RSWMP or not as the general biosecurity duty applies to these species.

Weed management is discussed in Sections 8.2 and 8.5.

6.3.19 Rural Fires Act 1997 (Rural Fires Act)

The Rural Fires Act provides for the preparation, mitigation and suppression of bush and other fires in local government areas and to provide protection of infrastructure and environment, economic, cultural, agricultural and community assets from damage arising from fire.

The Site contains Bushfire Prone Land as mapped on the Greater Hume Shire Bushfire Prone Land Map (Greater Hume Shire Council & LPI, 2011). However, the Proposed Development is not a subdivision for residential or rural residential purposes nor is it for a special fire protection purpose, hence issue of a bush fire safety authority under section 100B of the Rural Fires Act is not required. Furthermore, a section 100B authority is not required pursuant to section 4.41 of the EP&A Act.

Fire risk is discussed in Section 8.10 and Appendix E.

6.3.20 Waste Avoidance and Resource Recovery Act 2001 (WARR Act)

The WARR Act introduces a scheme to promote extended producer responsibility for the lifecycle of a product. The objectives of the WARR Act are:

- *(a) to encourage the most efficient use of resources and to reduce environmental harm in accordance with the principles of ecologically sustainable development,*
- *(b) to ensure that resource management options are considered against a hierarchy of the following order:*
  - *(i) avoidance of unnecessary resource consumption,*
  - *(ii) resource recovery (including reuse, reprocessing, recycling and energy recovery),*
  - *(iii) disposal,*
- *(c) to provide for the continual reduction in waste generation,*
- *(d) to minimise the consumption of natural resources and the final disposal of waste by encouraging the avoidance of waste and the reuse and recycling of waste,*
- *(e) to ensure that industry shares with the community the responsibility for reducing and dealing with waste,*
- *(f) to ensure the efficient funding of waste and resource management planning, programs and service delivery,*
- *(g) to achieve integrated waste and resource management planning, programs and service delivery on a State-wide basis,*
- *(h) to assist in the achievement of the objectives of the* Protection of the Environment Operations Act 1997.

Waste minimisation and management is discussed in Section 8.11.

6.3.21 Mining Act 1992

The objective of the *Mining Act 1992* is to encourage and facilitate the discovery and development of mineral resources in NSW, having regard to the need to encourage ESD.

There are no existing mining leases or exploration licences over the Site (further detail is provided in Section 8.5).

6.4 Other Relevant Policies and Plans

6.4.1 Ecologically Sustainable Development (ESD)

ESD integrates social, economic and environmental considerations into the decision-making process. The principles of ESD are defined within the NSW *Protection of the Environment Administration Act 1991* and have been incorporated into NSW legislation, including the EP&A Act and the EP&A Regulation.

The Commonwealth of Australia (1992) defines ESD as "*using, conserving and enhancing the community's resources so that the ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased*".

The principle basis for ESD is that current and future generations should leave a natural environment that functions as well or better than the one inherited. Each of the principles of ESD with respect to the Proposed Development and its environmental impact assessment are considered in the following subsections.

6.4.1.1 Precautionary principle

The precautionary principle means that if there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

The environmental consequences of the Proposed Development have been assessed as accurately as possible, using appropriate specialists in relevant disciplines where required. The assessment process involved computer modelling, scientific research, analysis and interpretation of the potential environmental impacts associated with the proposed operations.

This process has enabled the impacts of the Proposed Development to be predicted with a reasonable degree of certainty. All predictions, however, contain a degree of variability and uncertainty, which reflects the nature of the environment. Where there has been any uncertainty in the prediction of impacts throughout the EIS process, a conservative approach was adopted to ensure the worst-case scenario was predicted in the assessment of impacts.

The Proposed Development is consistent with the precautionary principle in that where there was uncertainty, conservative overestimates where used, examples include:

- Potential impacts were assessed assuming the use of larger footprint areas than will ultimately be developed

- Where potential threats to the environment have been identified, mitigation measures have been developed to minimise such impacts
- Monitoring will be undertaken, if required, as a precautionary measure to reduce the effect of any uncertainty regarding the potential for environmental damage.

6.4.1.2 Social equity in inter-generational equity

Social equity involves value concepts of justice and fairness so that the basic needs of all sectors of society are met and there is a fair distribution of costs and benefits to improve the well-being and welfare of the community, population and society. Social equity includes inter-generational equity, which requires that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

The Proposed Development is consistent with the principles of social equity and inter-generational equity through the efficient use of a renewable energy source that provides a number of benefits to society.

Increased adoption of renewable energy sources will assist Australia to transition away from traditional carbon intensive energy production which is linked to atmospheric pollution and carbon emissions associated with climate change. Reduced carbon emissions have the potential to slow the effects of climate change, benefitting current and future generations.

Electricity generated from the Proposed Development would provide a clean electricity source for local and regional consumers in a cost-effective manner, providing improved opportunities and quality of life for all members of the regional community.

6.4.1.3 Conservation of biological diversity and maintenance of ecological integrity

Biological diversity refers to the diversity of genes, species, populations, communities and ecosystems, and the linkages between them. Maintaining biological diversity safeguards life support functions and can be considered a minimal requirement for intergenerational equity.

The Proposed Development would unavoidably impact up to 10 ha of native vegetation and 80 paddock trees. This clearing has been minimised through the EIS process following the initial principle of avoiding more dense stands of trees around the Proposed Development's periphery. The residual, unavoidable impacts are assessed in Section 8.2 and, given its environmental context shall be fully offset in the proposed Biodiversity Offset Strategy (BOS) developed in accordance with the requirements of the BAM.

Areas of higher conservation value have been avoided during the evolution of the project design where possible, and where identified impacts are unavoidable these will be managed by the implementation of mitigation measures and ecosystem credits. At the conclusion of the 30-year development approval, the Proposed Development shall be fully decommissioned and rehabilitated.

Therefore, it is concluded that the Proposed Development would not have a significant negative impact upon the biological diversity or the ongoing ecological integrity in the locality.

6.4.1.4 Improved valuation and pricing of environmental resources

The environment has conventionally been considered a free resource, with the true cost to the environment not factored into cost of production or use of the resource. This principle involves placing a monetary or social value on the environment that ultimately increases its value in order to decrease future exploitation.

The Proposed Development recognises and makes use of the inherent value in solar energy. This converts an abundant, renewable natural resource (sunlight) into a valuable and valued commodity (electricity).

The commitment to offset impacts to native vegetation and to fund future biological conservation activities through the BDAR recognises and places an appropriate monetary value on environmental protection and the maintenance of biodiversity.

6.4.2 Large-Scale Solar Energy Guideline for State Significant Development

This guideline, released January 2019, promotes best practice methods to inform site selection and the environmental impact assessment process for solar energy projects that are SSD (DPE, 2018). The guideline does not determine the permissibility of solar projects, but it does identify factors to be considered when planning and siting large-scale solar projects. These include, among other matters, visibility and topography, biodiversity, residences, natural hazards, resources, Crown Lands and agriculture (BSAL and IAL). The Proponent has considered all of these environmental features in considering the siting of the Proposed Development and the nature of the Development Footprint. The Proposed Development's interaction with, and impacts upon, all of these environmental features are explored throughout this EIS.

6.4.3 NSW Climate Change Policy Framework (2016)

The NSW Climate Change Policy Framework aims '*to maximise the economic and environmental wellbeing of NSW in the context of a changing climate and current and emerging international and national policy settings and actions to address climate change*'. The Framework outlines the State's long term aspirational objectives to achieve net-zero emissions by 2050 and to ensure NSW is more resilient to climate change (Office of Environment and Heritage (OEH), 2016). This aspirational objective is intended to provide a clear statement of the government's intent, commitment and level of ambition and to set expectations about the future emissions pathways that will help all sectors of the community plan and act. To achieve this ambitious target, the NSW electricity sector will need to transition away from a system heavily reliant on emission intensive fossil fuels. Importantly, it is stated that that '*net-zero emissions [2050] is consistent with strong economic growth and the NSW emission record to date*'.

6.5 Summary of Licences and Approvals Required

A summary of approvals and licences required for GSF prior to construction are outlined in Table 6-2.

Table 6-2: Approvals and licences required for the Proposed Development

Legislation	Approval/Licence
Roads Act 1993	Section 138
Crown Land Management Act 2016	Part 5 Division 5.6 – Licences over Crown Land

Although all relevant environmental impacts have been assessed in this EIS, due to the Proposed Development nature and being SSD, there are several approvals and licences not required, which are outlined in Table 6-3.

Table 6-3: Approvals and licences not required for the Proposed Development

Legislation	Approval/Licence
Fisheries Management Act 1994	Section 201
	Section 205
	Section 219
Water Management Act 2000	Section 91
Heritage Act 1977	Section 139
National Parks and Wildlife Act 1974	Section 90
Protection of the Environment Operations Act 1997	Section 48

7. Stakeholder and Community Consultation

Prior to the Trina Solar acquisition of GSF, CWPR conducted early and extensive consultation. Trina Solar have built upon this to bring near neighbours and key stakeholders of the Proposed Development up to date and ensure the broader community remains informed regarding changes to the Proposed Development under Trina Solar's ownership.

7.1 Consultation

Effective and broad community and stakeholder consultation provides communities and stakeholders with a clear understanding of a development proposal as well as opportunities to provide feedback to identify issues important to them and, as such, it is an essential part of the EIS process. The Proponent has revisited and expanded upon the extensive consultation CWPR has carried out with the local community, stakeholders from the wider area and relevant Government Agencies in order to understand and respond to community concerns during the design and assessment process leading to this DA. Clear examples of where this consultation has resulted in amendments to the Project design are as follows:

- extension of the Project setback from Lindner Road
- increase in depth of vegetation visual screening buffers
- addition of new vegetation buffers to the South East corner of the Site
- reduction in the number of paddock trees to be removed from the site
- retention of existing dam and vegetation on Northern boundary of property.

7.1.1 Consultation Objectives

Table 7-1 below outlines how the consultation objectives for the Proposed Development were established. These objectives will continue to be developed and deployed through a plan which addresses community engagement issues post-consent for the construction and operational phases of the project.

Table 7-1: Development of Consultation Objectives

Question	Considerations	Objectives
Who are the community stakeholders for the proposal?	Community stakeholders may come from groups within a range of geographical scales, for example: • Local residents • Nearby villages or towns • The broader regional council area • The wider State level • The National level.	• Consultation needs to ensure that all geographical scales are considered in the development of stakeholder and community understanding • Ensure those community groups that are potentially most affected by the Proposed Development are engaged with as a priority • Utilise the SEARs responses as an additional tool to identify stakeholders.

Question	Considerations	Objectives
What could be the main issues associated with each group, and how can these issues be clarified?	• Issues may be positive or negative depending on stakeholder perspective, and the potential impacts of the Proposed Development • Open and regular dialogue with interested and potentially impacted stakeholders allow an understanding of stakeholder perspectives to be built over time.	• Following the identification of stakeholders, address using appropriate communication tools at a level that correlates to stakeholder interest • Ensure that consultation with stakeholders is developed in a timely manner (at appropriate geographical scales) so that feedback can be incorporated into assessment and design • Ensure that project information is transparent and easy to understand.
What tools could be used to provide and receive information for each stakeholder group and what would be an effective communication strategy for each group?	• Different stakeholder groups will favour different communication methods • All stakeholder groups will not necessarily be known at the beginning of the project lifecycle.	• Use a wide variety of communication tools in order to ensure that all interested stakeholder groups can participate in the consultation process • Invest in wide range of mediums to facilitate ease of communication with the project team • Communication and consultation strategies must be adaptive to ensure they remain relevant as the Proposed Development develops.
How will consultation requirements change over time?	• Stakeholders' requirements will be different at different stages of the proposal • Consultation strategies will need to be engaged over the course of all project timescales.	• Ensure that communication about project timelines is communicated effectively • Ensure that the changing needs for communication of potentially affected stakeholders, particularly at the local level, or those that are deemed to have a high sensitivity to the Proposed Development are understood • Commit to maintaining effective communication through different project stages.

7.1.2 Consultation to Date

Following consideration of the consultation objectives and the identification of key stakeholders, the Proponent proceeded to undertake a broad range of activities to ensure that the scope of the Proposed Development could be adequately communicated to all relevant stakeholders.

Activities that have taken place are listed below in Table 7-2 and then expanded in the text that follows.

Table 7-2: Consultation activities timeline

Date	Stakeholder(s)	Activities
January-April 2018	GSF potential host landholders	Concept discussions, gauging interest of hosts to participation.
April 2018	TransGrid	Concept discussion.
July 2018	Local community, neighbours	Newsletter distribution (#1), door-knocking, introduction to the Project.
July 2018	Greater Hume Shire senior staff	Introduction to the Project, discussions of Project interactions with Council and Council matters.

Date	Stakeholder(s)	Activities
July 2018	Local State MP	Informational meeting with MP Greg Aplin with discussions around possible community concerns and mitigation strategy.
August 2018	Local community, neighbours	Newsletter distribution (#2), door-knocking, general discussion of the Project, return information in response to earlier queries.
August 2018	Local Community, State and National	Media release, coverage in regional newspapers and national news websites.
August 2018	Greater Hume Shire Council senior staff	Further discussions of the Project interactions with Council and Council matters.
October 2018	Local community, neighbours	Newsletter distribution (#3), door-knocking, general discussion of the Project, return further information in response to earlier queries.
October 2018	Greater Hume Shire Councillors	Presentation to Councillors and senior staff regarding the Project including Q&A.
December 2018	Local community, neighbours	Newsletter distribution (#4), door-knocking, general discussion of the Project, discussion of EIS findings in relation to earlier queries.
June 2020	Local community	Media statement to provide update and details of project ownership change – commitment to community consultation prior to EIS lodgement.
July 2020	Local MPs, Greater Hume Council	Meeting with Justin Clancy, Member for Albury. Offer of meeting to Sussan Ley, Member for Farrer. Meeting with Council General Manager and Director Planning for project discussions and insights to preferred community engagement approach..
July 2020	Near Neighbours	One on one meetings with near neighbours and Landholders with CWPR to ensure handover and ongoing consideration of past issues raised.
August 2020	Local community, neighbours	Development of new Fact Sheet, Website. Establishment of dedicated Trina Solar Community Phone and Email.
August 2020	Local community, neighbours	Issue of Community Newsletter via Australia Post to 720 homes – provides detailed update on project planning.
August 2020	Meeting with CFA and RFS Command	Discussion of fire prevention measures incorporated into site layout.
August 2020	Neighbours	Letter delivery via Aust Post inviting near neighbours to a briefing with the Project Manager. Provide dedicated contact details.
August 2020	Councillors	Workshop with Councillors to provide detailed information and respond to likely community concerns.
August 2020	Community	Development of community survey as alternative means for collating community feedback in light of COVID-19 and physical distancing requirements. Included on Project website.
September 2020	Community	Publication of site concept map on Project Website for community review and comment.
September 2020	Community, general public	Public Exhibition of EIS.

Date	Stakeholder(s)	Activities
September 2020	Neighbours	Further door knocking of near neighbours and those met previously to provide specific details on concept plan and provide map.
Ongoing	Community, stakeholder	Ongoing responses to queries as required.

7.1.3 Consultation – Concept Discussions

The concept of co-locating a solar development to the adjacent Jindera substation was first proposed in conversations during January-March 2018 to a small group of residents with land near the substation. The idea of locating a solar farm adjacent to an existing grid connection point was how these early conversations came about. The opportunity was explored with those landholders individually in face to face meetings and phone calls.

Some landholders decided not to take the opportunity any further, while others continued with the discussions. The host landholders providing land and having a willingness to host the Proposed Development is the reason the Site is shaped the way it is presented in this EIS.

In parallel with early concept discussions with GSF host landowners, the proposal was also discussed with TransGrid in April 2018 in relation to design considerations associated with the existing Jindera substation and the potential use of the TransGrid land parcel along Ortlipp Road.

7.1.4 Consultation – Community and Potential Hosts

In April-July 2018, land suitability assessments were undertaken with a view to identifying preferable areas to host a development. The assessment involved evaluating topographic information such as contours and vegetation, with a land ownership overlay. This cursory evaluation provided the basis for further discussions with hosts and helped to shape the Proposed Development.

Primary areas of interest included flat, clear land located with minimal remnant vegetation and avoidance of creek lines. In general, these criteria resulted in shaping the Proposed Development in the land available.

Initial targeted landowner discussions were held with neighbours to the Site in July 2018, which expanded to wider community correspondence through the production and hand delivery of an initial newsletter introducing the Proposed Development and aimed at drawing feedback from the wider community. Fifty newsletters were distributed, which included among others, to 31 residences in the area and 25 face to face discussions were held.

During July 2018 consultation was undertaken with senior council staff at Greater Hume Shire Council and Albury City Council. This included an introduction to the Proposed Development with a major focus on community consultation (undertaken and planned) and the potential interactions with key council matters.

An informational meeting was held with Greg Aplin MP, the sitting state member for Albury. Newsletters and information were provided as well as details about technology, impacts and mitigations were discussed. A particular focus of the conversation was the concerns and opportunities for the community that arise from this project.

7.1.5 Consultation – Design Refinement

Feedback received during conversations in July 2018 was used to refine the design of the infrastructure within the Site, as well as define the transport routes. Refinements within the Site included introducing infrastructure setbacks from residences, retaining identified remnant vegetation patches, nominating site boundary vegetation screening, and limiting proposed transport routes to only the western part of Lindner Road and the southern part of Ortlipp Road, with a commitment to avoid Jindera town and Drumwood Road.

The refined Proposed Development was incorporated into consultation in August through the distribution of a second newsletter via door knocking and further discussions with Greater Hume Shire Council senior staff. Further feedback was received from neighbours near the south east of the Site which resulted in an additional setback of the Development Footprint from residences. This second round of consultation allowed for the response to particular questions or concerns raised by individuals during the August consultation. In all, 34 residences in the area were attended where newsletters were distributed and 23 face to face discussions were held.

7.1.6 Consultation – Environmental Assessment Requirements

In August 2018 the GSF Preliminary Environmental Assessment (PEA) was lodged with the NSW Department of Planning and Environment (DPE), requesting that SEARs be issued. The project Site outlined in the PEA had been guided by preceding consultations (as outlined above).

The SEARs were provided by DPE on the 14 of September 2018. The SEARs are intended to guide the structure and content of the EIS and reflect the responsibilities and concerns of NSW government agencies in relation to the environmental assessment of the Proposed Development.

During the preparation of the EIS according to the SEARs, it was identified that approval was not required from the Australian Government Environment Minister due to an absence of impact significance on MNES, thus the GSF was not referred for approval (Section 6.2.1).

A summary of key issues raised in the SEARs and the section of the EIS where they are addressed is provided in Table 7-3. In addition to the SEARs, additional issues raised by statutory agencies through formal correspondence attached to the SEARs are summarised in Table 7-4, together with the relevant section which addresses that issue in the EIS.

Table 7-3: Secretary's Environmental Assessment Requirements for GSF

Issue	Requirement	Section in EIS
General Requirements	• A stand-alone executive summary	Executive Summary
	• A full description of the development, including:	Section 3
	○ Details of construction, operation, and decommissioning	
	○ 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)	Figure 2-4 Appendix B
	○ Detailed constraints map identifying the key environmental and other land use constraints that have informed the final design of the development.	Figure 2-3

Issue	Requirement	Section in EIS
	• 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 farms, rural residential development and subdivision potential).	Section 3
	• 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 Jindera Solar Farm (JSF)), 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) ○ A description of the measures that would be implemented to monitor and report on the environmental performance of the development.	Section 8
	• A consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS	Section 9
	• The reasons why the development 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 have been incorporated into 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 ○ Feasible alternatives to the development (and its key components), including the consequences of not carrying out the development.	Section 9.3
	• a detailed consideration of the capability of the project to contribute to the security and reliability of the electricity system in the National Electricity Market, having regard to local system conditions and the Department's guidance on the matter.	Section 3
	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 EP&A Regulation) of the proposal, including details of all assumptions and components from which the CIV calculation is derived • certification that the information provided is accurate at the date of preparation. 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 EP&A Regulation).	Supplied to DPIE in separate transmittal
Key Issues	**Biodiversity**	

Issue	Requirement	Section in EIS
	• An assessment of the biodiversity values and the likely biodiversity impacts of the development project in accordance with Section 7.9 of the *Biodiversity Conservation Act 2016* (NSW), the Biodiversity Assessment Method (BAM) and documented in a Biodiversity Development Assessment Report (BDAR), unless OEH and DPE determine that the proposed development is not likely to have any significant impacts on biodiversity values • the BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM. • An assessment of the likely impacts on listed aquatic threatened species, populations or ecological communities, scheduled under the Fisheries Management Act 1994, and a description of the measures to minimise and rehabilitate impacts.	Section 8.2 Appendix C Section 8.9
	Heritage	
	• An assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development, including adequate consultation with the local Aboriginal community in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents*.	Section 8.3 and 8.4 Appendix D
	Land	
	• An assessment of the impact of the development on existing land uses on the site and adjacent land, including: ○ a consideration of agricultural land, flood prone land, Crown lands, mining, mineral or petroleum rights ○ a soil survey to determine the soil characteristics and consider the potential for erosion to occur ○ a cumulative impact assessment of nearby developments • An assessment of the compatibility of the development with existing land uses, during construction, operation and after decommissioning, including: ○ consideration of the zoning provisions applying to the land including subdivision ○ completion of a Land Use Conflict Risk Assessment in accordance with the Department of Industry's Land Use Conflict Risk Assessment Guide • A description of measures that would be implemented to remediate the land following decommissioning in accordance with State Environmental Planning Policy No 55 - Remediation of Land.	Section 8.5 Section 8.9
	Visual	
	• 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 to demonstrate it has been developed in consultation with affected landowners.	Section 8.6 Appendix F
	Noise	

Issue	Requirement	Section in EIS
	• 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 Industrial Noise Policy for Industry 2017* (INP), and cumulative noise impacts (considering other operations in the area) and a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria.	Section 8.7 Appendix G
	Transport	
	• An assessment of the peak and average traffic generation, including over-dimensional vehicles and construction worker transportation • An assessment of the likely transport impacts to the site access route (including Walla Walla Jindera Road, Lindner Road and Ortlipp Road), site access point, rail safety issues, any Crown land, particularly in relation to the capacity and condition of the roads • A cumulative impact assessment of traffic from nearby developments • A description of any proposed road upgrades developed in consultation with the relevant road and rail authorities (if required) • A description of the measures that would be implemented to mitigate any transport impacts during construction • Demonstration of consideration of potential cost-sharing of road upgrades with Jindera Solar Farm.	Section 8.8 Section 8.13 Appendix H
	Water	
	• An assessment of the likely impacts of the development (including flooding) on surface water and groundwater resources (including Bowna Creek and Dead Horse Creek, drainage channels, wetlands, riparian land, farm dams, 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 • A description of the erosion and sediment control measures that would be implemented in accordance with *Managing Urban Stormwater: Soils & Construction* (Landcom, 2004).	Section 8.9 Appendix I Appendix J
	Hazards and Risks	
	• A preliminary risk screening in accordance with the *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) • An assessment of all potential hazards and risks including but not limited to bushfires, spontaneous ignition, electromagnetic fields or the proposed grid connection infrastructure.	Section 8.10
	Socio-Economic	
	• An assessment of the likely impacts on the local community, provision of or increase the demand for public amenities and public services within the area and a consideration of the construction workforce accommodation.	Section 8.12

Issue	Requirement	Section in EIS
Consultation	In preparing the EIS for the development, you should consult with relevant local, State or Commonwealth Government authorities, infrastructure and service providers, community groups, affected landowners, exploration licence holders, quarry operators and mineral title holders (including Jindera Solar Farm). In particular, you must undertake detailed consultation with affected landowners surrounding the development, and Greater Hume 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 7

Table 7-4: Key issues raised by statutory agencies for GSF

Agency	Issues raised	Section in EIS
Greater Hume Shire Council	Greater Hume Shire Council requires the EIS to include: • detailed information concerning the proposed recycling of generated packaging waste • traffic assessment to include cumulative impacts of the possibility of an adjacent large-scale solar development being constructed concurrently to this proposal • clarity concerning the numbers employed during the operational phase of the development.	Section 8.11 Section 8.8 Section 8.13 Appendix H Section 8.12
	Greater Hume Shire Council make other notes: • Greater Hume Shire Council prefers their own fixed development contribution plan, however acknowledges that if the DPIE so wish, they could enforce a VPA • Greater Hume Shire Council requests the VPA is finalised prior to consent being granted.	Separate consultation with Greater Hume Shire Council
NSW Department of Planning & Environment (DPE) **- Division of Resources and Geoscience (DRG)**	The Draft SEARs require the proponents to address the projects potential impacts on existing land uses on the site and adjacent lands including mining, mineral and petroleum rights. The Draft SEARs also includes the requirement for consultation during the preparation of the Environmental Impact Statement (EIS) with exploration licence holders, quarry operators and mineral title holders. DPE(DRG) requires the EIS to include: • a dated and referenced search of current mining and exploration titles and applications. Evidence of the search should be provided in the form of a date referenced map. It should also be noted in the EIS that there are no operating quarries in the vicinity. Current mining and exploration titles and applications can be viewed through the Division's Minview map viewer at: http://www.resourcesandenergy.nsw.gov.au/miners-and-explorers/geoscienceinformation/services/online-services/minview • Consultation with the Division in relation to the proposed location of any offsite biodiversity offset areas or any supplementary biodiversity measures to ensure there is no consequent reduction in access to prospective land for mineral exploration, or potential for sterilisation of mineral or extractive resources.	Section 8.5 Section 1.3 Section 6.3.21 Section 8.5.2 Figure 8-9 To be completed during biodiversity offset site studies
Fire & Rescue NSW	Should a fire or hazardous material incident occur, it is important that first responders have ready access to information which enables effective hazard control measures to be readily	Section 8.10 Appendix E

Agency	Issues raised	Section in EIS
	implemented. Without limiting the scope of the emergency response plan (ERP), the following matters are recommended to be addressed: 1. That a comprehensive ERP is developed for the site. 2. That the ERP specifically addresses foreseeable on-site and off-site fire events and other emergency incidents, (e.g. fires involving solar panel arrays, bushfires in the immediate vicinity or potential hazmat incidents). 3. That the ERP detail the appropriate risk control measures that would need to be implemented to safely mitigate potential risks to the health and safety of firefighters and other first responders (including electrical hazards). Such measures would include the level of personal protective clothing required to be worn, the minimum level of respiratory protection required, decontamination procedures, minimum evacuation zone distances and a safe method of shutting down and isolating the photovoltaic systems (either totally or partially, as determined by risk assessment). 4. Other risk control measures that may need to be implemented in a fire emergency (due to unique hazards specific to the site) should also be included in the ERP. 5. That two copies of the ERP (detailed in recommendation 1 above) be stored in a prominent 'Emergency Information Cabinet' located in a position directly adjacent to the site's main entry point/s. 6. Once constructed and prior to operation, that the operator of the facility contacts the relevant local emergency management committee (LEMC). The LEMC is a committee established by Section 28 of the State Emergency and Rescue Management Act 1989. LEMCs are required to be established so that emergency services organisations and other government agencies can proactively develop comprehensive inter agency local emergency procedures for significant hazardous sites within their local government area. The contact details of members of the LEMC can be obtained from relevant local council.	
NSW Rural Fire Service (RFS)	The New South Wales Rural Fire Service advises that the preparation of an Environmental Assessment should incorporate a bush fire hazard assessment report prepared by a suitably qualified person. This assessment shall include site-specific recommendations for the proper design of: • asset protection zones (APZs) • measures to prevent a fire occurring within the site from developing into a bush/grass fire risk to the surrounding area • water supply for firefighting purposes • land and vegetation management • emergency management procedures, including the development of a Fire Management plan in consultation with the local NSW RFS District fire Control Centre • vehicular access and defendable space around the solar array. Protection for the facilities from bush fires can be achieved through a combination of strategies which will: • minimise the impact of radiant heat and direct flame contact by separating development from bush fire hazards • minimise the vulnerability of buildings to ignition and fire spread from flames, radiation and embers • enable appropriate access and egress for the public and firefighters • provide adequate water supplies for bush fire suppression operations • focus on facility preparedness, including emergency planning and property maintenance requirements	Section 8.10 Appendix E

Agency	Issues raised	Section in EIS
	• facilitate the maintenance of asset protection zones, fire trails, access for firefighting and on-site equipment for fire suppression and prevention of fire spreading from the site.	
NSW Office of Environment & Heritage	The EIS should fully describe the proposal, the existing environment and impacts of the development including the location and extent of all proposed works that may impact on ACH and biodiversity. The scale and intensity of the proposed development should dictate the level of investigation. It is important that all conclusions are supported by adequate data. The assessment must include all ancillary infrastructure associated with the project and Rural Fire Service requirements for asset protection.	Throughout EIS
	Biodiversity	
	Biodiversity impacts related to the proposal are to be assessed in accordance with Section 7.9 of the Biodiversity Conservation Act 2017 the Biodiversity Assessment Method (BAM) and documented in a Biodiversity Development Assessment Report (BDAR). The BDAR must include information in the form detailed in the Biodiversity Conservation Act 2016 (s6.12), Biodiversity Conservation Regulation 2017 (s.6.8) and Biodiversity Assessment Method, unless OEH and DPE determine that the proposed development is not likely to have any significant impact on biodiversity values. The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the Biodiversity Assessment Method. The BDAR must include details of the measures proposed to address the offset obligation as follows: • The total number and classes of biodiversity credits required to be retired for the development/project • The number of classes of like-for-like biodiversity credits proposed to be retired • The number and classes of biodiversity credits proposed to be retired in accordance with the variation rules • Any proposal to fund a biodiversity conservation action • Any proposal to conduct ecological rehabilitation (if a mining project) • Any proposal to make a payment to the Biodiversity Conservation Fund. If seeking approval to use the variation rules, the BDAR must contain details of the reasonable steps that have been taken to obtain requisite like-for-like biodiversity credits. The BDAR must be submitted with all spatial data associated with the survey assessment as per Appendix 11 of the BAM. The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s6.10 of the Biodiversity Conservation Act 2016.	Section 8.2 Appendix C
	The site for the proposed development contains many patches of vegetation as well as paddock trees. The PEA includes a figure showing the distribution of vegetation across the site which does not match the OEH mapping of vegetation. The EIS will need to clearly explain the method used to map trees as paddock trees rather than components of vegetation patches, which will affect the assessment of the site using the Biodiversity Assessment Method under the Biodiversity Conservation Act 2016. Paddock trees may provide habitat for threatened species that have been recorded locally, including the Superb Parrot (*Polytelis swainsonii*). The PEA states that further analysis of the site will determine the final layout of the development. If paddock trees are to be impacted, the EIS should detail the value of paddock tree habitat to all threatened species known or likely to occur in the area and an assessment of the impacts of clearing those trees.	Section 8.2 Appendix C
	Aboriginal cultural heritage	

Agency	Issues raised	Section in EIS
	The EIS must identify and describe the Aboriginal cultural heritage values that exist across the whole area that will be affected by the development and document these in an Aboriginal Cultural Heritage Report (ACHAR). This may include the need for surface survey and test excavation. The identification of cultural heritage values must be conducted in accordance with the Code of Practice for Archaeological Investigations of Aboriginal Objects in NSW (OEH 2010), and be guided by the *Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW* (Department of Environment, Climate Change and Water (DECCW) 2011) and consultation with OEH regional branch officers.	Section 8.3 Appendix D
	Consultation with Aboriginal people must be undertaken and documented in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW). The significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be documented in the ACHAR.	Section 7.1.8 Section 8.3 Appendix D
	Impacts on Aboriginal cultural heritage values are to be assessed and documented in the ACHAR. The ACHAR must demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcomes. Where impacts are unavoidable, the EIS must outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented and notified to OEH. All Aboriginal objects identified must be reported to the OEH through registration on AHIMS in accordance with the mandatory notification requirements of section 89A of the National Parks and Wildlife Act 1974.	Section 8.3 Appendix D
	The assessment of cultural heritage values must include a surface survey undertaken by a qualified archaeologist in areas with potential for subsurface Aboriginal deposits. The result of the surface survey is to inform the need for targeted test excavation to better assess the integrity, extent, distribution, nature and overall significance of the archaeological record. The results of the surface survey and test excavations are to be documented in the ACHAR.	Section 8.3 Appendix D
	The EIS must outline the procedures to be followed if Aboriginal objects are found at any stage of the life of the development to formulate appropriate measures to manage unforeseen impacts.	Section 8.3.4 Appendix D
	The ACHAR must outline procedures to be followed in the event Aboriginal burials or skeletal material is uncovered during construction to formulate appropriate measures to manage impacts to this material.	Section 8.3.4 Appendix D
	Historic Heritage	
	The EIS must provide a heritage assessment including but not limited to an assessment of impacts to *State and local heritage* including conservation areas, natural heritage areas, places of Aboriginal heritage value, buildings, works, relics, gardens, landscapes, views, trees should be assessed. Where impacts to State or locally significant heritage items are identified, the assessment shall: • Outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) generally consistent with the *NSW Heritage Manual* (1996) • Be undertaken by a suitably qualified heritage consultant(s) (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria) • Include a statement of heritage impact for all heritage items (including significance assessment)	Section 8.4

Agency	Issues raised	Section in EIS
	• Consider impacts including, but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, landscape and vistas, and architectural noise treatment (as relevant) • Where potential archaeological impacts have been identified develop an appropriate archaeological assessment methodology, including research design, to guide physical archaeological test excavations (terrestrial and maritime as relevant) and include the results of these test excavations.	
	Water and soils	
	The EIS must map the following features relevant to water and soils including: • Acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Planning Map) • Rivers, streams, wetlands, estuaries • Groundwater • Groundwater dependent ecosystems • Proposed intake and discharge locations.	Figure 8-12 Appendix J Figure 8-27 Figure 8-28 Figure 8-37 Figure 8-37
	The EIS must describe background conditions for any water resource likely to be affected by the project, including: • Existing surface and groundwater • Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations • Water Quality Objectives (as endorsed by the NSW Government) including groundwater as appropriate that represent the community's uses and values for receiving waters • Indicators and trigger values/criteria for the environmental values identified at (c) in accordance with the ANZECC (2000) Guidelines for Fresh and Marine Water Quality and/or local objectives, criteria or targets endorsed by the NSW Government.	Section 8.9.2 Appendix I
	The EIS must assess the impacts of the project on water quality, including: • The nature and degree of impact on receiving waters for both surface and groundwater. Demonstrating how the project protects the Water Quality Objectives where they are currently being achieved, and contributes towards achievement of the Water Quality Objectives over time where they are not currently being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction • Identification of proposed monitoring of water quality.	Section 8.9.3 Appendix J
	The EIS must assess the impact of the project on hydrology, including: • Water balance including quantity, quality and source • Effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas • Effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems • Impacts to natural processes and functions within rivers, wetlands, estuaries and floodplain that affect river system and landscape health such as nutrient flow, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches) • Changes to environmental water availability, both regulated/licensed and unregulated/rules-based sources of such water	Appendix I Section 8.9.3 Section 8.9.3 Section 8.9.3 Section 8.9.3 Section 8.9.3

Agency	Issues raised	Section in EIS
	• Mitigating effects of proposed stormwater and wastewater management during and after construction on hydrological attributes such as volumes, flow rates, management methods and re-use options • Identification of proposed monitoring of hydrological attributes.	Section 8.9.4 Appendix J
	Flooding	
	The EIS must map the following features relevant to flooding as described in the Floodplain Development Manual 2005: • Flood prone land • Flood planning area, the area below the flood planning level • Hydraulic categorisation (floodways and flood storage areas).	Section 8.9.2 Appendix I Section 8.9.2 Appendix J Appendix J
	The EIS must describe flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 5% Annual Exceedance Probability (AEP), 1% AEP flood levels and the probable maximum flood, or an equivalent extreme event.	Section 8.9.3 Appendix I
	The EIS must model the effect of the proposed project (including fill) on the flood behaviour under the following scenarios: • Current flood behaviour for a range of design events as identified above. This includes the 0.5% and 0.2% AEP year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.	Section 8.9.3 Appendix I
	Modelling in the EIS must consider and document: • Existing council flood studies in the area and examine consistency to the flood behaviour documented in these studies. • The impact on existing flood behaviour for a full range of flood events including up to the maximum probable maximum flood • Impacts of the development on flood behaviour resulting in detrimental changes in potential flood affection of other developments or land. This may include redirection of flow, flow velocities, flood levels, hazards and hydraulic categories • Relevant provisions of the NSW Floodplain Development Manual 2005.	Section 8.9.3 Appendix I
	The EIS must assess the impacts on the proposed project on flood behaviour, including: • Whether there will be detrimental increases in the potential flood affection of other properties, assets and infrastructure • Consistency with Council Floodplain Risk Management Plans • Consistency with any Rural Floodplain Management Plans • Compatibility with the flood hazard of the land • Compatibility with the hydraulic functions to flow conveyance in floodway's and storage in flood storage areas of the land • Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site • Whether there will be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses • Any impacts the development may have upon existing community emergency management arrangements for flooding. These matters are to be discussed with the SES and Council • Whether the proposal incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the SES and Council	Section 8.9 Appendix I Appendix J Appendix J Appendix J Section 8.9.3 Section 8.9.3 Section 8.9.3 Appendix J

Agency	Issues raised	Section in EIS
	• Emergency management, evacuation and access, and contingency measures for the development considering the full range or flood risk (based upon the probable maximum flood or an equivalent extreme flood event). These matters are to be discussed with and have the support of Council and SES • Any impacts the development may have on the social and economic costs to the community as consequences of flooding.	Appendix J Section 8.9.3
NSW Roads & Maritime Services (RMS)	Roads and Maritime Services emphasises the need to minimise the impacts of any development on the existing road network and maintain the level of safety, efficiency and maintenance along the road network. For such a development an assessment of the potential traffic impacts on the surrounding road network due to the development, particularly during the construction phase, should be submitted with the Development Application. The required contents and detail of the Traffic Impact Assessment (TIA) will depend on the scale of the proposed development, the characteristics of the potential traffic generation and the traffic volumes and other traffic generating influences on the surrounding public road network. Given the scale and operational characteristics of the proposed development Roads and Maritime Services considers that the traffic related issues relevant to the development should be considered and addressed in 2 distinct stages as follows: • Construction and Decommission phases - the transport of materials and equipment/components for the establishment of the facility and ancillary infrastructure, the movement and parking of construction related vehicles, including personal vehicles, during the construction of the facility, • Operational phase - the ongoing traffic generation due to the operation, maintenance and servicing of the various elements of the project.	Section 8.8 Appendix H
	Given the potential volume of traffic and the need for deliveries of the components to the development site during the construction period a Transport Management Plan for the construction activity should also be prepared for the proposed development. This is referred to in the submitted Preliminary Environmental Assessment Report. Details for deliverables of ancillary materials such as gravel and concrete should also be considered as part of the submitted documentation.	Section 8.8 Appendix H
	The TIA shall detail the potential impacts associated with the phases of the development, the measures to be implemented to maintain the standard and safety of the road network, and procedures to monitor and ensure compliance. Where road safety concerns are identified at a specific location along the haulage route/s, the TIA may be supported by a targeted Road Safety Audit undertaken by suitably qualified persons.	Section 8.8 Appendix H
	Further to the above it is understood that a development proposal for the Jindera solar farm project (SSD 9549) is being proposed for a nearby site. The potential for both projects being constructed at the same time needs to be considered. Therefore, unless it is guaranteed that the construction of these 2 projects will not coincide the cumulative traffic impacts of the simultaneous construction of both these projects needs to be addressed as part of the TIA.	Section 8.8 Section 8.13 Appendix H
	For guidance in the preparation of the TIA the applicant is referred to section 2 of the "Guide to Traffic Generating Developments" prepared by the RTA and the Austroads publications, particularly the Austroads Guide to Traffic Management Part 12: Traffic Impacts of Development and Austroads Guide to Traffic Management Part 3 - Traffic Studies and Analysis. The TIA should contain information such as the expected traffic generation, vehicle numbers and types of vehicles, and travel routes for vehicles accessing the development site.	Section 8.8 Appendix H
	Given the type and scale of the proposed development and its proximity to the public road network it is considered appropriate that issues relating to potential for distraction of, and	Section 8.6

Agency	Issues raised	Section in EIS
	for glint/glare impacts on, passing motorist be addressed in the development submission. Consideration could be given to the establishment and maintenance of a visual buffer, such as a vegetated buffer, within the subject site along its frontage to any public road.	Appendix F
TransGrid	TransGrid note the works are acceptable subject to conditions being met during the assessment: • Grid connection and ancillary infrastructure has been included in the scope. • TransGrid requires the project scope description to include all ancillary electrical transmission works (all works associated with connection to the National Electricity Market, such as ancillary substation works, transmission line works (direct and upstream), and telecommunications works) that would be necessary for the construction and operation of the Project. • The EIS should identify all land parcels affected by these works and include them within the project boundary. • The proponent has contacted TransGrid as the Transmission Network Service Provider for connection of their proposed project. As part of their project development, the proponent will need to follow the connection process, in accordance with the National Electricity Rules and TransGrid's requirements in order to connect.	Section 4.1
Department of Industry – Water **(DoI – Water)**	The identification of an adequate and secure water supply for the life of the project. This includes confirmation that water can be sourced from an appropriately authorised and reliable supply. This is also to include an assessment of the current market depth where water entitlement is required to be purchased. • A detailed and consolidated site water balance. • Assessment of impacts on surface and ground water sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts. • Proposed surface and groundwater monitoring activities and methodologies. • Consideration of relevant legislation, policies and guidelines, including the NSW Aquifer Interference Policy (2012), the DPI Water Guidelines for Controlled Activities on Waterfront Land (2012) and the relevant Water Sharing Plans (available at https://www.industry.nsw.gov.au/water).	Section 8.9
Department of Industry – Crown Lands (DoI – Lands)	There are Crown Public Roads within the proximity of the proposal. Should any of the Crown Public Roads be required for the development they are either to be closed and purchased or transferred to Council as a Council Public Road.	Section 6.3.14
NSW Department of Primary Industries (DPI) Agriculture	The EIS should be required to address or provide the following: • Assessment of impacts to surrounding agricultural landuses and industries, including impacts resulting in a temporary or a permanent loss to land capability or agricultural productivity. This would include demonstration that all significant impacts on current and potential agricultural developments and resources can be reasonably avoided or adequately mitigated. • Complete a Land Use Conflict Risk Assessment (see link in Attachment A), including: o Identification of potential land use conflict, in particular relating to separation distances and management practices to minimise dust, noise and visual impacts from sensitive receptors. For example, this may include outlining strategies to avoid land use conflict around agricultural aerial spraying and fertilising in the area.	Section 8.5

Agency	Issues raised	Section in EIS
	○ Consultation and negotiation with owners/managers of affected adjoining agricultural operations and landholders (see comment in Attachment A).	Section 8.5
	• Include a biosecurity (pests, weeds and livestock disease) risk assessment outlining the likely plant, animal and community risks (as per the Infrastructure Proposal guideline below) including monitoring and mitigation measures.	Section 8.5
	• A rehabilitation and decommissioning strategy that will ensure that the land is returned to its predevelopment state. The rehabilitation and decommissioning strategy should include the removal of all underground infrastructure to ensure all previously cropped lands and returned to their predevelopment state.	

In the period following submission of the PEA, a media release detailing the project was issued to the local newspapers and radio stations. This was published by the Border Mail with a story on the GSF printed on 18 August 2018.

Public activity in August 2018 also included launching a Project website (https://glenellensolarfarm.com.au/).

On 3 October 2018 the Proponent presented the GSF Project to the Greater Hume Shire Councillors and senior staff. This incorporated the proposed setbacks, vegetation screening, and transport routes. A third round of community consultation was undertaken in October 2018 via doorknocking, providing the opportunity to present further responses to issues raised during previous consultation. Newsletters were distributed to 36 homes in the area and 25 face to face discussions were held.

7.1.7 Consultation – Council

Consultation with Council and Councillors commenced in August 2018, with a focus on areas for consideration within the EIS. Consultation with Council senior staff and Councillors has been ongoing through the latter part of 2018, the early part of 2019 and mid-2020. These consultations with Greater Hume Shire Council highlighted impacts to local roads and management of waste streams arising from project construction and operation, approach to engagement and removal of onsite vegetation. Feedback received has been considered within Traffic and Transport and Waste Section 8.8 and 8.11, respectively. Further correspondence from Greater Hume Shire Council was received by the Proponent in late August 2020 relating to a nominated preferred transport route by Council for consideration within this EIS. The preferred transport route has been considered further within Section 8.8.

7.1.8 Consultation – Registered Aboriginal Parties

Consultation with the Aboriginal community was conducted by NSW Archaeology Pty Ltd in the preparation of their ACHA in 2018, in accordance with guidance set out in the DECCW (2010a) *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*. As consultation between NSW Archaeology and the Aboriginal community expired after a period of six months of no correspondence, consultation was restarted by ELA in 2020, as part of the preparation of this EIS and also conducted in accordance with the DECCW (2010a) *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*. A summary of the consultation is provided in the draft Aboriginal Cultural Heritage Assessment (ACHA) provided in Appendix D. Registered Aboriginal Parties (RAPs) have had the opportunity to provide feedback on the draft ACHA prior to its finalisation and submission to Heritage NSW.

7.1.9 Consultation – Host landowner and Community

A fourth round of consultation via doorknocking was held in December 2018 during which the preliminary results of the environmental assessment were discussed with nearby residents providing an opportunity to further discuss particular issues raised during all previous rounds of consultation. In all, 49 newsletters were distributed in the area and 32 face to face discussions were held. Further, 43 digital copies of the newsletters have been distributed via email to subscribers, Councillors and council staff. Local state MP Greg Aplin and local national MP Sussan Ley were provided with copies of the December newsletters, too.

With the change in ownership, this approach to Host Landowner and near-neighbour engagement was repeated. Trina Solar instigated meetings with five near-neighbours in July – to facilitate a smooth handover from CWP and to reassure these neighbours that engagement on key issues would continue.

Supporting information was provided via an updated Project Website (https://glenellensolarfarm.com.au/) and Fact Sheet and a dedicated email and phone enquiries line were established.

In August 2020, Trina Solar produced a Community Update outline its approach to finalise the GSF concept and collating community feedback as part of this process. This Newsletter was mailed to all households within the region via Australia post Unaddressed Mail (720 households). Further copies were mailed directly to near neighbours, with a cover letter inviting them to get in touch should they wish to meet and raise questions. Two responses were received and follow up meetings with these neighbours were offered.

1. Further consultation via face to face engagement has been planned for September 2020. Trina Solar intends to meet with those neighbours that have shown high interest in the project to further discuss mitigation responses to their specific issues. Additionally, Trina Solar will attempt to visit neighbours that are yet to contact the Project team and that may be impacted – to provide another opportunity to initiate discussions and answer any queries that arise. These visits will be via door-knocking and leaving copies of the Project Newsletter as appropriate.
2. The Project Engagement Register and Employee/Supplier Log continue to be updated as a live resource for use by the Project Team.

7.1.10 Consultation - Jindera Solar Farm

Consultation has been undertaken with Green Switch Australia, the Proponent of the proposed JSF during the preparation of this EIS. Consultation was undertaken in August 2019 by CWPR, and general topics discussed included a background to both Green Switch Australia and CWPR, the proposed layouts to be considered for both Projects within the cumulative impact assessment, timing of the proposed JSF and GSF (construction of each solar farm will not be undertaken concurrently and is further addressed within Section 8.13), traffic routes (key haulage routes were discussed and are further addressed within Section 8.13), consultation undertaken for both the JSF and GSF to date and issues of concern raised by Council and the community, and consideration of further interactions between the two Projects.

7.1.11 Consultation – EIS Exhibition

With the onset of the COVID-19 pandemic, physical distancing requirements and limits on group gatherings were brought in by the NSW Government. At the time of public exhibition of the GSF EIS, these restrictions were still in place. In conventional circumstances, a public drop in session would have been provided to enable community members to view proposed plans and ask questions of Trina Solar. Given this consultation format can involve large groups of people moving about and meeting others (Trina Solar team) from outside the region, Trina Solar has opted not to run these sessions to ensure compliance with Government restrictions.

Alternative measures have subsequently been provided to enable residents to provide detailed feedback and pose any questions they have. These include a detailed Project Website with a copy of the Concept Map and a resident survey. Trina Solar will also continue to notify interested members of the public about the Project's progress – including release of the EIS – via emails to the Project's subscriber email list.

7.1.12 Ongoing Stakeholder Consultation

In addition to the consultation activities summarised above, Trina Solar is committed to continued community and stakeholder consultation. It will perpetually provide information and engage in consultation with the community and interested stakeholders with respect to the Proposed Development's environmental assessment.

7.2 Consultation Themes and Discussion

During the community consultation undertaken to date, many productive discussions have been held including questions, concerns, support and advice from the people that live and work locally. This is very important as it helps shaping a sustainable project that is well adjusted to both the physical and social environment it is built in.

Consultation and engagement have not been a 'tick box' exercise. Feedback and suggestions from stakeholders and neighbours have informed aspects of the Project's development. A key example of this has been the Project's adoption of greater setbacks from the boundaries of neighbours' properties and the addition of vegetation plantings to further reduce visual impacts. This result mirrors suggestions put forward to Trina Solar during lengthy discussions and in many cases, has resolved some of the primary concerns held by neighbours.

During the course of engaging with neighbours, both CWPR and Trina Solar sought to engage with 42 distinct households within a 5 kilometre radius of the Project site. Discussions were held with 38 of these neighbours over the course of 2 years.

A majority (T=27 neighbours) indicated they had no material issues with the project. Many raised valid questions which Trina Solar sought to provide responses to via email, phone and follow up meetings.

A smaller group of neighbours voiced a higher number of individual concerns with some also expressing their opposition to the Project (T=9 neighbours). Through concerted engagement, Trina Solar was able to alleviate some of these concerns for these specific neighbours. In other cases, concerns remain unresolved. In all cases, Trina Solar will continue to engage and consult with all neighbours as the Project moves through the Approvals process.

General themes are grouped and the frequency they were raised during the consultation is shown in the following pie-chart (Figure 7-1).

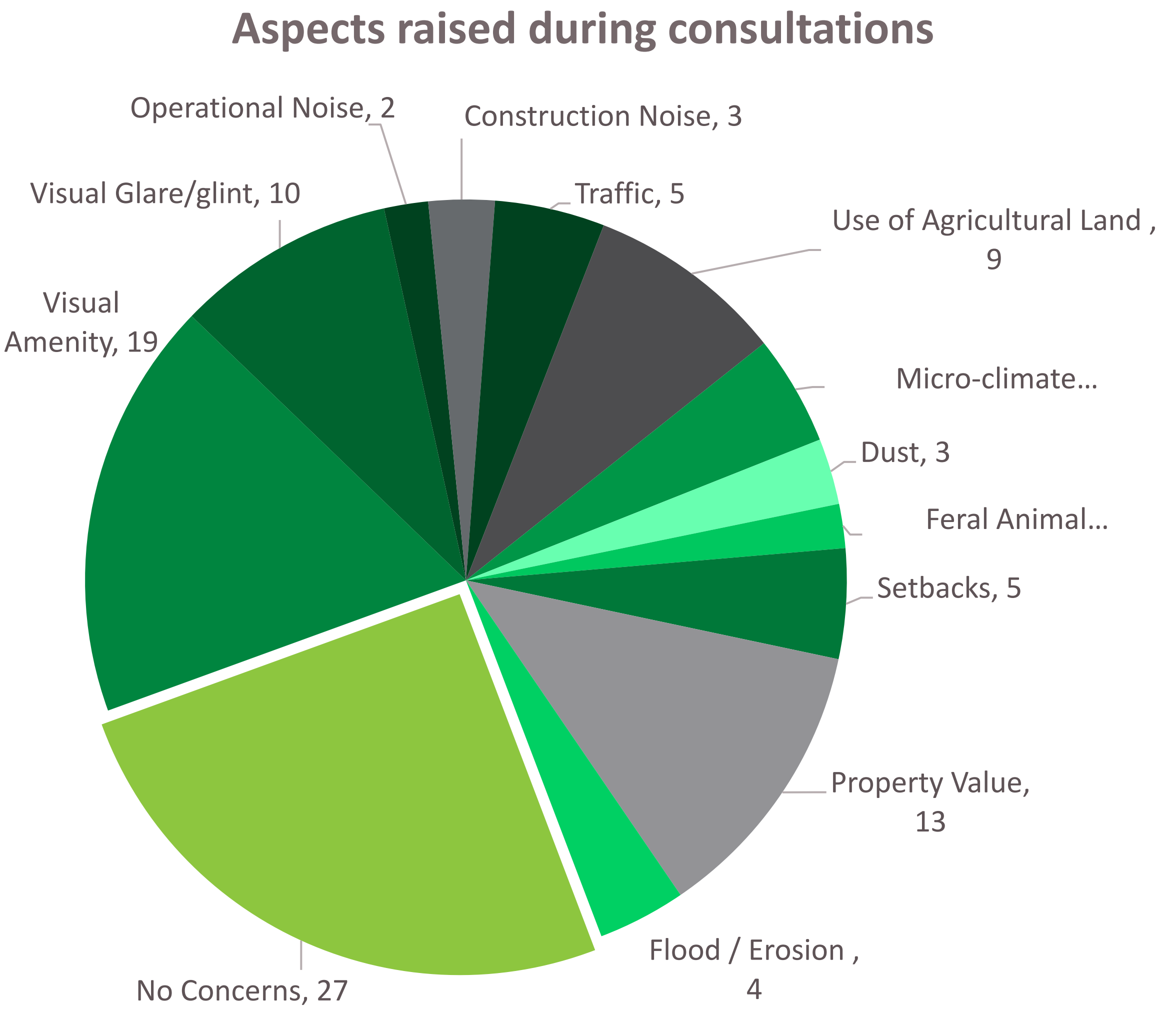

Figure 7-1: General themes raised during ongoing consultation

The general themes of comments and questions were used as the basis of analysis in this EIS, in combination with the SEARs. Table 7-5 below identifies the general themes of the consultation, with a summary of the responses for context, and a cross-reference to where the topic is discussed in this EIS.

Table 7-5: General consultation themes and responses

General Theme	Context	Related chapter in the EIS	Summary of Analysis
Agricultural land loss	Concerns regarding the loss of productive prime agricultural land	Section 8.5	The solar project will be constructed on agricultural land currently used for grazing only. The total land impacted represents a fraction of the overall agricultural land in the shire and region. Based on the classification of soil present at the Site, the area isn't categorised as "prime agricultural land". The aim of the project is to allow multiple uses of the land by maintaining grass cover under the constructed panels.

General Theme	Context	Related chapter in the EIS	Summary of Analysis
			Opportunities will be pursued to allow co-use of continued sheep grazing plus electricity production, also known as 'Agri-solar' and 'agrivoltaics'. This will continue an agricultural output and increase the value generated on the land.
Bushfire	Questions regarding whether the project would create more bushfires	Section 8.10	Managing bushfire risk is of high importance for the solar project. Detailed management plans are part of the standard Development Consent and will outline how fire risks are managed on site. Electrical equipment will be protected in a way that it will not pose a fire risk.
Bushfire fighting	Questions regarding the impacts of the proposed project in relation to firefighting operations	Section 8.10	Bushfire management plans are developed cooperating with RFS to allow firefighting on and around the Site. The design will include access tracks throughout the site act as a barrier against grass fires and allow easy access for fire crews. Buffer zones around the Site perimeter offer additional protection. While these measures are expected to improve on-ground firefighting, the project will also have no impact to aerial operations.
Construction noise	Noise emitted during the construction phase has been raised as a concern by the local community.	Section 8.7	Noise emissions during the construction period will have multiple sources. The detailed noise characteristics are outlined in the respective chapters of this EIS. To alleviate noise impact to neighbours, the construction times will be limited to standard construction hours and traffic flows will be using access routes that were selected to avoid passing many residences.
Dust	The creation of dust during dry periods when constructing and operating the solar farm was raised as concern by neighbours to the project.	Section 8.5	Dust generation can occur during the construction phase due to a high level of on-site vehicle movements on internal gravel roads. Machinery being moved around the Site creates dust that may be carried beyond the project site by wind where it may potentially impact neighbours of the project. To reduce this risk, dust suppression by regular watering is proposed during construction. The same measures will apply to unsealed public access roads. Additional dust mitigation strategies are outlined in Section 8.5. During operation, vegetation cover will prevent dust creation. Significantly lower vehicle movement numbers will further reduce the risk of dust being generated on internal roads.
Electromagnetic Fields (EMF)	Questions raised regarding the impact of electromagnetic fields.	Section 8.10	Electrical equipment produces electromagnetic fields. This electromagnetic radiation produced from transformers and inverters is reduced through performance standards that apply to standard components. The strength of these fields will decrease with distance from the source and become indistinguishable within 5 to 10 metres of substations and even less for lower voltage equipment such as used at this project. Design and layout of the facility will account for these factors so that no impacts outside the Site will occur.
Flooding impediment / creation of	Questions raised about whether the solar panels cause	Section 8.9 Section 8.5	It is correct that solar panels are an 'impervious surface', however water falls from the panels onto the ground and is allowed to infiltrate into the grass layer and topsoil. It is found in peer-

General Theme	Context	Related chapter in the EIS	Summary of Analysis
erosion/ sedimentation	erosion during rainfall events, being impervious surfaces.	Appendix I	reviewed scientific literature that the key variable in erosion below solar panels is the type of groundcover, such that panel installations over soil with good grass cover resulted in an indistinguishable change to runoff patterns as opposed to where the panels had hardstand underneath. The Proposed Development will not be creating large amounts of hardstand and will manage the grass layer for maximum coverage. Hence no significant change in land surface will take place and therefore flooding or erosion risk will not increase as a result of the Proposed Development.
Feral Animal Control	Questions asked in regard to the management of feral animals and pests within the Site.	Section 8.5	A detailed management plan will outline the strategies to minimise impacts from unwanted animals within the Site and to neighbouring properties. Since the Proposed Development is set in an agricultural area, management of pests and feral animals will be undertaken in a similar manner to typical practices on farms in order to preserve neighbour amenity.
Foreign ownership	Concerns raised regarding development activities being controlled by foreign companies and profits being transferred overseas.	Section 8.12	Glenellen Solar Farm Pty Ltd is an Australian company. When financing the project after approval has been received, Glenellen Solar Farm Pty Ltd will seek investments to cover the high initial cost of construction. It is likely that investment will be received from a variety of sources. This may include Australian and overseas investment.
General Environmental pollution/ contamination	CWP received questions regarding the risks of environmental pollution posed by the development, relating to materials used on site. Trina Solar received one further query in relation to subsoil leachate.	Section 8.5 Section 8.11	Construction and operation of utility scale solar photovoltaics is commonly undertaken on projects around the world. This is an advanced process utilising a technology that has been proven to be safe. Solar panels are a product that can be safely operated on roofs of houses and does not cause the risk of contamination. Other materials will be used for electrical and structural installations for the project, as well as packaging. The strategy to manage these materials as well as a detailed risk assessment has been prepared for this EIS. This has been undertaken to a level that ensures contamination will not pose a risk to the site or neighbouring properties.
Jobs creation	Questions have been asked regarding the job opportunities the project will create and what the impact to the local community will be. Comments in this section were also positive in nature and supported the potential for the	Section 8.12	The construction and operation of the project will bring jobs and economic activity to the rural area of Jindera. It is expected that during the construction period there will be up to 200 workers on site. It is anticipated that part of those will be employed by locals while certain activities will be carried out by local contractors. Others will provide specialist services that are not available in the local area and will be working on site while utilising accommodation, subsistence and other services, increasing the economic flow-on effects. During the operation period, there will be up to an estimated 10 jobs created. Activity on site will be significantly lower than

General Theme	Context	Related chapter in the EIS	Summary of Analysis
	project to create new employment opportunities.		during construction, however these are long term jobs provided to a small community. Multiple community members have already enquired about work opportunities on the project as it is regarded as new employment option close to home. While during construction there will be a significant amount of activity on and around site, there will therefore be moderate and stable activity during operation which is expected not to be intrusive to the local area while providing increased economic activity.
Microclimate Change	Questions regarding the impact to local microclimates.	Section 8.5	Concerns regarding the effect of the project on local climate have been raised in relation to increased temperatures, reduced rainfall and effects on soil and its moisture. While solar PV panels are designed to capture the energy of sunlight and to transform it into electricity, there may be a small increase in air temperatures above panels. Below the panels the temperatures are reduced by the shading effect and research found that as a result soil moisture increases. These temperature changes are not recognisable at locations outside the solar farm, indicating that these are very local effects and neighbours will not experience a change in climate. No research indicates that a solar development of the scale such as proposed here, has an effect on rainfall to the local environment.
Operational Noise	These questions related to the generation of noise during the projects operational period.	Section 8.7 Appendix G	Noise generation during operations may be caused by two sources: power generation equipment and maintenance activity. The power generation equipment generates very little noise. Motors and transformers may emit audible noises that have been assessed in the respective chapter. This is not expected to be audible against natural background noise by any residences in the area. Maintenance activities may cause noise generation through vehicles driving on site and activities necessary to ensure safe operation of the solar farm. These will in most cases be limited to common working hours in such a setting and be local. Overall, the operational noise impact to neighbours is estimated to be low.
Property Value	Concerns raised regarding the impact on land values.	Section 8.12	Property values are determined by many factors, many of which cannot be controlled by the owner of a landholding. Further, impacts on property values may be subjective. A carefully designed solar farm in a rural area, which includes mitigation measures to neighbouring properties, is not expected to have a major impact on property values in its vicinity. Most lots in the area surrounding the project are zoned RU1 and RU4. Property will therefore mostly be valued by its productivity for agricultural purposes. This will not be affected by the solar farm in any way, therefore an anticipated change in property value cannot be established.

General Theme	Context	Related chapter in the EIS	Summary of Analysis
			A suite of mitigation measures including setbacks and screening measures will further mitigate the impact to residences and as a result a possible negative impact on values.
Proponent secrecy / deception	Claims that the proponent would purposely hide activity to deceive local community were received.	Section 7.1	CWPR and Trina Solar have been engaging with landowners and neighbours very early in the process of development. Immediate landowners and residences with visibility of the project have been attended with priority, given the likelihood of affecting impacts. The wider community has been informed through newsletters, media coverage and engagement with the local council and politicians. While all efforts have been undertaken to attend properties in person and receive feedback from the community, not all local residences have been able or willing to be engaged. CWPR and Trina Solar will continue to provide information and updates, attempting to include currently uninvolved neighbours.
Setback	Questions asked on how close a solar farm would be built to existing homes.	Section 8.6.4	Setback distances to neighbouring properties and residences have evolved through discussions with the local community. There are currently no guidelines in NSW that demand a specific setback. During consultation with neighbours it was established that setback would be preferred as a means of mitigating potential impacts such as visual amenity, noise, dust. Subsequently setbacks were introduced to the design to reflect the feedback received and remove the project from being to impactful to the community. Subsequent feedback from some impacted neighbours indicates that this approach has removed their specific concerns. This outcome has in principle, been the biggest achievement of the Glenellen Solar Farm engagement process.
Subdivision Loss	Concerns to lose the opportunity of subdividing neighbouring land for the purpose of selling.	Section 8.5	The subdivision potential of neighbouring lots for the purpose of rural living will not be affected by the development. While the future subdivision value will be determined by overarching factors such as the availability of housing lots and the desire of people to move into the area.
Traffic	Questions regarding the impact of increased traffic on rural roads due to the development	Section 8.8 Appendix H	A detailed traffic management plan will be developed reflecting the projected vehicle movements and detailing the management of the traffic to and from site during construction which will consist of heavy and light vehicles. In conjunction with council, the least impactful route has been chosen to avoid passing homes, as well as to reduce noise and dust impacts. During operations, traffic movements will occur at a much lower scale than during construction.
Visual Amenity	Questions regarding the change in landscape amenity due to the project.	Section 8.6	The project, once installed, will mean a change in landscape and therefore has the potential to change the visual amenity from certain viewpoints. The introduction of setbacks off neighbouring properties as well as screening measures in response to requests from neighbours

General Theme	Context	Related chapter in the EIS	Summary of Analysis
			will alleviate the visual impact to surrounding residences and key view points to an acceptable level. Screening will be provided in form of selected vegetation planting which will be monitored and maintained throughout the lifetime of the Proposed Development.
Visual Glint / Glare	Concerns were raised that reflections from solar panels may impact neighbours or cars driving past.	Section 8.6.2 Appendix F	Glint and glare is caused by panels or structural parts of the solar installation reflecting sunlight. It is therefore dependent on the reflective characteristics of the surfaces and the angle of the sun as well as the angle of the viewpoint towards the Site. In general, solar panels are designed to absorb sunlight to transform it into electricity and are therefore designed with unreflective surfaces. However, in certain angles and for some structural parts, glint or glare may occur. A detailed glint and glare study has been undertaken as part of the EIS assessment. The results have determined that there is very little possibility of impacts from glint or glare to neighbouring properties and key viewpoints. For details, see the relevant chapter and technical study.

8. Environmental Assessment

8.1 Assessment methodology

The **Environmental Assessment** (this section) has been undertaken to assess potential environmental impacts for a range of specific issues identified within the SEARs and through site investigations. These are:

Issues	Section
Biodiversity	8.2
Aboriginal Cultural Heritage	8.3
Historic Heritage	8.4
Land Use and Soils	8.5
Visual Impact	8.6
Noise	8.7
Traffic and Access (Transport)	8.8
Water Resources	8.9
Hazards and Risks (Hazardous Materials; Bushfire and Electrical Fire; Electromagnetic Interference)	8.10
Waste and Resource Use	8.11
Socio-Economic Factors	8.12
Cumulative Impacts	8.13

A description of ***existing conditions*** is provided for each issue, considering existing levels of development, as well as antecedent conditions as relevant. This provides an opportunity to consider both environmental state and function in the absence of the Proposed Development.

In accordance with the requirements of the SEARs, all ***potential impacts*** associated with the Proposed Development are considered across the entire lifespan of the development, considering construction, operational and decommissioning phases. Potential impacts are considered in addition to existing environmental conditions, representing potential cumulative impacts. Furthermore, where known future development is proposed (i.e. JSF), consideration is given to potential cumulative impacts as relevant.

Mitigation measures are proposed to effectively manage all potential environmental impacts. These may include design considerations, monitoring strategies, construction safeguards, consultation, training and awareness programs, modified work practices, management plans or other relevant management strategies. A full list of mitigation and environmental management strategies and commitments is provided in **Environmental Management** (Section 9).

The **Project Justification** (Section 3) provides triple-bottom-line (environmental/social/economic) evaluation of the Proposed Development in order to fully describe potential benefits and impacts to the environment and the local, regional and NSW community.

Potential **residual environmental risks** following mitigation are investigated using likelihood/consequence analysis to describe the potential magnitude of residual impacts. Where the mitigated impact remains high or extreme, further justification is provided to contextualise project risks going forward.

Justification against high level social and economic expectations is then considered against the principles of **ESD**, and more specifically, considering the particular **socio-economic** attributes associated with the Proposed Development.

Finally, **potential alternatives** are considered to ensure that approval of the Proposed Development is not detrimental when assessed against potential alternative land uses or development.

The **Conclusion** (Section 10) integrates the relevant **Statutory and Planning Framework** (Section 6) and commitments made through the **Stakeholder and Community Consultation** process (Section 7) with the findings of the **Environmental Assessment** to provide a concise statement regarding the suitability of the Proposed Development and outlines any key points for consideration as part of the development approval process.

8.2 Biodiversity

8.2.1 Introduction

As the Proposed Development is SSD, the impacts must be assessed according to the BAM established under section 6.7 of the NSW BC Act, and a BDAR must be prepared. The purpose of the BDAR is to assess the impacts to biodiversity, propose mitigating and ameliorating options, as well as calculate offsets for unavoidable residual impacts in accordance with the project SEARs:

- *an assessment of the biodiversity values and the likely biodiversity impacts of the project in accordance with Section 7.9 of the Biodiversity Conservation Act 2016 (NSW), the Biodiversity Assessment Method (BAM) and documented in a Biodiversity Development Assessment Report (BDAR), unless OEH and DPE determine that the proposed development is not likely to have any significant impacts on biodiversity values*
- *the BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM*
- *an assessment of the likely impacts on listed aquatic threatened species, populations or ecological communities, scheduled under the Fisheries Management Act 1994, and a description of the measures to minimise and rehabilitate impacts.*

The current GSF Site Plan has considered the biodiversity values known to occur within the Site, and has where possible avoided areas of native vegetation, threatened species, and their habitats. In particular, the project has avoided (where possible) areas of TECs and known threatened species habitats. The GSF Development Footprint has reduced through each iteration of design to provide a final footprint that:

- Co-locates the grid connection point infrastructure
- Locates panel arrays within areas of cultivation
- As far as practicable avoids drainage lines, high quality vegetation, and known threatened species records.

The full BDAR is included in Appendix C and summarised below.

8.2.2 Survey Effort

The biodiversity assessment was undertaken using a combination of desktop and field surveys. Field surveys were undertaken during the period 25 June 2018 to 21 September 2018 and are summarised below. Detailed survey methods are included in Appendix C. Vegetation surveys were undertaken by Eco Logical Australia (ELA) ecologists Matthew Dowle and Clare Duck on June 25 - June 26, 2018 to stratify the Site into vegetation communities (Plant Community Types - PCTs) and map biodiversity constraints to inform the project design. Identified PCTs were further divided into vegetation zones which represent different condition types. Justification is given in Section 8.2.3. Further field survey was undertaken to target specific aspects of biodiversity onsite, including:

- August 21 – 24, 2018
  - Map paddock trees and hollow-bearing trees within 200 m of a water body
  - Conduct targeted fauna surveys for *Crinia sloanei* (Sloane's Froglet), *Petaurus norfolcensis* (Squirrel Glider) and *Phascolarctos cinereus* (Koala).
- September 18 – 21, 2018

- Complete BAM plots and floristic surveys (eleven full-floristic/vegetation integrity plots were surveyed to identify PCTs and TECs within the Development Footprint in accordance with the BAM (Table 8-1 and Figure 8-1))
- Conduct targeted survey for *Polytelis swainsonii* (Superb Parrot), *Callocephalon fimbriatum* (Gang-gang Cockatoo), *Hieraaetus morphnoides* (Little Eagle), *Haliaeetus leucogaster* (White-bellied Sea-Eagle), *Lophoictinia isura* (Square-tailed Kite) and *Myotis macropus* (Southern Myotis) (Table 8-2 and Figure 8-2).

Table 8-1: Vegetation integrity plots

Veg Zone	PCT ID	PCT Name	Condition	Area (ha)	Plots required	Plots surveyed
1	277	Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	Grazing / Exotic Pasture	7.28	3	3
2	277	Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	Planted	0.64	1	1
3	277	Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	Low	2.46	1	3
4	9	River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion	Low	1.02	1	4~
5	277	Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	Paddock Trees	N/A*	N/A	N/A

* A total of 81 paddock trees have been mapped within the Development Footprint.

~ Plots 3 and 4 have not been included in the BAMC for PCT 9, as they occur outside the Development Footprint and sufficient plots have been completed within.

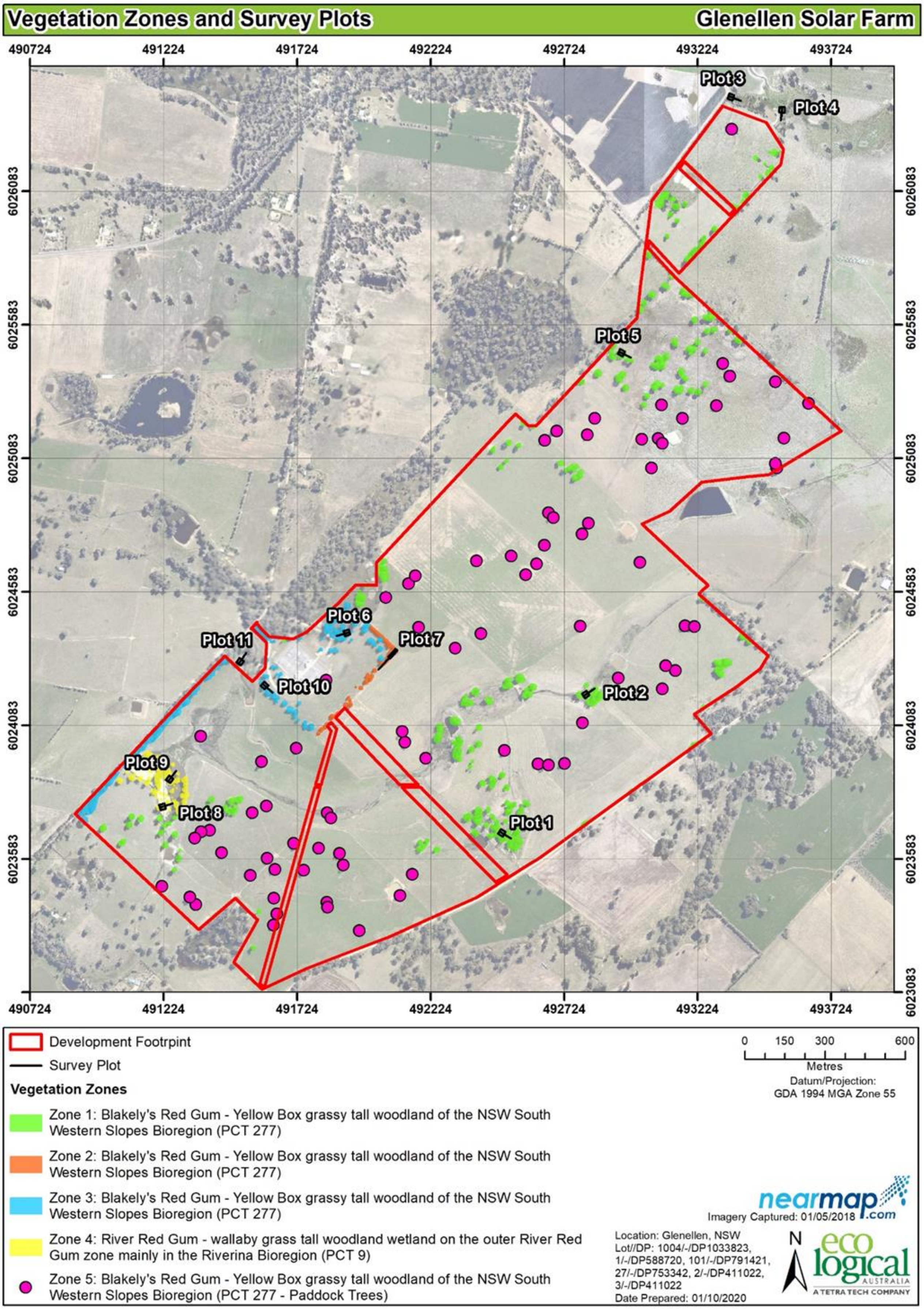

Figure 8-1: Vegetation zones and plot locations

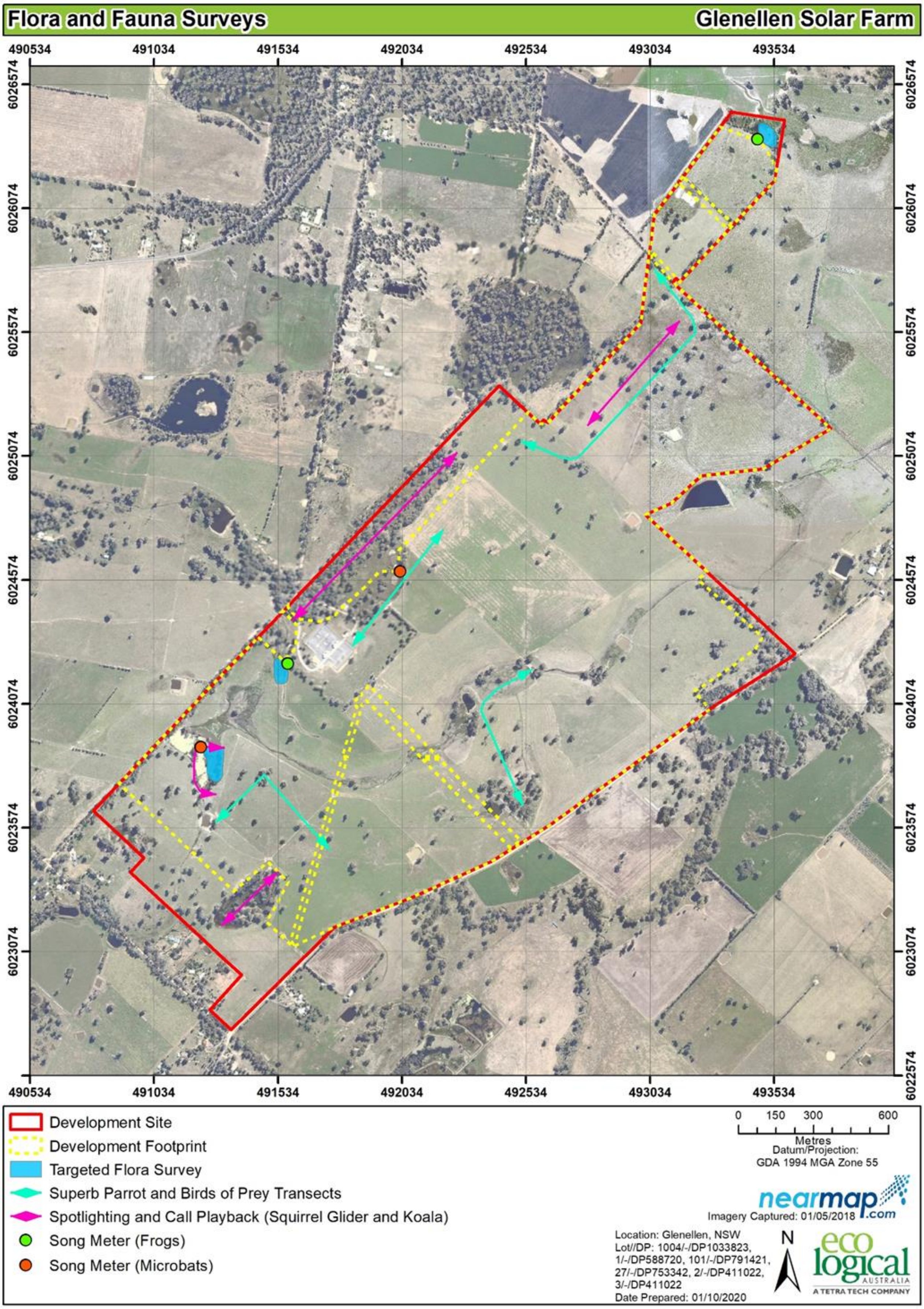

Figure 8-2: Threatened flora and fauna survey

Targeted threatened flora surveys involved transects of suitable habitat for *Pilularia novae-hollandiae* (Austral Pillwort) and followed the NSW Guide to Surveying Threatened Plants (OEH, 2016a) (Table 8-2). Targeted threatened fauna surveys for the Sloane's Froglet, Squirrel Glider, Koala, Superb Parrot, Little Eagle, Square-tailed Kite and White-bellied Sea-eagle were consistent with the Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (NSW DEC, 2004) and the requirements within the BAM and Biodiversity Assessment Method Credit Calculator (BAMC) (based on information in BioNet) (Table 8-2).

The Southern Myotis was not surveyed during the time period specified in the Threatened Biodiversity Data Collection (October to March) and has been assumed to be present within potential habitat. Surveys for the Gang-gang Cockatoo were conducted a week prior to the nominated time in the BAMC (and BioNet) and this was considered appropriate due to the species' nomadic habit.

Table 8-2: Targeted flora and fauna survey effort

Candidate species	Survey method	Total effort within Site	BAM survey period
Austral Pillwort*	Flora transects*	2 hours	Oct-Dec
Sloane's Froglet^	Songmeter – active listen	6 hours	July-Aug
Squirrel Glider~	Spotlighting Call play-back	4 hours 1 hour	All year
Koala~	Spotlighting Opportunistic (diurnal survey)	4 hours Paddock tree and HBT survey	All year
Superb Parrot#	Active search Opportunistic (diurnal survey)	12 hours Paddock tree and HBT survey	Sept-Nov
Gang-gang Cockatoo~	Active search Opportunistic (diurnal survey)	12 hours Paddock tree and HBT survey	Oct-Jan
Little Eagle~	Active search Opportunistic (diurnal survey)	12 hours Paddock tree and HBT survey	Aug-Sept
Square-tailed Kite~	Active search Opportunistic (diurnal survey)	up to 12 hours Paddock tree and HBT survey	Sept-Jan
White-bellied Sea-Eagle~	Active search Opportunistic (diurnal survey)	up to 12 hours Paddock tree and HBT survey	July-Dec
Southern Myotis~	Active search Opportunistic (diurnal survey)	up to 12 hours Paddock tree and HBT survey	Oct-Mar

* *NSW Guide to Surveying Threatened Plants* (OEH, 2016a).

^ *Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians* (Department of Environment and Climate Change (DECC), 2009).

~ *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC, 2004).

Survey guidelines for Australia's threatened birds' (DEHWA, 2010)

8.2.3 Existing Environment

8.2.3.1 Site Description

The Proposed Development is located within the Greater Hume LGA. The Site is located within a low hill landscape or alluvial / colluvial plain, with elevation ranging between 200 - 220 m (AHD), and is influenced by modifications to the natural creek and ephemeral and permanent drainage channels. The Site is in the Mitchell Landscape 'Brokong Plains – NSS Lower Slopes'.

The Australian Soil Classification mapping indicates Chromosols associated with the Yarra Yarra landscape in the south, and Sodosols associated with the Kindra landscape in the north (OEH, 2010). The Site comprises land that is highly modified, with paddock trees and an understorey of exotic pasture or pasture improved land. The surrounding area shows a long history of clearing and agricultural activities such as grazing and land improvement. Native species persistence within the Site are largely limited to the canopy.

The hydrology of the Site is typified by Strahler first, second and third order streams. Several drainage lines intersect each other upstream of the Site to form Kilnacroft Creek which is classed as a third order stream (Strahler, 1952) as it passes through the Site. Dead Horse Creek, also a third order stream, passes through a small area in the far north of the Site. These streams flow into Bowna Creek downstream of the Site which drains to the Murray River.

8.2.3.2 Native Vegetation

The Development Footprint covers an area of approximately 334.2 ha, which includes 11.4 ha of PCT native vegetation and approximately 322.8 ha of cleared land and exotic pasture. The extent of native vegetation within the Development Footprint is shown on Figure 8-1 The extent of native vegetation was determined through aerial imagery, in conjunction with field assessments.

Two PCTs were identified within the Development Footprint (Table 8-3), all of which occur in varying condition states / vegetation zones:

- PCT 277: Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion. This PCT was stratified into three vegetation zones based on three condition classes (grazing / exotic pasture, planted vegetation and low condition). PCT 277 has also been selected as the likely PCT for the mapped paddock trees (vegetation zone 5) (Figure 8-1)
- PCT9: River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion. This PCT contained one condition class and has been stratified into a single vegetation zone (Figure 8-1).

Table 8-3: Plant Community Types within the Development Footprint

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Area (ha)	Percent cleared
277	Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	10.38	94%
9	River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion	Inland Riverine Forests	Forested Wetlands	1.02	66%

The PCTs within the Development Footprint fall within a category of vegetation that has been highly disturbed, with the mid-storey and ground-layer species diverging considerably from species characteristic of these PCTs.

PCT 277 was comprised of the canopy species *Eucalyptus blakelyi* (Blakely's Red Gum) and *Eucalyptus melliodora* (Yellow Box). A few *Eucalyptus bridgesiana* (Apple Box) were also present along the western edge of the Development Footprint. This PCT was further split into three separate vegetation zones (Figure 8-1). Although all were considered to be of low condition, they were split due to their level of past disturbances and management:

- Vegetation Zone 1 is representative of an improved pasture, where native canopy species are all that remain in the way of native occurrence. The land has been improved over the last 40+ years (sown pasture species, fertilisers and other nutrients) to the point where there is basically no native resilience and the soil nutrient levels are significantly different to a natural system.
- Vegetation Zone 2 occurs as screening vegetation between paddocks and has likely been entirely managed/planted. The species present do not match a nominated PCT, but PCT277 was assigned as it was most likely there pre-European interference.
- Vegetation Zone 3, although also in low condition, is more closely aligned to remnant vegetation as it has not been as significantly altered as the other two vegetation zones.

PCT 9 was comprised of a single remnant canopy species *Eucalyptus camaldulensis* (River Red Gum) and has been identified as vegetation Zone 4.

8.2.3.3 Paddock Trees

Paddock trees form a considerable component of the vegetation within the Development Footprint and have been mapped as paddock trees based on the definition provided in Appendix 1 of BAM. The paddock trees mapped within the Development Footprint form part of PCT 277 and are scattered across the Development Footprint. A total of 81 paddock trees have been mapped within the Development Footprint (Figure 8-3).

8.2.3.4 Threatened Ecological Communities

One Critically Endangered Ecological Community (CEEC) listed under the NSW BC Act occurs within the Development Footprint, 'White Box Yellow Box Blakely's Red Gum Woodland' (Box Gum Woodland). Vegetation zone 3 of PCT 277 (Figure 8-4) aligns with this EEC and has been justified through a review of the PCT against the NSW Scientific Committee Final Determination for the EEC, presence of diagnostic species in the upper stratum, vegetation structure and characteristic soil of the community. Vegetation zones 1 and 2 (PCT 277) were not considered to meet the listing criteria for the EEC under the BC Act.

PCT 277 within the Development Footprint represents highly degraded and modified vegetation, with varying degrees of disturbance.

While PCT 277 can also comprise part of the Critically Endangered Ecological Community (CEEC) 'White Box Yellow Box Blakely's Red Gum Woodland', listed under the Commonwealth EPBC Act, the condition of vegetation in the Site did not meet the minimum condition thresholds under the EPBC Act.

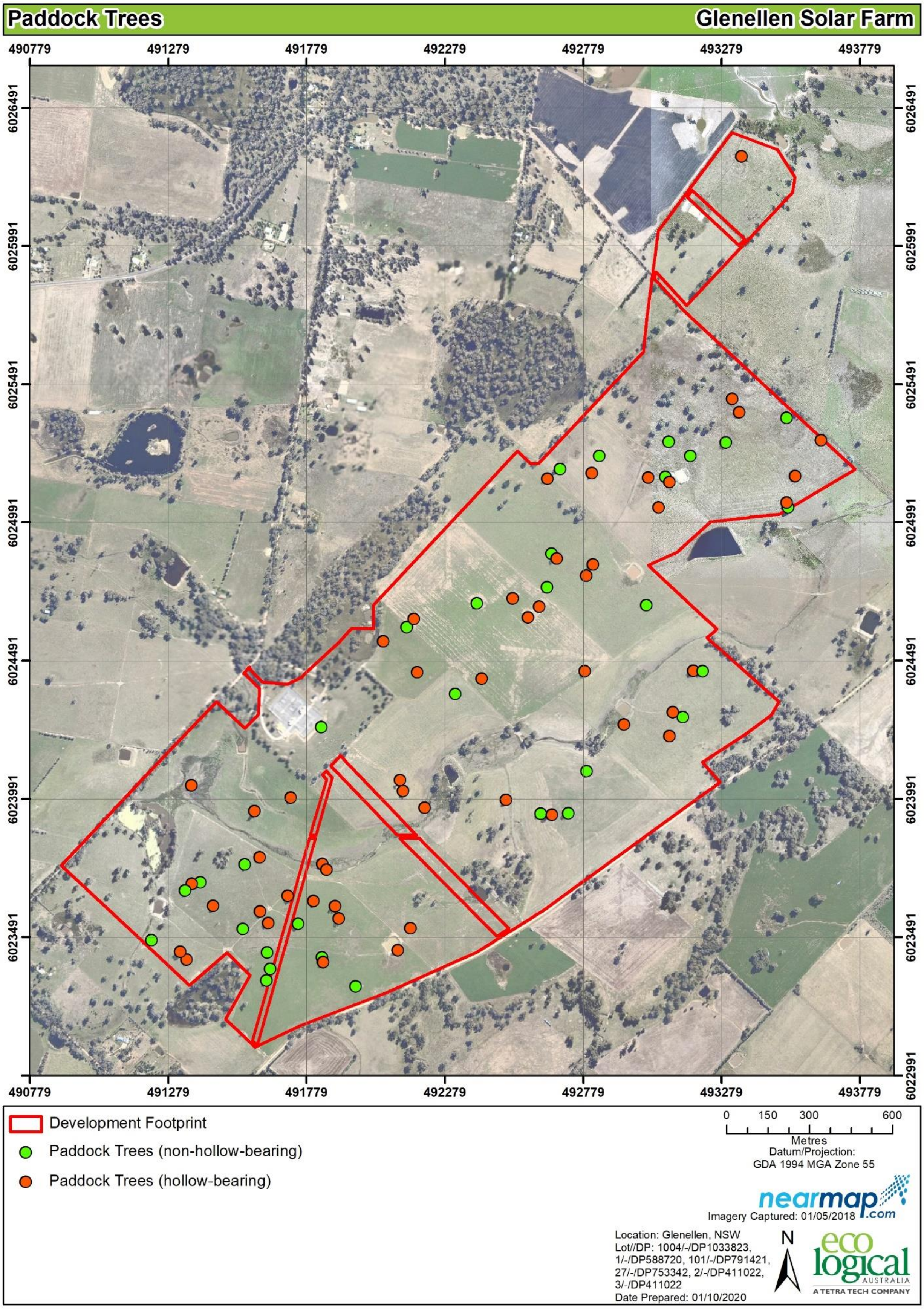

Figure 8-3: Paddock trees

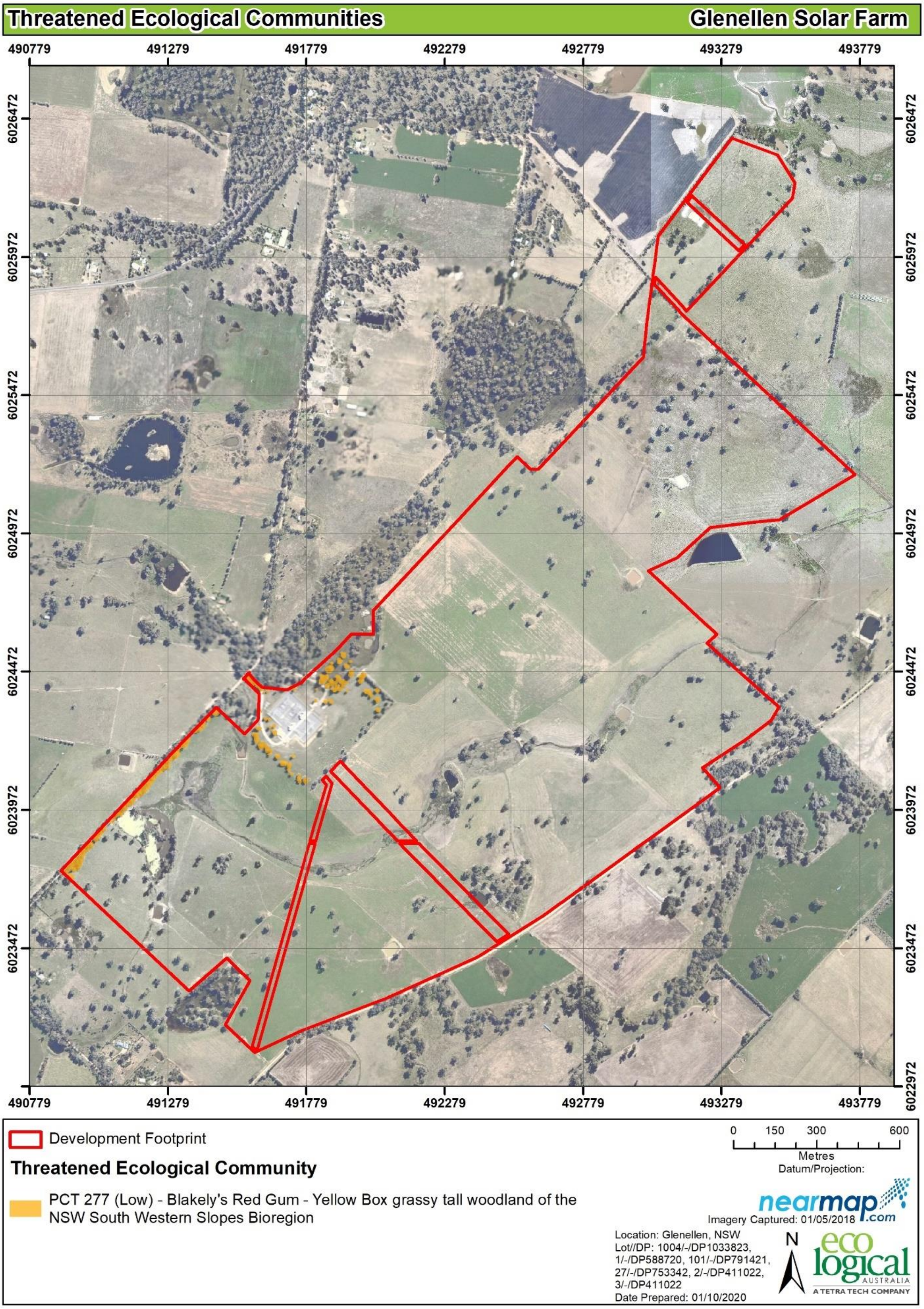

Figure 8-4: Threatened Ecological Communities

8.2.3.5 Threatened species and populations

The following ecosystem credit species and species credit species have been predicted to occur within the Development Footprint from the BAMC. Table 8-4 outlines which species were detected during field surveys and furthermore, if any of the species are expected to be impacted by the Proposed Development. Note, species that are unlikely to occur within the Development Footprint based upon the absence of necessary habitat components have been excluded for the table below. Justifications for species exclusion are further explained within the BDAR in Appendix C.

Table 8-4: Predicted ecosystem and species credit species

Species	Common Name	Habitat constraints/ Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Present on Site
Ecosystem Credit Species						
Anthochaera phrygia	Regent Honeyeater (foraging)	N/A	High	CE	CE	
Artamus cyanopterus cyanopterus	Dusky Woodswallow	N/A	Moderate	V	Not Listed	
Chalinolobus picatus	Little Pied Bat	N/A	High	V	-	
Chthonicola sagittata	Speckled Warbler	N/A	High	V	Not Listed	
Circus assimilis	Spotted Harrier	N/A	Moderate	V	Not Listed	
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	N/A	High	V	Not Listed	
Daphoenositta chrysoptera	Varied Sittella	N/A	Moderate	V	Not Listed	
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	N/A	High	V	Not Listed	
Glossopsitta pusilla	Little Lorikeet	N/A	High	V	Not Listed	
Haliaeetus leucogaster	White-bellied Sea-Eagle (foraging)	N/A	High	V	Not Listed	
Hieraaetus morphnoides	Little Eagle (foraging)	N/A	Moderate	V	Not Listed	
Lathamus discolor	Swift Parrot (foraging)	N/A	Moderate	E	CE	
Lophoictinia isura	Square-tailed Kite (foraging)	N/A	Moderate	V	Not Listed	
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	N/A	Moderate	V	Not Listed	
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	N/A	Moderate	V	Not Listed	
Neophema pulchella	Turquoise Parrot	N/A	High	V	Not Listed	
Petroica boodang	Scarlet Robin	N/A	Moderate	V	Not Listed	
Petroica phoenicea	Flame Robin	N/A	Moderate	V	Not Listed	
Polytelis swainsonii	Superb Parrot (foraging)	N/A	Moderate	V	V	
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	N/A	Moderate	V	Not Listed	

Species	Common Name	Habitat constraints/ Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Present on Site
Pteropus poliocephalus	Grey-headed Flying-fox (foraging)	N/A	High	V	V	
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	N/A	High	V	Not Listed	
Stagonopleura guttata	Diamond Firetail	N/A	Moderate	V	Not Listed	
Species Credit Species						
Callocephalon fimbriatum	Gang-gang Cockatoo (breeding)	N/A	Moderate	V	Not Listed	
Crinia sloanei	Sloane's Froglet	N/A	High	V	Not Listed	
Haliaeetus leucogaster	White-bellied Sea-Eagle (Breeding)	N/A	High	V	Not Listed	
Hieraaetus morphnoides	Little Eagle (breeding)	N/A	Moderate	V	Not Listed	
Lophoictinia isura	Square-tailed Kite (breeding)	N/A	Moderate	V	Not Listed	
Myotis macropus	Southern Myotis	Hollow-bearing trees within 200m of riparian zone or other water body	High	V	Not Listed	Assumed Present*
Petaurus norfolcensis	Squirrel Glider	N/A	High	V	Not Listed	
Phascolarctos cinereus	Koala (breeding)	N/A	High	V	V	
Pilularia novae-hollandiae	Austral Pillwort	Semi-permanent ephemeral wet areas. Periodically water-logged sites	High	E	Not Listed	
Polytelis swainsonii	Superb Parrot (breeding)	N/A	High	V	V	

Habitat is considered as all areas of PCT 9 (listed on the TBDC as being associated with the species) that is within 200 metres of a permanent water body greater than 3 metres wide.

Targeted threatened flora surveys undertaken for *Pilularia novae-hollandiae* obtained no positive identification results for this species. Furthermore, no other threatened flora was found during the surveys.

Targeted threatened fauna surveys for Sloane's Froglet, Squirrel Glider, Koala, Superb Parrot, Gang-gang Cockatoo, Little Eagle, White-bellied Sea-Eagle, Square-tailed Kite and Southern Myotis achieved no positive identification of any of the targeted species.

8.2.4 Potential Impacts

8.2.4.1 Avoidance of impacts

The (334.2 ha) Development Footprint has been positioned and designed in a way as to avoid and minimise as far as possible impacts to biodiversity within the (398.5 ha) Site. The Development Footprint avoids 55.5% (14.22 ha) of the total area of PCT native vegetation found within the Site (25.62 ha), including 75.9% (7.75 ha) of the White Box Yellow Box Blakely's Red Gum Woodland EEC (10.21 ha). Additionally, much of the vegetation within the Substation Lot included in the Development Footprint will be avoided, as the Development Footprint accommodates for uncertainty regarding the location of the NEM connection point. Table 8-5 outlines the location approaches and Table 8-6 outlines the design approaches undertaken to avoid and minimise biodiversity impacts of the Proposed Development.

Table 8-5: Location avoidance and minimisation approaches

Approach	How addressed	Justification
Locating the project in areas where biodiversity values are lowest	Areas of cleared land containing low biodiversity values have bene utilised.	The placement of the Development Footprint has been centred on the area of lowest biodiversity value (cleared, grazed). The footprint has been adjusted to avoid adjacent areas of higher biodiversity value, such as the stand of Box-Gum Woodland along the western boundary. The project has undergone a development design following BAM surveys to further avoid areas of biodiversity values, such as the native vegetation within the substation and drainage channel in the far north of the site.
Locating the project in areas where the native vegetation or threatened species habitat is in the poorest condition	Development Footprint placed on area of significant previous disturbance from historical clearing and constant agricultural practices (e.g. improvement and grazing).	The placement of the Development Footprint has centred on the area of lowest biodiversity value (cleared, grazed), with majority of native vegetation containing lower vegetation integrity scores. Nearby areas of remnant native vegetation outside the footprint to the south and west will not be impacted by the proposal, and following project design changes, will not impact on the vegetation within the substation or drainage channel in the far north of the Site.
Locating the project in areas that avoid habitat for species and vegetation in high threat categories (e.g. an EEC or CEEC), indicated by the biodiversity risk weighting for a species	The location of the Development Footprint has been designed to avoid areas of high quality vegetation and species habitat, e.g. by including Biodiversity Retention areas that retain patches of PCT 277.	The placement of the Development Footprint primarily utilises an area of low biodiversity value (cleared, grazed) and the Development Footprint has been designed to avoid areas or higher biodiversity value, such as remnant stands of PCT 277 along the western edge of the Site. These areas contain the EEC Box-Gum Woodland and are marked for biodiversity retention. They also serve a screening function.
Locating the project such that connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained	The Development Footprint has been able to avoid any impediments to connectivity.	The Development Footprint contains limited habitat connectivity and is located within a fragmented landscape. Lands directly adjoining (not impacted by project) are either heavily grazed and no habitat connectivity exists, or contain remnant vegetation (avoided) and contribute to the connectivity function. The Development Footprint has been placed to minimise any barrier to the movement of species and genetic material between areas of nearby habitat.

Table 8-6: Design avoidance and minimisation approaches

Approach	How addressed	Justification
Reducing the clearing footprint of the project	The Development Footprint has been placed in a previously cleared area with low biodiversity values.	The project has minimised vegetation clearing through strategic design changes following the initial BAM surveys.
Locating ancillary facilities in areas where biodiversity values are lowest	The entire Development Footprint has been designed to fit within the areas of lowest biodiversity values.	As highlighted in Table 8-5, placement of the Development Footprint occurs primarily on land with low biodiversity values, representing pasture improved agricultural land.
Locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower vegetation integrity score)	The design has endeavoured to locate the ancillary facilities in areas of vegetation in poor condition, with low vegetation integrity scores.	The project uses existing roads and tracks, and is proposed across an area that has for decades undergone pasture improvements under agricultural management. Native vegetation is largely lacking (except paddock trees) and the vast majority of the site is below the condition threshold that requires offsets. No threatened species were recorded and one assumed present.
Locating ancillary facilities in areas that avoid habitat for species and vegetation in high threat status categories (e.g. an EEC or CEEC)	It has not been possible to completely avoid impacts to areas providing species habitat. The placement of the Development Footprint has minimised impacts as far as practicable to species habitat whilst maximising extent necessary for development.	The Development Footprint is utilising existing areas of previously cleared or disturbed (improved) land. Native vegetation is largely lacking (except paddock trees) and the vast majority of the site is below the condition threshold that requires offsets. No threatened species were recorded and one assumed present.
Providing structures to enable species and genetic material to move across barriers or hostile gaps	No regional or local corridors or remnant vegetation is impacted.	The Development Footprint has been strategically placed in a location where no current habitat connectivity exists. All existing corridors are off-site, thus the project is allowing for the movement of species and genetic material to be retained.
Making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on the Study Area.	During construction, additional infrastructure will be established including site offices and amenities, vehicle parking and turning areas, equipment laydown and storage areas, safety fencing, and temporary power. This infrastructure will be removed at completion of commissioning and disturbed ground made good through rehabilitation and revegetation.	The placement of the Development Footprint has been located to include the poorest condition native vegetation and species habitat where possible (majority of land is below the condition threshold for offsets). Areas outside the Development Footprint boundary are to be retained as no go areas to avoid impacts occurring to intact higher quality native vegetation adjacent to the site.
Ensuring vehicles remain on designated roads and tracks whenever possible	Use of signposting and driver education during the induction process and in ongoing project discussions	These areas have been included in the Development Footprint and avoid the higher condition native vegetation.
Establishment and regular maintenance of erosion and sediment controls during construction -until disturbed areas are revegetated.	Erosion and maintenance of regular sediment and erosion control is likely to be minimal during construction and operation, due to the vegetated nature of areas and flat landscape.	These areas have been included in the Development Footprint and avoid the higher condition native vegetation

8.2.4.2 Impacts on native vegetation

The Proposed Development will unavoidably impact up to 11.4 ha of native vegetation and 81 paddock trees, which includes vegetation communities listed under the BC Act. Noteworthy is that this area calculation includes an overestimation of the actual vegetation to be cleared because it uses the entire solar PV inclusion area as a 'block' of vegetation which will be completely cleared whereas the solar panel arrangement is panels in rows separated by approximately 6 - 16 m between which current vegetation will mostly remain (refer to Sections 1.2 and 4.1 for a description of the Proposed Development). A summary of the vegetation zone areas to be directly impacted by the Proposed Development is shown in Table 8-7.

The changes in vegetation integrity scores as a result of clearing for the Proposed Development for each vegetation zone are shown in Table 8-8.

Table 8-7: Direct loss of native vegetation

Zone	PCT name	BC Act	EPBC Act	Area to be removed (ha)
1	PCT277: Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	-	-	7.28
2	PCT277: Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	-	-	0.64
3	PCT277: Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	White Box Yellow Box Blakely's Red Gum Woodland EEC	-	2.46
4	PCT9: River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion	-	-	1.02
5	PCT277: Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion			81 individual paddock trees
Total				**11.4**

Table 8-8: Change in vegetation integrity

Veg Zone	PCT ID	Condition	Area (ha) / Individuals*	Current vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity
1	277	Degraded	7.28 ha	14.8	0	-14.8
2	277	Planted	0.64 ha	30.7	0	-30.7
3	277	Low	2.46 ha	36.7	0	-36.7
4	9	Low	1.02 ha	19.6	0	-19.6
5	277	Paddock Trees	81*			

* Represents number of individuals

8.2.4.3 Loss of species credit species habitat or individuals

The loss of species credit species habitat or individuals as a result of the Proposed Development's direct impacts is shown in Table 8-9.

Table 8-9: Direct impacts on threatened species and threatened species habitat

Species	Common Name	Direct impact habitat (ha)	NSW listing status	EPBC Listing status
Myotis macropus	Southern Myotis	1.02 ha (PCT 9*)	V	Not Listed
Pilularis novae-hollandiae	Austral Pillwort	1.02 ha (PCT 9)	E	Not Listed

*Habitat is consistent with the OEH (2018a) document, *Species credit threatened bats and their habitat – NSW survey guide for the Biodiversity Assessment Methodology* and corresponds to PCTs that are associated with the species and that are within 200m of a waterbody (e.g. creek or dam). PCT 9 is listed in the TBDC as being associated with the Southern Myotis (OEH 2018a).

8.2.4.4 Indirect Impacts

The construction and operational phases of the Proposed Development have the potential to impact biodiversity values within the Site that cannot be avoided. Indirect impacts that may occur during the construction phase of the Proposed Development are detail in depth within the BDAR (Appendix C) and include:

- Sedimentation and contamination and/or nutrient rich run-off
- Noise, dust or light spill
- Inadvertent impacts on adjacent habitat or vegetation
- Transport of weeds and pathogens from the Site to adjacent vegetation
- Vehicle strike
- Trampling of threatened flora species
- Rubbish dumping
- Wood collection
- Bush rock removal and disturbance
- Increase in predatory species populations
- Increase in pest animal populations
- Increased risk of fire
- Disturbance to specialist breeding and foraging habitat.

Indirect impacts that may occur during the operational phase of the Proposed Development are detailed in depth within the BDAR (Appendix C) and include:

- Vehicle strike
- Trampling of threatened flora species
- Rubbish dumping
- Wood collection
- Bush rock removal and disturbance
- Increase in predatory species populations
- Increase in pest animal populations
- Increased risk of fire
- Disturbance to specialist breeding and foraging habitat.

8.2.4.5 Serious and Irreversible Impacts (SAIIs)

The Development Footprint contains two SAII candidate entities, as identified in Table 8-10. It is noted that the SAII threshold for these entities are yet to be published.

Table 8-10: Candidate Serious and Irreversible Impacts

Species / Community	Common Name	Principle	Direct impact individuals / area (ha)	Threshold
White Box Yellow Box Blakely's Red Gum Woodland (BC Act)	Box Gum Woodland	Principle 1 and Principle 2	2.46	Not yet released
Pilularia novae-hollandiae	Austral Pillwort	Principle 1 and Principle 2	1.02	Not yet released

SAII values have been considered as part of this assessment. '*White Box Yellow Box Blakely's Red Gum Woodland*' and *Pilularia novae-hollandiae* are listed candidate entities potentially subject to SAII. The SAII threshold for these entities are yet to be published. Given the small area (2.46 ha) of PCT 277 vegetation zone 3 representing Box-Gum Woodland, its degraded condition state, and it forming part of a contiguous larger patch including road verge vegetation and large stands, it is considered unlikely that the development would result in an SAII to this entity. Similarly, considering the low potential occurrence of *Pilularia novae-hollandiae* within the Development Footprint, and that only 1.02 ha of highly degraded and modified habitat (vegetation integrity score of 19.6) to be cleared, it is considered unlikely that the development would result in an SAII to this entity.

8.2.4.6 Matters of National Environmental Significance

Eight MNES were originally considered as having the potential to occur based on a desktop review, including NSW BioNet Records, Atlas of Living Australia records, aerial imagery and the BAMC. These MNES include:

- Box-Gum Woodland
- Regent Honeyeater
- Swift Parrot
- *Litoria raniformis* (Growling Grass Frog)
- *Nyctophilus corbeni* (Corben's Long-eared Bat)
- Superb Parrot
- Koala
- *Amphibromus fluitans* (River-Swamp Wallaby Grass).

However, following initial field surveys conducted in June 2018 to identify biodiversity constraints and map potential habitat and vegetation types, only the Superb Parrot was considered as having a likely potential to occur within the Site.

Detailed descriptions and assessments for Box-Gum Woodland, Superb Parrot and Koala have been included within the BDAR (Appendix C) and all have concluded that the Proposed Development is not likely to impact upon Box-Gum Woodland, Superb Parrot and Koala, and therefore a referral is not required.

8.2.5 Mitigation Measures

Measures proposed to mitigate and manage direct and indirect impacts from the Proposed Development during the construction and operational phases are outlined in Table 8-11.

Table 8-11: Measures proposed to mitigate and manage impacts to biodiversity

Environmental safeguard	Timing
A qualified ecologist/licensed wildlife handler will be present to supervise during clearing of identified fauna roosting or nesting habitat, in accordance with best practice methods to relocate fauna in a sensitive manner. Any fauna utilising habitat within the development footprint will be identified and managed to ensure clearing works minimise the likelihood of injuring fauna.	Prior to and during removal of habitat trees
Vegetation that is to be removed nearby to retained vegetation will be removed using a chain-saw rather than heavy machinery to avoid any additional impacts on adjacent vegetation.	During clearing works
If possible in considering the Project construction schedule, construction activities should be programmed to avoid impacts; for example, timing construction activities for when migratory species are absent from the Site, or when particular species known to or likely to use the habitat on the Site are not breeding or nesting. Where possible, timing of vegetation clearance should be planned to occur outside of the period between August and March, during the breeding/nesting/nursing time for the majority of avian and micro-bat species, to avoid impacts to fauna during these critical life cycle events.	During clearing works
Instigating clearing protocols including staged clearing. Clearing of vegetation will be undertaken via a two-stage clearing process. Clearing will not be undertaken until pre-clearance surveys and assessment are conducted by qualified ecologists. Stage 1 of the clearing process involved marking of habitat features, and removal of all vegetation except habitat features. Stage 2 involves removal of habitat features under the supervision of ecologists to relocate resident fauna. All clearing staff will be briefed about the two-stage clearing process, and their responsibilities to minimise impacts to biodiversity.	During clearing works
Construction works are to occur during standard construction hours to maximise daylight hours. Any request for an out of hours works protocol should consider construction activities during non-daylight hours as having potential fauna impacts.	For the duration of construction works
Control of sediment and erosion will include the management of exposed soil surfaces and the installation of stormwater management systems, sediment barriers (e.g. silt nets downslope from workings) or sedimentation ponds to control the quality of water released from the Site into the receiving environment.	Duration of the Proposed Development
A weed management plan will be included within a biodiversity management plan for the Site which will include hygiene protocols for the cleaning and inspection of light vehicles and mobile plant prior to entering/exiting the Site. There are currently no weeds on the Site listed under the *NSW Biosecurity Act 2015*. Future weed infestations should be managed/removed by a suitably qualified agricultural land management contractor.	Duration of the Proposed Development
All staff working on the development will undertake an environmental induction to communicate environmental features to be protected and measures to be implemented as part of their Site familiarisation. Site briefings should be updated based on phase of the work. This induction will include items such as: • Site environmental procedures (vegetation management, sediment and erosion control, exclusion fencing and noxious weeds) • What to do in case of environmental emergency (chemical spills, fire, injured fauna) • Key contacts in case of environmental emergency	To occur for all staff entering / working at the Site and when environmental issues become apparent

Environmental safeguard	Timing
Development control measures to regulate activity in vegetation and habitat adjacent to residential development should be implemented to protect flora and fauna surrounding the Proposed Development Footprint. These measures should include installation of signage to indicate no go zones, rubbish disposal guidance, prohibition of wood collection, prohibition from lighting fires, prohibition of disturbance to vegetation outside of the Proposed Development Footprint, and pest & disease management Fences will be placed around key biodiversity areas to prevent rubbish dumping by contractors. Appropriate security measures will also be in place to reduce illegal dumping.	Duration of the Proposed Development
Other measures to minimise the impacts of the project on biodiversity will be detailed within the construction environmental management plans. These measures will include at a minimum: • Temporary fencing to be installed prior to works, to delineate work zones and clearing boundaries and to protect retained vegetation • Marking of trees for retention • Cleaning of mobile plant prior to works to prevent the spread of weeds and pathogens • Sediment controls along drainage lines and creeks to prevent impacts downstream • Signage within the works area to advise contractors and responsibilities.	For the duration of construction works
A monitoring program will be considered within the management plans to measure infrequent and cumulative impacts of the project. The monitoring program will include baseline data capture to measure any effects of the project over time. Given the low biodiversity values at the Site, the monitoring program should focus on likely ongoing impacts of the development such as erosion.	Duration of the Proposed Development

8.2.6 Impacts requiring offsets

Up to 4.12 ha of native vegetation and 81 paddock trees requiring offsetting will be removed as part of the construction of the Proposed Development. Additionally, 1.02 ha of Southern Myotis and *Pilularia novae-hollandiae* habitat will be removed as part of the construction phase. The offsetting requirement has been calculated using the BAMC. A summary of ecosystem credits and species credits required for the Proposed Development are shown in Table 8-12 and Table 8-13.

Table 8-12: Ecosystem credits required

Veg Zone	PCT ID	PCT Name	Vegetation Formation	Direct impact	Credits required
2	277	Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	Grassy Woodlands	0.64 ha	10
3	277	Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	Grassy Woodlands	2.46 ha	45
4	9	River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion	Inland Riverine Forests	1.02 ha	9
5	277 (paddock trees)	Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	Grassy Woodlands	81 individuals	74

* Represents number of individuals

Table 8-13: Species credits required

Species	Common Name	Direct impact habitat (ha)	Credits required
Myotis macropus	Southern Myotis	1.02 ha (assumed presence)	10
Pilularis novae-hollandiae	Austral Pillwort	1.02 ha (assumed presence)	15

A Biodiversity Offset Strategy (BOS) will be developed to acquire and retire the full quantum of credits as required by the BAMC.

8.3 Aboriginal Cultural Heritage

8.3.1 Introduction

NSW Archaeology Pty Ltd undertook an ACHA for the Proposed Development in 2017. This ACHA report was updated in 2020 by ELA to include renewed Aboriginal community consultation, Aboriginal heritage database searches and updated mitigative measures for Aboriginal heritage at risk of being impacted by the Proposed Development. The assessment report, including additions made by ELA, is provided in Appendix D and summarised below. The assessment was undertaken to address the project SEARs for Aboriginal Cultural Heritage as listed below, (also applicable to the Historic Heritage section):

- *an assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development, including consultation with the local Aboriginal community in accordance with the Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW 2010b).*

The ACHA has been guided by the specifications set out in the following documents:

- *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in New South Wales* (OEH, 2011)
- *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010a).

A process of Aboriginal community consultation has been undertaken in accordance the Heritage NSW, Department of Premier and Cabinet (Heritage NSW) *Aboriginal cultural heritage consultation requirements for proponents* (DECCW, 2010b). The study has sought to identify and record Aboriginal cultural areas, objects or places, assess the archaeological potential of the proposal area and formulate management recommendations based on the results of the community consultation, background research, field survey and a significance assessment.

8.3.2 Existing Environment

A search of the Heritage NSW Aboriginal Heritage Management Information System (AHIMS) database was conducted for this project on 20 May 2020 (AHIMS Reference: #506767). The search area measured 432 km² and encompassed the area between eastings 487000 – 498000, and northings 6020000 – 6029000. Forty-seven (47) Aboriginal object sites are listed for the search area (Table 8-14; Figure 8-5), three of which occur within the Site (Table 8-15; Figure 8-6) and were recorded during the site survey undertaken by NSW Archaeology for this ACHA in 2018.

Table 8-14: AHIMS sites types and contexts within search area

Site Context	Site Type	Site Frequency	% of Site Types
Valid	Artefact	38	80.85
	Artefact Scatter	2	4.25
	Modified Tree (Scarred or Carved)	7	14.9
		47	**100%**

Table 8-15: Location of AHIMS sites within the Proposed Development area

Site ID	Site Name	Datum	Description
55-6-0111	Glenellen SF Survey Unit 2/Locale 1	GDA	Artefact
55-6-0112	Glenellen SF Survey Unit 2/Locale 3	GDA	Artefact
55-6-0113	Glenellen SF Survey Unit 2/Locale 2	GDA	Artefact

A field assessment was conducted in 2018 by Andrew Pearce and Tom Knight (NSW Archaeology Pty Ltd), and Troy McGrath and Draie McGrath (Albury District Local Aboriginal Land Council). The assessment was conducted on 25, 26 and 27 September 2018. The field survey was aimed at locating Aboriginal objects. An assessment was also made of prior land disturbance, survey coverage variables (ground exposure and archaeological visibility) and the potential archaeological sensitivity of the land.

Survey Units (SU) were established based on landform units. These are utilised as a framework of recording, analysis and the formulation of recommendations. The Site was found to contain discrete distributions of stone artefacts. For the purposes of defining the artefact distribution in space it has been labelled as a locale (eg. Survey Unit 1/Locale 1).

The Aboriginal object sites recorded during the assessment are summarised in Table 8-16 below.

Table 8-16: A summary of Aboriginal object sites recorded during the assessment (NSW Archaeology Pty Ltd, 2018)

Survey Unit (SU)	Locale	Exposure	Context	Artefact Number/ type	Predicted Density	Integrity
SU2	L1	Animal treadage/ bog: area: 10 x 10m	A drainage depression; open aspect; very gentle gradient	3 x Quartz flake	Very low	Moderately to highly disturbed: ploughing, grazing (heavily pugged by cattle)
SU2	L2	Animal treadage/ water: area: 40 x 40 m	A drainage depression; open aspect; very gentle gradient	3 x Quartz flake	Very low	Moderately to highly disturbed: ploughing, grazing (heavily pugged by cattle)
SU2	L3	Animal treadage/ bog: area: 20 x 20m	A drainage depression; open aspect; very gentle gradient	3 x Quartz flake	Very low	Moderately to highly disturbed: ploughing, grazing (heavily pugged by cattle)

The locations of Aboriginal object sites are shown in Figure 8-7.

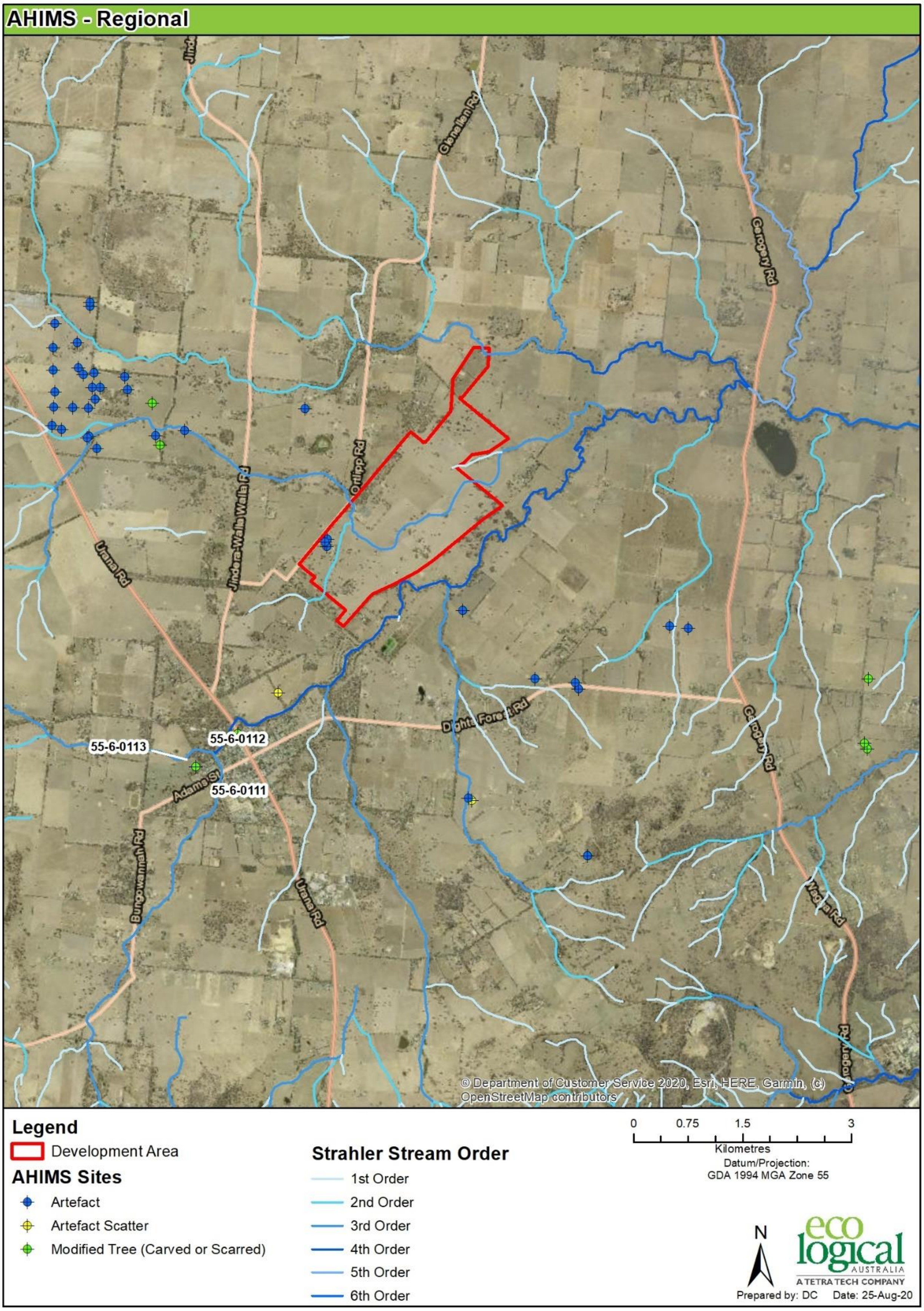

Figure 8-5: Location of AHIMS sites within the search area

Figure 8-6: Location of AHIMS sites recorded by NSW Archaeology within the study area

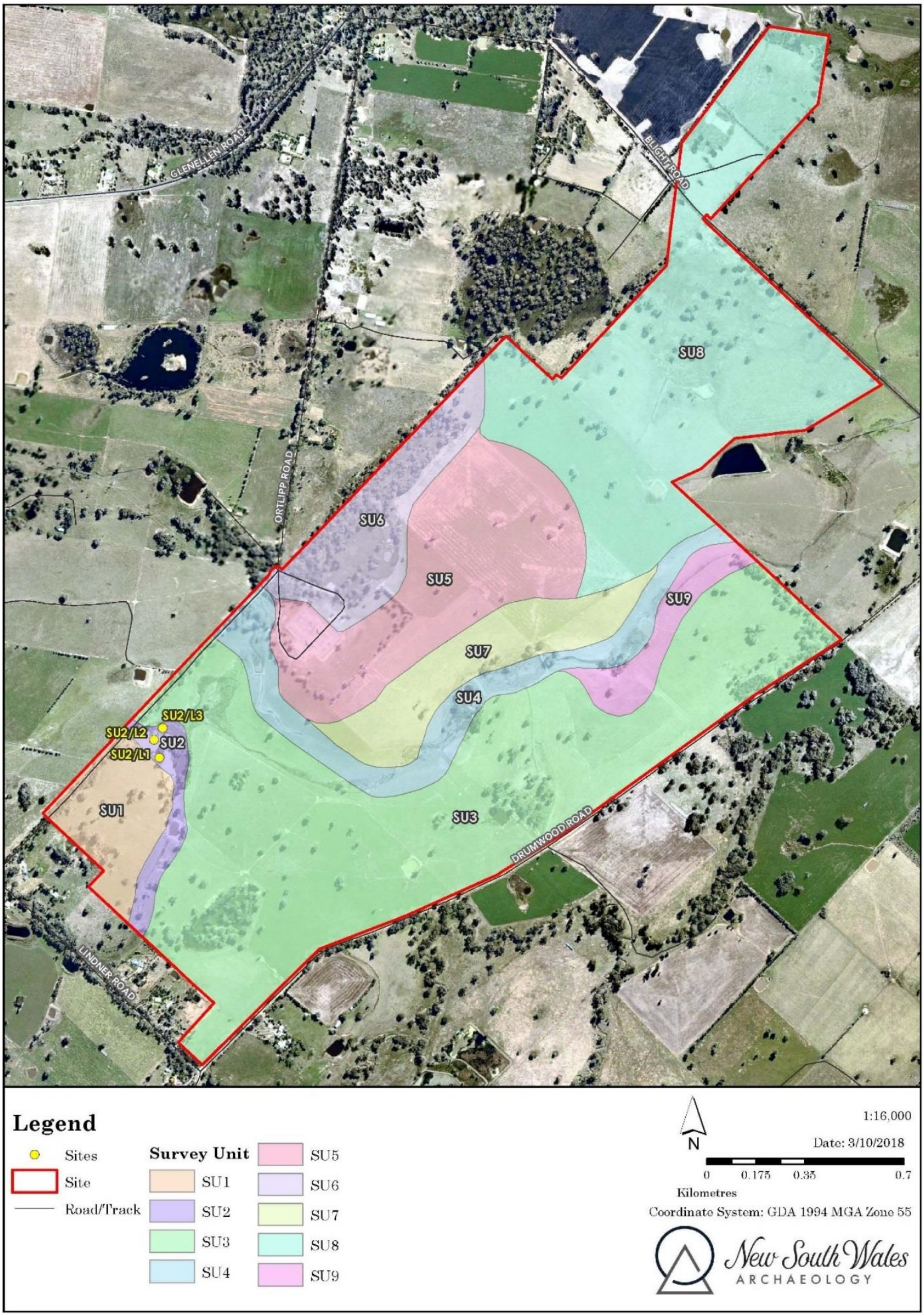

Figure 8-7: Location of Aboriginal object sites recorded during the field survey (NSW Archaeology Pty Ltd, 2018)

Most heritage evidence is highly valued by Aboriginal people given its symbolic embodiment and physical relationship with their ancestral past. The archaeological significance of the recorded Aboriginal artefact locales in the project area is set out in the table below (Table 8-17).

Table 8-17: Heritage significance

Site	Significance	Criteria
SU2/L1	Low local significance	Common site type, Low educational value, Low aesthetic value, Low research potential: disturbed; predicted very low density.
SU2/L2	Low local significance	Common site type, Low educational value, Low aesthetic value, Low research potential: disturbed; predicted very low density.
SU2/L3	Low local significance	Common site type, Low educational value, Low aesthetic value, Low research potential: disturbed; predicted very low density.

8.3.3 Potential Impacts

The potential impacts on Aboriginal cultural heritage items and places posed by the Proposed Development include:

- Direct impact to Aboriginal items and/or places within the Proposed Development site:
  - brought about by solar panel array installation and construction activities
  - as a result of modifications to the landscape relating to on-site support infrastructure; or
  - from modifications to the landscape relating to access track construction and/or existing road upgrades
- Indirect impact to Aboriginal items and/or places within the identified work zones as the result of altered vegetation structures and/or altered wind/water movement.

An impact assessment is set out below in Table 8-18 below.

Table 8-18: Impact assessment of Aboriginal object locales within the Study Area.

Site	Significance	Type of harm	Degree of harm	Consequence of harm
SU2/L1	Low local significance	direct	whole	Total loss of value
SU2/L2	Low local significance	direct	whole	Total loss of value
SU2/L3	Low local significance	direct	whole	Total loss of value

8.3.4 Mitigation Measures

Heritage NSW aims to ensure impacts to Aboriginal objects and places are avoided or reduced and that where possible Aboriginal sites should be conserved. The guiding principle is that, wherever possible, avoidance should be the primary management option, but if avoidance is not feasible, measures shall be taken to mitigate against impacts to Aboriginal items and/or places.

The original ACHA prepared by NSW Archaeology in 2018 recommended that no further archaeological investigations or mitigation measures were required, due to low site numbers and low site integrity. However, discussions between ELA and Heritage NSW in 2020 regarding the necessity for mitigative measures to be put in place led both Heritage NSW and ELA to conclude that unmitigated impact to the three AHIMS sites within the Proposed Development area is an unacceptable outcome.

Therefore, it is now recommended that community collection of the artefacts comprising the three AHIMS sites within the Proposed Development area be undertaken in partnership with Aboriginal community representatives as a means of mitigation.

Management and mitigation measures are set out in Table 8-19 and Table 8-20 below.

Table 8-19: Management and mitigation.

Aboriginal object site	Significance	Impacts	Management
SU2/L1 (55-6-0111)	Low local significance	direct	Community collection
SU2/L2 (55-6-0113)	Low local significance	direct	Community collection
SU2/L3 (55-6-0112)	Low local significance	direct	Community collection

ACHA recommendations

The following recommendations are made:

- No heritage constraints were identified during the NSW Archaeology assessment as documented in Appendix D
- The Study Area has been assessed to be of low heritage potential and sensitivity. Artefact density in the Study Area is assessed to be very low if not negligible. The three Aboriginal object locales recorded in the Study area were determined by NSW Archaeology to be of low significance and unmitigated impact was considered an appropriate management outcome
- After discussion with Heritage NSW, it was determined by ELA that unmitigated impact to the Aboriginal sites identified within the Proposed Development area is an unacceptable outcome. Therefore, it has been recommended by ELA that mitigation in the form of collection of these artefact sites be undertaken in partnership with Aboriginal community representatives
- Aside from community collection, no further archaeological investigations are required in respect of the proposal. No areas were identified that could be characterised as places with a high probability of possessing subsurface Aboriginal objects with high potential conservation value. Accordingly, archaeological test excavation has not been undertaken in respect of the proposal as it could not be justified (DECCW, 2010a)
- It is recommended that additional archaeological assessment is conducted in any areas which are proposed for impacts that have not been surveyed during the current assessment. The assessment may be conducted by predictive modelling, if appropriate.

Table 8-20: Mitigation measures for Aboriginal cultural heritage

Environmental safeguard	Timing*		
	C	O	D
Community collection in partnership with the RAPs is proposed prior to works commencing in order to mitigate impacts against AHIMS sites: 55-6-0111, 55-6-0112 and 55-6-0113. A methodology for undertaking community collection has been produced by ELA and is included within Appendix D.	✓		

Environmental safeguard	Timing*		
	C	O	D
It is recommended that additional archaeological assessment is conducted in any areas which are proposed for impacts that have not been surveyed during the current assessment. The assessment may be conducted by predictive modelling, if appropriate.	✓		
In the extremely unlikely event that human remains are found, works should immediately cease and the NSW Police should be contacted. If the remains are suspected to be Aboriginal, the OEH may also be contacted to assist in determining appropriate management.	✓		

***** C = Construction, O = Operation and D = Decommissioning

8.4 Historic Heritage

8.4.1 Introduction

The historic heritage assessment was undertaken in accordance with the *NSW Heritage Manual* (NSW Heritage Office & NSW Department of Urban Affairs and Planning, 1996), specifically the guidelines *Assessing Significance for Historical Archaeological Sites and 'Relics'* (Heritage Branch Department of Planning, 2009), and with reference to the Burra Charter (the Australian ICOMOS Charter for Places of Cultural Significance) (ICOMOS (Australia), 2013).

The primary objectives of the historical heritage assessment were to:

- identify, through heritage register searches, historical research and targeted archaeological investigations, the historical heritage values of the land within the Site
- assess the significance of potentially impacted heritage items in accordance with the NSW Heritage Branch guidelines: Assessing Heritage Significance (NSW Heritage Office, 2001)
- provide, based on significance and impact assessments against the Proposed Development, appropriate management and mitigation strategies for all identified and potential historic heritage items.

This involved the following key tasks:

- A search of relevant historic heritage registers, databases and lists, including:
    - National Heritage List (NHL)
    - Commonwealth Heritage List (CHL)
    - NSW State Heritage Register
    - Greater Hume LEP Heritage Schedule
- Background research concerning land within, and in the vicinity of, the Site in order to identify historic heritage items
- Comprehensive field survey of the Site to identify potential historic items
- Identify potential direct and indirect impacts to historic items
- Undertake a significance assessment for potentially impacted items in accordance with the guidelines *Assessing Heritage Significance* (NSW Heritage Office, 2001) to establish why a particular site or item is of significance and, if necessary, to enable appropriate mitigation strategies to be developed.

8.4.2 Existing environment

8.4.2.1 Desktop research

A search of the relevant databases revealed that there are no heritage items within the Site listed on the National Heritage Database, the CHL or the State Heritage Register.

A search of the Greater Hume Shire LEP revealed that while there are various items listed as historic heritage of local significance within 5 km of the Site, there are no heritage items currently listed in the Site (Figure 8-8; Table 8-21).

Table 8-21: Local heritage results within the Greater Hume LGA

Item No.	Class	Item Name	Significance	Distance[1]
I128	General	"Drumwood" homestead and outbuildings	Local	30 m
I131	General	Jindera General Cemetery	Local	700 m
I67	General	Glenellen School (former)	Local	1 km
I130	Landscape	Government Dam	Local	2 km
I134	General	Police Residence (former) and outbuildings	Local	2 km
I135	General	Police Stables	Local	2 km
I132	General	Jindera School of Arts	Local	2.3 km
I126	General	Blacksmiths Shop	Local	2.3 km
I138	General	St Paul's Anglican Church	Local	2.3 km
I133	General	Pioneer Museum (Wagners Store) and outbuildings	Local	2.3 km
I137	General	St John's Lutheran Church	Local	2.7 km
I127	General	Bethlehem Lutheran Cemetery	Local	3.3 km
I136	General	St John's Lutheran Cemetery	Local	3 km
I66	Landscape	Big Gum Swamp	Local	4.1 km
I62	General	Gerogery West General Cemetery	Local	4.5 km
I139	General	"Westerndale" homestead	Local	5 km

[1] Distance from the Site to the curtilage of the heritage item

8.4.2.2 Historic Survey Results

No historic heritage items or relics were recorded in the Site. The Site has no historic heritage values.

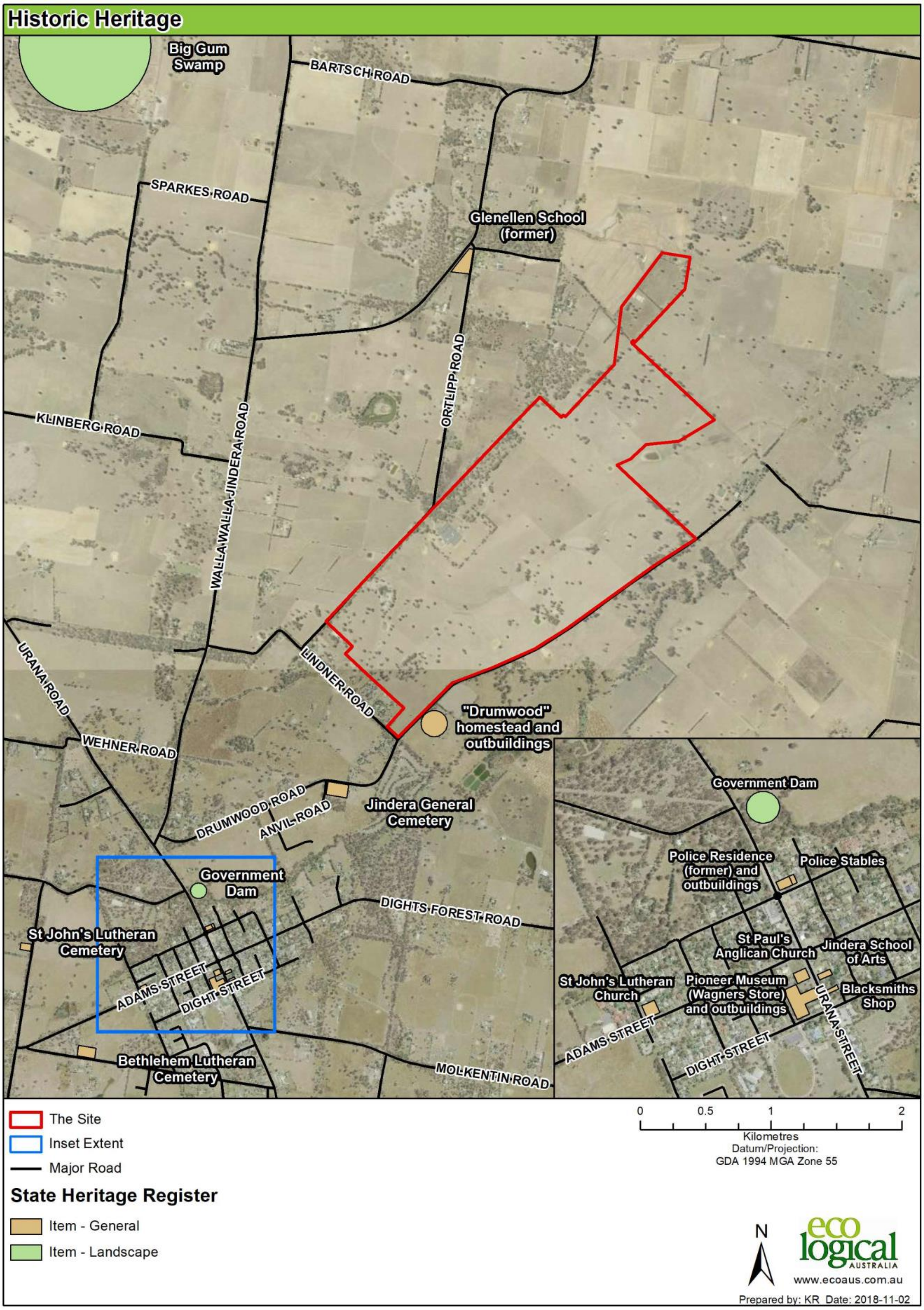

Figure 8-8: Location of historic heritage items identified in the Greater Hume LEP.

8.4.3 Potential Impacts

No items of historic significance have been identified within the Site. Potential impacts on identified historic heritage items are described in Table 8-22 below.

Table 8-22: Potential impacts on local heritage results

Item Name	Curtilage distance from		Significance	Potential Impacts
	The Site	Development Footprint		
"Drumwood" homestead and outbuildings	30 m	243 m	Local	Low - Nil
Jindera General Cemetery	700 m	1 km	Local	Nil
Glenellen School (former)	1 km	1 km	Local	Nil
Government Dam	2 km	2.3 km	Local	Nil
Big Gum Swamp	4.1 km	3.9 km	Local	Nil
Police Residence (former) and outbuildings	2 km	2.5	Local	Nil
Police Stables	2 km	2.5	Local	Nil
Jindera School of Arts	2.3 km	2.7 km	Local	Nil
Blacksmiths Shop	2.3 km	2.7 km	Local	Nil
St Paul's Anglican Church	2.3 km	2.7 km	Local	Nil
Pioneer Museum (Wagners Store) and outbuildings	2.3 km	2.7 km	National	Nil
St John's Lutheran Church	2.7 km	3.1 km	Local	Nil
Bethlehem Lutheran Cemetery	3.3 km	3.3 km	Local	Nil
St John's Lutheran Cemetery	3 km	3.5 km	Local	Nil
Gerogery West General Cemetery	4.5 km	4.5 km	Local	Nil
"Westerndale" homestead	5 km	5 km	Local	Nil
Gerogery Railway Station group	10 km	10 km	State	Nil

The Proposed Development will not cause direct or indirect impact to any known or unidentified items of historic significance. Potential low impact changes to visual amenity in the curtilage but not the residence associated with “Drumwood” were possible, however with the mitigation strategies, including undertaking the committed setback and committing to vegetation screening identified in Section 8.6.4, no impact to historic heritage values are anticipated.

8.4.4 Mitigation measures

The above historic heritage assessment indicates that no impacts to known or unknown heritage sites are anticipated from the Proposed Development, and accordingly, mitigation strategies are not proposed. In the event potentially significant historic heritage items or relics are found during construction activities, works in that area shall cease until an assessment is made by an appropriately qualified archaeologist and the Heritage Council or its delegate has been consulted. Contractors and staff will be advised of this requirement through Site induction and toolbox talks.

8.5 Land Resources

8.5.1 Introduction

In accordance with the requirements of the SEARs, this section establishes a baseline assessment of current land use, soils and land capability currently present at the Site. The SEARs include:

- *an assessment of the potential impacts of the development on existing land uses on the site and adjacent land, including:*
  - *a consideration of agricultural land, flood prone land, Crown lands, mining, mineral or petroleum rights*
  - *a soil survey to determine the soil characteristics and consider the potential for erosion to occur*
  - *a cumulative impact assessment of nearby developments*

- *an assessment of the compatibility of the development with existing land uses, during construction, operation and after decommissioning, including:*
  - *consideration of the zoning provisions applying to the land, including subdivision, and*
  - *completion of a Land Use Risk Assessment in accordance with the Department of Industry's Land Use Conflict Risk Assessment Guide*
  - *a description of the measures that would be implemented to remediate the land following decommissioning in accordance with the State Environmental Planning Policy No 55 - Remediation of Land.*

Potential impacts that are associated with the Proposed Development on agricultural land and mineral exploration activities in proximity to the Site have been considered as part of this assessment to ensure the compatibility of the development with existing land use on and adjacent to the Site during construction, operation and after decommissioning.

8.5.2 Existing Environment

The Site is located in a predominantly flat landscape, with elevation ranging between 200 - 220 m (Australian Height Datum (AHD)). The Site has been historically cleared and cultivated for mainly grazing of improved pastures and infrequent cropping, and is typical of farmland areas in the region. A number of stock dams have been developed across the Site. Surrounding land uses include:

- Agriculture
- A small amount of rural residential subdivision along Lindner Road
- Electricity transmission (Jindera substation on Ortlipp Road).

8.5.2.1 Land Use

The Murray regional economy has historically been based on agriculture, and it remains one of the most productive agricultural areas in Australia. Agricultural land occupies 8,490,000 ha or 87% of the region (ABARES, 2020). The most common land use by area is grazing native vegetation which occupies 4,830,000 ha or 49% of the region (ABARES, 2020). In 2018-19, the gross value of agricultural production in the Murray region was $1.5 billion, and the agriculture, forestry and fishing sector employed 4,100 people, equating to 13% of the region's employment (ABARES, 2020).

All land within and surrounding the Site is zoned RU1 Primary Production. Land zoned RU4 Primary Production Small Lots adjoins the Site to the south of the intersection of Lindner and Drumwood Roads (Figure 6-1). Under existing land management, the Site is used predominantly for sheep grazing, with some cattle grazing. To increase agricultural productivity, pastures in the Site have been improved, except for a few isolated areas with intact vegetation. NSW land Use mapping (https://data.gov.au/dataset/ds-nsw-de27e381-9595-4562-9347-b00e71d4c3bd/details?q=) shows that cropping occurs in the surrounding area and that the Site is mapped as having a cropping land use.

The TransGrid Jindera substation is located on the north western side of the Site, accessed via Ortlipp Road. Transmission lines and easements currently exist on the Site connecting to the substation, including two 132 kV lines and a 22 kV line. The Jindera Substation will serve as the grid connection point for the Proposed Development.

Other renewable energy projects proposed nearby are discussed under cumulative impacts (Section 8.13)

Mining Exploration

A search of the NSW MinView portal (DPE, 2018) was undertaken 19 June 2020. There are no mining leases or exploration licences over the Site (see Figure 8-9 for further details).

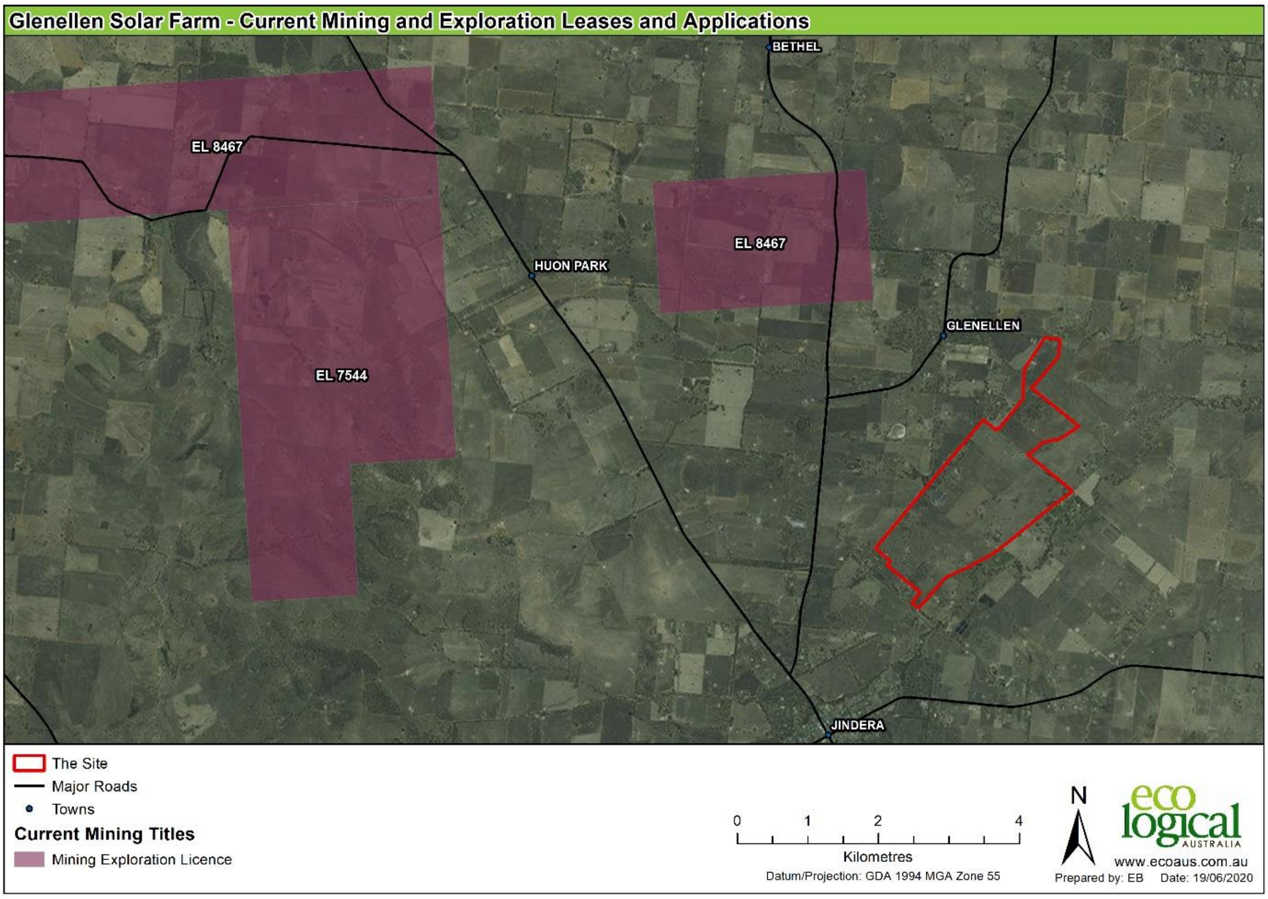

Figure 8-9: Mining titles context

8.5.2.2 Regional and Local context

A desktop survey was undertaken of the Site and surrounds, hence assessments are based on broad-scale mapping. The discussion below is based on existing published data for the region, and is complemented where possible by site observations made during the biodiversity site inspections.

Topography and Geology

The topography of the Site falls generally northwards at very flat grades. Elevations within the Site vary from approximately 210 to 220 m AHD, with a small rise in the centre of the site. Shallow flat depressions meander through the Site, draining water to several farm dams. The landform of the Site would be described as level plain to undulating rises (National Committee on Soil and Terrain, 2009).

The Site lies within two geological formations: a large area of intrusive Jindera Granite and associated sediments from the Silurian period, overlaid by an unconsolidated Quaternary alluvium (Geological Survey of New South Wales, 2009).

Mitchell Landscapes

Mitchell Landscapes are defined 1:250,000 scale ecosystem units based upon geologic, geomorphic and pedologic factors (Mitchell, 2002). One Mitchell Landscape intersects the Site: Brokong Plains (Mitchell, 2002). This landscape consists of alluvial plains and has a general elevation of 170 m AHD with local relief <10 m (Mitchell, 2002). Soils are described as red-brown texture contrast. The Brokong Plains landscape has been extensively cleared and cropped, and the vegetation was formerly woodland to open forest of *Eucalyptus microcarpa* (Grey Box), *Eucalyptus melliodora*, *Eucalyptus blakelyi* and *Callitris glaucophyll*a (White Cypress Pine) (Mitchell, 2002).

Soil Landscapes

The *Reconnaissance Soil and Land Resources of the Murray Catchment* 1:250 000 map sheet (OEH, 2010) identified the following soil landscapes occurring over the project area (Figure 8-10):

- Kindra
- Yarra Yarra.

The Kindra landscape is located in the northern portion of the Site occurring on broad sloping plains (1 – 3% slope) (OEH, 2010). Generally, two soil types are associated with plains in this soil landscape: Haplic and Sodic Hypercalcic Red Chromosols (also referred to as Red-browned Earths under the Great Soil Group (GSG) Classification System), and Haplic Eutrophic and Duric Red Dermosols (SGSs Brown Podzolic Soils and Non-calcic Brown Soils) (OEH, 2010). Chromosols have a strong texture contrast between the A and B horizons, and are not strongly acidic and are generally not sodic (McKenzie, Isbell, Brown and Jacquier, 1999). However, Sodic Hypercalcic Red Chromosols have sodicity in at east part of the lower B (subsoil) horizon (layer). Localised poor drainage and waterlogging occur in this soil landscape.

Fertility is moderate and acidic pH in the surface soil is common in this landscape (OEH, 2010; OEH, 2017). Soil structure decline and hard-setting surfaces commonly result from cultivation and sheet erosion may occur in some cultivated lands (OEH, 2010). Gully erosion may occur where drainage lines are concentrated, however, continuous ground cover vegetation reduces erosion risk. High levels of groundcover were noted, and no gully erosion was observed, at the Site during site inspections during September 2018.

The Yarra Yarra landscape covers the southern portion of the Site. It is described as occurring on the gently inclined foot slopes (2 – 8% slope) (OEH, 2010). Soils found associated with this landscape are deep to very deep (OEH, 2010). Soils occurring within the Yarra-Yarra landscape are very deep (>1.5 m), imperfectly to moderately well-drained Red, Brown and Yellow Chromosols (GSG Podzolic Soils) occur on the upper slopes (and unlikely to occur based on the landform and topography of the Site), while deep (1 – 1.5 m) imperfectly drained Brown and Grey Sodosols and Kurosols (GSGs Soloths and Solodized Solonetz Soils) occur on lower slopes, with very deep (1.5 – 5 m), well drained Orthic Tenosols (GSG Earthy Sands) on fans (OEH, 2010). Sodosols have a strong texture contrast between the A horizon and the sodic clay B horizons and are not strongly acidic (McKenzie, Isbell, Brown and Jacquier, 1999) whereas Kurosols are texture contrast soils with strongly acidic B horizons. Fertility is moderately low (OEH, 2017). There is localised poor drainage and seasonal waterlogging. Sodosols have dispersive subsoils, making these soils susceptible to water erosion and this risk is reflected in the severe branching gully erosion that occurs in valley depressions in the Yarra Yarra landscape (McKenzie, Isbell, Brown and Jacquier, 1999; OEH, 2017). No gully erosion was observed at the Site during site inspections.

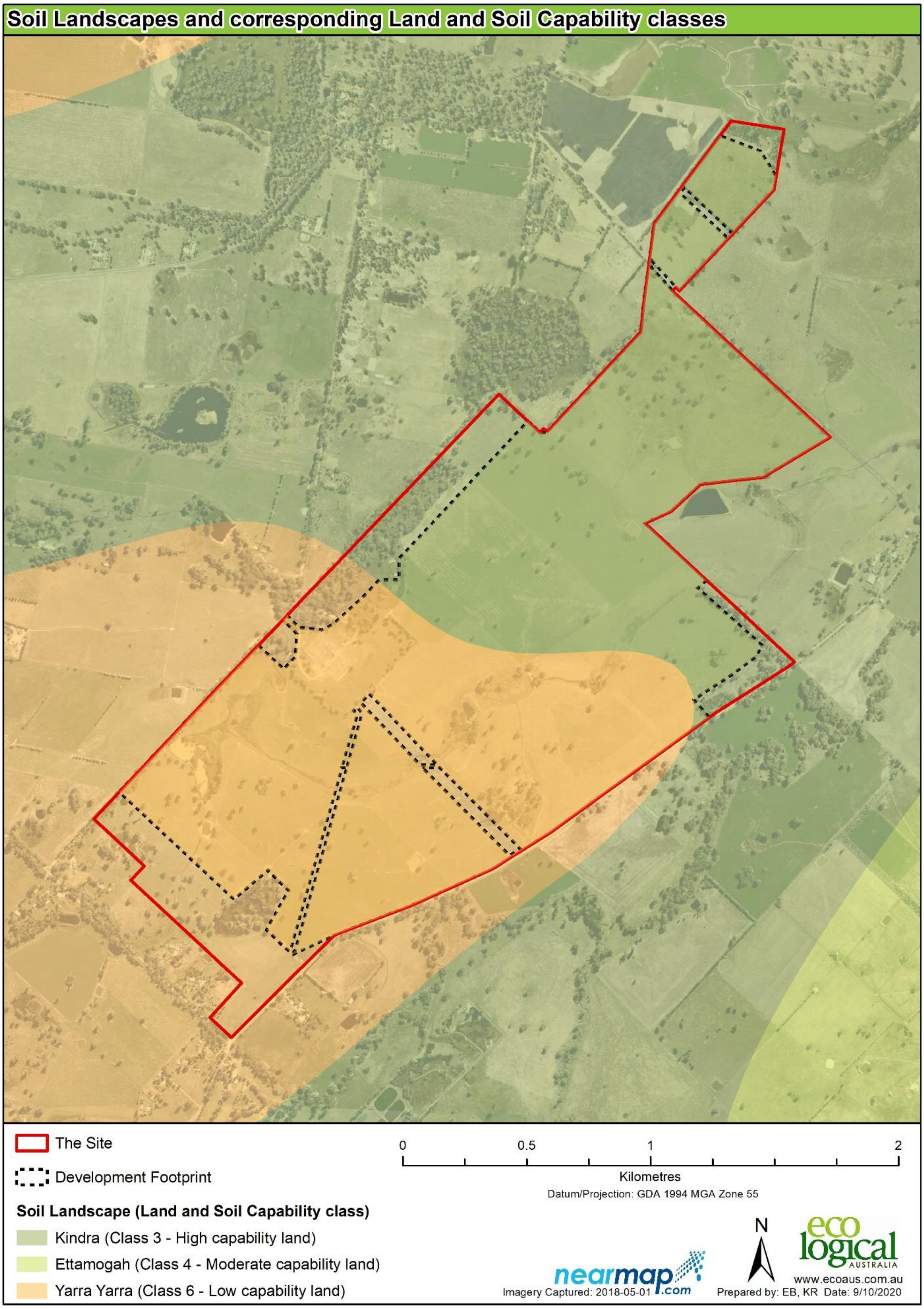

Figure 8-10: Soil landscapes in the Site. Source: OEH (2010)

Land and Soil Capability

Land capability is the inherent physical capacity of land to sustain a range of land uses and management practices in the long term without degradation to soil, land, air and water resources (OEH, 2012). The classification of any land is based on biophysical features which determine the limitations and hazards of that land. The main hazards and limitations include: water erosion, wind erosion, soil structure decline, soil acidification, salinity, waterlogging, shallow soils, rockiness, and mass movement.

The Land and Soil Capability Assessment Scheme (OEH, 2012) is an eight-class system which recognises four types of land uses with land capability decreasing from Class 1 to Class 8:

- Class 1 – 3: land suitable for cultivation
- Class 4 – 5: land suitable for grazing and restricted cultivation
- Class 6 – land suitable for grazing
- Class 7 – 8: land not suitable for agricultural production.

Land and soil capability (LSC) class is ascribed to each soil landscape, based on the most limiting hazard. The northern portion of the Development Footprint (corresponding to the Kindra Soil Landscape) is mapped as high LSC (Class 3), covering 153.05 ha, which is 0.44% of all land classified as Class 3 land within the Greater Hume LGA. Class 3 land has moderate limitations for more intensive uses other than grazing and cropping with cultivation, and suitability for a variety of land uses can be maintained if carefully managed to prevent long-term degradation (OEH, 2012). The most limiting factors are soil structural decline and salinity. The southern portion of the Development Footprint (corresponding to the Yarra Yarra Soil Landscape) is mapped as land and soil capability Class 6 land in, covering 181.14 ha and representing 0.21% of Class 6 land within the Greater Hume LGA. Class 6 land has very high limitations for high impact land uses such as cropping with cultivation, and land use is restricted to grazing (OEH, 2012). Soil structural decline and water erosion are the most limiting factors. The LSC class for each soil landscape is provided in Table 8-23.

Table 8-23: Land and soil capability classes within the Site

Hazard Classification	Soil Landscape	
	Kindra	Yarra Yarra
Soil Acidification	2	4
Water Erosion	1	5
Soil Structure Decline	3	6
Wind Erosion	2	2
Shallow soils/Rockiness	1	1
Salinity	3	1
Mass Movement	1	1
Water-logging	2	3
Land and Soil Capability Class	**3 (High)**	**6 (Low)**

Source: Land and Soil Capability Mapping for NSW (OEH, 2017a)

Hydrogeological Landscapes for the Eastern Murray Catchment (OEH, 2015) identified the Walla Walla hydrogeological landscape (HGL) as roughly coinciding with areas mapped as Kindra Soil Landscape within the Site. OEH (2015) presents this HGL as having an LSC Class 4 (i.e., land suitable for grazing and restricted cultivation) with the key land degradation issues being:

- sodicity in lower landscape
- salinity (isolated)
- waterlogging (common)
- gully erosion (localised)
- poor soil structure
- acidity
- sheet erosion.

At the nearby proposed JSF, McMahon (2020) re-assessed the LSC of areas occupied by the Kindra Soil Landscape as LSC Class 4 based on the following limitations:

- Soil structural decline. This is based on surface soil properties (high silt and fine sand and or sodicity)
- Soil acidification hazard
- Waterlogging. This is based on the presence of imperfectly drained and inferred 2-3-month waterlogging, every 2 to 3 years.

A geotechnical investigation conducted at the Site (Douglas Partners, 2019) provides information on subsoils characteristics relevant to soil surface and subsoil conditions that affect land quality. Douglas Partners classified all surface soils (0.2 – 0.3m) as sandy silt and silt (i.e. fine grained soils with at least 50% particles <0.075 mm). This would make them susceptible to soil structural degradation and correlates with limitations noted in OEH (2015) and McMahon (2020) indicating soil conditions more consistent with LSC Class 4.

Douglas Partners (2019) described subsoils silty clay (with particle size analysis data showing generally >80% particles <0.075 mm) and generally stiff. This is consistent with high clay content subsoils associated with texture contrast soils (chromosols, sodosols and Kurosols; all mapped in the area). Over large parts of the area mapped as Kindra, Douglas Partners (2019) described the presence of red and orange mottles in the soils below 0.2 to 0.3 m (occasionally 0.5 m) depth (i.e. within the upper subsoil). This feature is in indication of imperfect or poor soil drainage and periodic waterlogging. This correlates with limitations noted in OEH (2015) and McMahon (2020) indicating soil conditions more consistent with LSC Class 4.

Important Agricultural Land (IAL)

The NSW DPI is undertaking a mapping program across NSW to assist state and local government, other organisations and industries to recognise and value IAL. IAL mapping will identify the most productive and highly suitable land for agricultural industries, which has the inherent capability of being productive with minimal inputs, on a state-wide basis.

There was 3,687 ha of IAL mapped in the Greater Hume LGA and 61,276 ha of IAL mapped in the Riverina Murray area under the Draft Riverina-Murray IAL Mapping Program, 2018 (DPI, 2018). The 2018 draft map was accompanied by a report detailing the methods used to identify IAL which detailed that the land identified IAL was fairly consistent with LSC Classes 3, 2 and 1.

The Kindra soil landscape (mapped as LSC Class 3 land), which covers 164.5 ha of the Development Footprint (Figure 8-10), was mapped as IAL in the Draft Riverina-Murray IAL Mapping Program 2018. This was 0.27% of all land classified as IAL within the Riverina Murray Region (61,276 ha). The Yarra Yarra soil landscape is mapped as LSC Class 6 and was not identified as IAL in the 2018 IAL mapping.

New mapping updates (Riverina-Murray IAL Map, 2019) mean that now the entirety of the Site is mapped as IAL. The new GIS data (accessed here arcgis.com/apps/webappviewer/index.html?id=65e3be0196f44197b0c6c8e91d1c7ae7) covers far more area than the previous draft mapping. Even though the map legend says FINAL, it is still a draft as the State government wants it to cover the whole of NSW when it's released later this year.

The 2019 map update is not accompanied by a report; therefore, the reasoning behind the expansion of land identified as IAL is unclear. Due to the absence of a report and the GIS data not being available for download or viewing at a finer scale than screenshotted below in Figure 8-11, the relative area of land now classified as IAL cannot be ascertained.

Figure 8-11: Updated draft IAL mapping (DPI, 2019)

Soil Condition and Land Management

Results from 2008-09 monitoring, evaluation and reporting program, undertaken as part of the 2009 State of the Environment report, reveal that the overall soil condition index for the Murray Catchment Management Authority (CMA) region is 4 (good) indicating that there is a slight loss of soil function, but no significant deterioration against reference condition (OEH, 2014). The identified broad issues of concern are sheet erosion, salinity and structure decline (OEH, 2014). Evidence of these issues were not observed on the Site during site inspections.

The overall land management within capability index for the Murray CMA region is 3.4 (fair) indicating that land is managed within capability and there is an acceptable risk of soil and land degradation, while the broad issue of concern in relation to land management was structure decline (OEH, 2014).

Biophysical Strategic Agricultural Land (BSAL)

No areas of high agricultural value have been identified and mapped as BSAL within or in the vicinity of the Site. The closest mapped area of BSAL is located approximately 21 km southeast of the Site.

Groundcover

During the site inspection in August 2018, existing groundcover was high, consisting of mainly exotic pasture species in the cleared areas. Dominant exotic pasture species included *Lolium* sp. (Rye Grass), *Vulpia* sp. (Fescue), *Hordeum* sp. (Barley), *Festuca arundinacea* (Tall Fescue) and *Phalaris aquatica* (Phalaris) (Appendix C). Native pasture species included *Rytidosperma* sp. (Wallaby Grass), *Anthosachne scabra* (Wheatgrass) and *Lachnagrostis filiformis* (Blown Grass) (ELA, 2020). Native grasses were not as widespread and their cover was low.

Perennial grasses are classified as either C3 or C4 plants. These are the different pathways used by plants to fix carbon dioxide during photosynthesis. All species have the primitive C3 pathway, where the first product of carbon fixation is a 3-carbon molecule. C4 plants initially produce a 4-carbon molecule as an addition pathway that then enters the C3 cycle. C4 plants have adapted to warm or hot seasonal conditions under wet or dry environments, while C3 grasses have adapted to cool season establishment in either wet or dry environments, and are more frost tolerant (DPI, n.d.b). No C4 pasture species were identified within the Site.

8.5.2.3 Erosion Potential Assessment

The desktop assessment undertaken uses data based on 'bare earth' scenarios. As noted above groundcover at the Site is high (>70%), therefore the existing erosion potential of the Site may be reduced when consideration is given to current groundcover and land management practices.

Climate

Climate factors are a major influence on the character and potential hazards of any development site, including erosion and plant growth potential (DLWC, 2000).

The Site is located within the South Western Slopes bioregion. This bioregion is dominated by a sub-humid climate characterised by hot summers and no dry season (NPWS, 2003). Warm summers occur at higher elevation along the eastern boundary, however mean annual temperature (11 - 17°C) increases across the bioregion from low temperatures in the south to higher temperatures in the north and west (NPWS, 2003).

The closest BoM weather station is at Albury Airport (Station 072146), located approximately 15 km south east of the Site. The mean annual maximum temperature is 22.1°C and the mean annual minimum temperature is 8.7°C (BoM, 2018). Mean annual rainfall is 710 mm and records indicate monthly mean rainfall received at the Site is highest in the months of June – August, however winter rainfall is not strongly dominant (BoM, 2018). The mean number of rainfall days >1 mm are higher in winter and range between 4 days (March) to 11.5 days (July) (BoM, 2018). However, mean rainfall days >25 mm are less frequent, ranging from 0.2 days in June to 0.6 in October, and are generally higher in the summer months

(0.5 days) (BoM, 2018). This indicates that while mean rainfall at the Site is mildly winter dominant, rainfall intensity is generally higher in August to February.

Wind speeds are generally higher in the afternoon (3 pm conditions) and are generally stronger and more frequent in spring and summer, and are predominantly westerlies ranging between 7.8 and 11 km/h (BoM, 2018). In autumn and winter wind mean wind speeds are slower ranging between 4.6 to 8.4 km/h, however wind direction is more variable, but stronger winds are caused by westerlies (BoM, 2018). Wind erosive power is based on overall wind patterns, and the Site is mapped as having a high wind erosive power (OEH, 2012). Douglas Partners (2019) noted that due to the silty nature of the surface soils, they can be very fragile and produce bull dust. This will need to be managed during construction.

Soil Erodibility and Dispersibility

Soil erodibility is the measure of the susceptibility of individual soil particles to detachment and transport by erosive agents such as water and wind. Erodibility is influenced by the chemical, physical and mechanical properties of the soil.

Modelled Exchangeable Sodium Percentage (ESP) at the Site ranges between 2 – 6% in soil 0 – 30 cm deep and 2 – 8% in 30 – 100 cm soil depth (OEH, 2017b). In Australia, soil sodicity is defined as an ESP of >6% (Isbell, 2016). Modelled ESP of the site, and Australian Soil Classification mapping indicate the subsoils across the Site are sodic, particularly in the southern portion mapped as Sodosols, indicating the dispersion is likely if exposed to water from rainfall or runoff (OEH, 2010). The geotechnical assessment (Douglas Partners 2019) indicated that the majority of subsoils (from 0.3 to 1 m) on Site are sodic or highly sodic and all soils tested had Emerson Class 2 (i.e., show some dispersion). Exposed subsoils would be susceptible to gully erosion. Given the shallow slopes and good ground cover, erosion is not a serious risk and this is supported by field observations with no evidence of sheet or significant gully erosion recorded on the Site during site inspections.

Rainfall Erosivity

Rainfall Erosivity (also called the R-factor) is a measure of the ability of rainfall to cause erosion, and is calculated based on total energy and maximum 30 minute storm intensity (Landcom, 2004). The R-factor varies between 600 (low) in parts of western NSW to over 10,000 (high) on the far north coast of NSW.

The R-factor for the GSF is approximately 1,000 – 1,250 based on *Rainfall Erosivity Values for New South Wales 1: 250,000 Topographic Sheet in Appendix B* of the 'Blue Book' (Landcom, 2004). Given this range the Rainfall Erosivity for the Site can be considered low.

Soil Erosion Hazard

Soil erosion hazard refers to the susceptibility of a parcel of land to the prevailing agents of erosion and is typically described as high or low erosion hazard (Landcom, 2004). It differs from soil erodibility which is based on soil properties, and the soil erosion hazard is considerate of field conditions, and whilst dependent on soil erodibility, climate (Rainfall Erosivity), landform, groundcover and land management are factors considered in determining the erosion hazard (Landcom, 2004). Sites with high erosion hazard may require control measures beyond the normal suite of erosion control measures applied to construction sites.

The Kindra landscape unit within the Site is mapped as Chromosols, which generally have a low to moderate erosion hazard, depending on slope and land practices. Within this landscape, the sheet erosion hazard is widespread, and localised gullies. The Yarra Yarra landscape is associated with Sodosols within the Site. The erosion hazard of this landscape is generally high, particularly in areas under cultivation for cropping and exposed to overgrazing. The sheet and gully erosion hazard across this landscape is widespread. However, no sheet or gully erosion was observed onsite despite the erosion hazard of these soil landscape units. However, subsoils will be susceptible to gully erosion if exposed during construction.

Based on the above information, including the R-factor (1,000 to 1,250), high groundcover (>70%), and a slope gradient of ~1.2%, the erosion hazard across the Site is considered to be low. Under current land management, the groundcover contains a mix of perennial and annual pasture species that provide additional protection of the moderately sodic topsoil and sodic subsoils.

Salinity

Often the result of clearing of deep-rooted native vegetation and establishing shallow-rooted crops and pastures that take up less water leads to rising groundwater dissolving salts stored in the soil (OEH, 2018b). Impacts to the environment include decreased plant growth resulting in reduced groundcover and increased susceptibility to erosion, as well as off-site impacts from salt export to wetlands and rivers (OEH, 2018c). Salt accumulation in soils can have adverse impacts on developments including damage to building foundations, breaking up road pavements and corrosion of underground pipes and services (Landcom, 2004). The *Hydrogeological Landscapes for the Eastern Murry Catchment* (OEH, 2015) identified the following HGLs as occurring over the Site:

- Walla Walla
- Burrumbuttock.

In both landscapes, salts are typically restricted in localised drainage depressions and adjacent to soil profile texture changes, and are often the result of evaporative concentration of salts at waterlogged sites.

The Walla Walla HGL (Figure 8-12) is a depositional environment, comprising of unconsolidated Cainozoic fluvial and lacustrine sediments and water logging is common in low depressions (OEH, 2015). Soils are very deep and sodic soils have developed on areas of older terraces (OEH, 2015).

The Burrumbuttock HGL is moderate to highly weathered, characterised by rolling steep hills, undulating hills, long colluvial slopes, and gently inclined foot-slopes and fans. Localised depressions are present at the bottom of the Burrumbuttock HGL. Soils are generally very deep and are imperfectly to moderately well-drained, and present on upper slopes, however in areas of poor drainage swamps have developed. Within this landscape, sodic soils that have sealed and become waterlogged interact and contribute to salinity (OEH, 2015).

The overall salinity hazard, and characteristics of each HGL are provided in Table 8-24.

Table 8-24: Salinity hazard within the Site (OEH, 2015)

Hydrogeological Landscape	Salinity Expression	Salt Mobility	Overall Salinity Hazard
Walla Walla	**Land Salinity Occurrence** Moderate – Salinity outbreaks occur within an on the margins of swampy depression and are driven by seasonal conditions. **Salt Load (export)** Low – Streams are mainly terminal basins and are not incised into salt bearing materials. **EC (water Quality)** Low – no observations of high EC water.	High – There is a moderate salt store that has high availability.	Low
Burrumbuttock	**Land Salinity Occurrence** Moderate – Typically observed in localised drainage depressions and adjacent to soil texture changes and bedrock highs, resulting from evaporative concentration of salts at waterlogged sites. **Salt Load (export)** Moderate – infrequent baseflow input into main flow lines during wet seasons. **EC (water Quality)** Likely that the area has moderate EC.	High – There is a high salt store that has moderate availability.	Low

Lower-lying areas are located to the west of the Site and extend into the western portions of the site north of the existing substation. However, salinity was not observed in any of the landscapes that intersect the Site during site inspections.

8.5.2.4 Other local environmental constraints

Expansion or reactive soils

Most soils will shrink or swell depending on changes in their moisture content. Soils that shrink significantly are called expansive or reactive soils and may be problematic in structures such as sediment basins or roads (Landcom, 2004). Soils that typically exhibit shrink-swell properties (or 'cracking') to varying degrees have not been identified on site. Soils that typically exhibit shrink-swell properties (or 'cracking') to varying degrees have not been identified in soils mapping for the Site. Douglas Partners (2019) did record some moderate or high reactivity in the fine textured subsoils and made recommendation regarding the re-use site won fill material on Site.

Depth to water table

The design of erosion and sediment controls may be influenced by the presence of water tables near to the surface, whether seasonal or permanent (Landcom, 2004). An analysis of groundwater elevation forms part of the water resources assessment (see Section 8.9) and indicates that groundwater depths, as measured by bores within 5 km of the Site, are moderately deep, and range between approximately 21.9 m below ground level (mbgl) and 54.8 mbgl. Douglas Partners (2019) did not encounter free water in the boreholes drilled for the geotechnical assessment, but noted that they may vary seasonally.

Acid Sulfate Soils

The Australian Soil Resource Information System (ASRIS) online data base indicates that there is a low probability of occurrence (6 – 70% chance) of potential acid sulfate soils at the Site (Figure 8-12; Fitzpatrick, Powell & Marvanek, 2011). However, the Walla Walla HGL contains a high hazard for inland acid sulfate processes (OEH, 2016). Both datasets are inferred from surrogate datasets. The confidence level of the ASRIS map polygon overlaying the Site indicates the classification is provisional due to no analytical data available or ground truthing. The Confidence level of the Walla Walla HGL is also low. Inland acid sulfate soils occur on inland waterways, wetlands and drainage channels, and develop in waterlogged, saline and anaerobic conditions.

Contaminated Land

A review of the EPA Contaminated Land Record under section 58 of the *Contaminated Land Management Act 1997* and the List of NSW contaminated sites notified to the NSW EPA under section 60 of *Contaminated Land Management Act 1997* did not reveal any registered contaminated land sites within or surrounding the Site.

A review of premises currently regulated by an EPL under the POEO Act and premises that are no longer required to be licensed under the POEO Act did not reveal any identified premises within or surrounding the Site.

Pursuant to Clause 7 of SEPP 55 there is no apparent reason to consider that land to be utilised by the Proposed Development would be contaminated. Whilst no registered contaminated land occurs within the Site, potential contamination associated with agricultural activities may exist on site. These include sheep dips, import and fill material, demolition of old buildings and stockpiling of wastes.

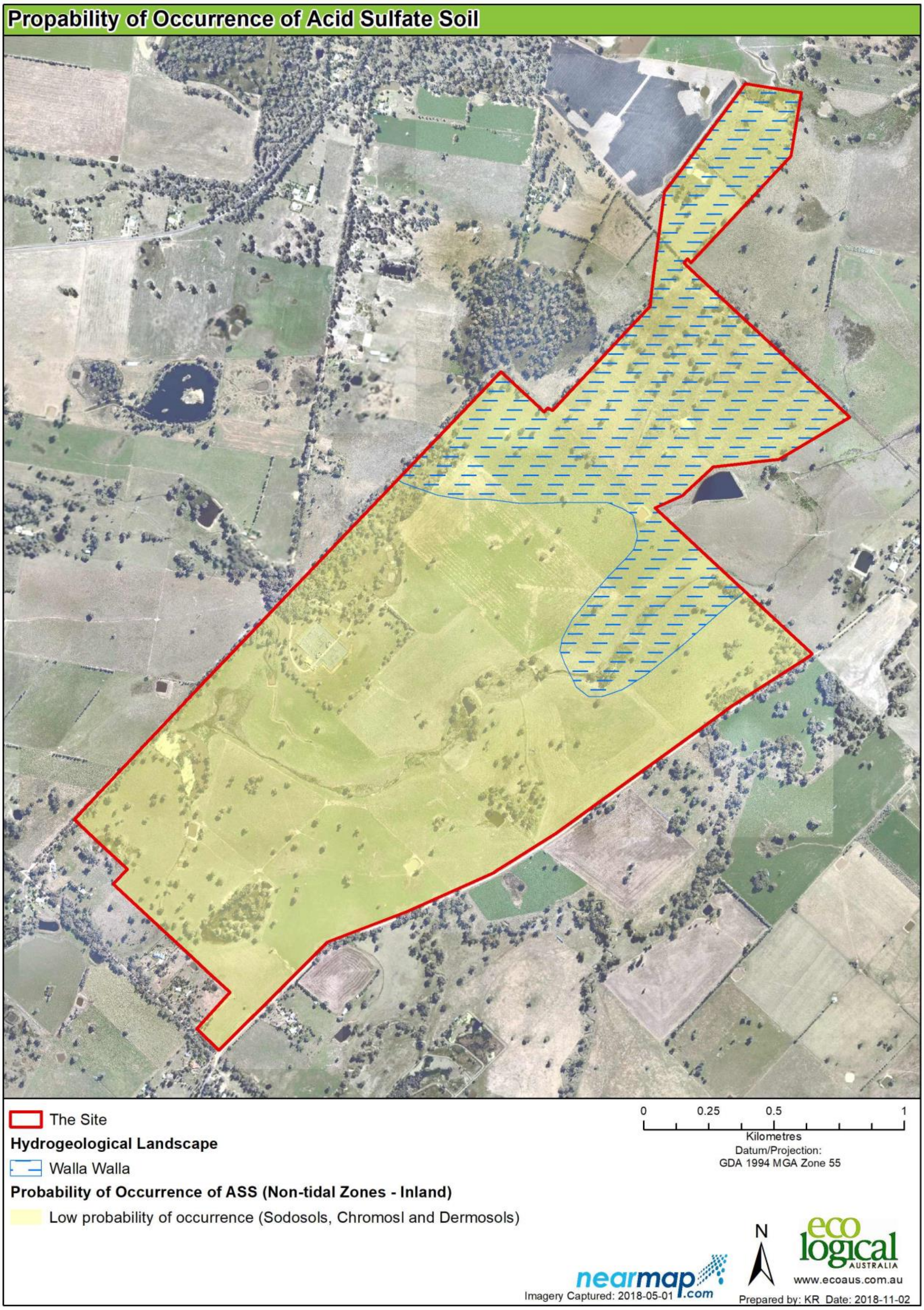

Figure 8-12: Probability of occurrence of acid sulfate soil within the Site. Source: Fitzpatrick, Powell & Marvanek (2011) and OEH (2016)

8.5.3 Potential Impacts

8.5.3.1 Land use

The Proposed Development involves a temporary diversification in land use of up to 334.2 ha, accounting 0.0037% of all land used for agriculture in the ABARES Murray region (8,490,000 ha; ABARES, 2020), for the duration of the project life (estimated to be 30 years). This changed land use may temporarily reduce agricultural production, including on the land mapped as IAL (DPI, 2018). However, once constructed sheep grazing will continue within the Site to control vegetation beneath the solar array, allowing for the continuation of existing agricultural activities. Therefore, impacts of the Proposed Development on agricultural production at a regional level are not significant. Relative impacts on land mapped as IAL are very minimal and the Proposed Development is co-located with existing grid connection therefore lowering impacts by not requiring new transmission and connection infrastructure. At the conclusion of the life of the project, the Proposed Development would be decommissioned in order to permit the resumption of other agricultural uses.

The entire Site and most of the surrounding land is zoned RU1 Primary Production. An assessment of the Proposed Development's compatibility with the objectives of the RU1 zone is provided in Table 8-25.

Table 8-25: Compatibility of the Proposed Development with the RU1 zone objectives

Objective	Proposed Development
To encourage sustainable primary industry production by maintaining and enhancing the natural resource base	The Development Footprint accounts for 0.06% of all land within the Greater Hume LGA and will not substantially reduce the availability of agricultural land within the LGA. Furthermore, the Proposed Development allows for the continuation of sheep grazing within the arrays to control vegetation growth. Following decommissioning the land will be rehabilitated back to its current use as a grazing operation.
To encourage diversity in primary industry enterprises and systems appropriate for the area	Sunshine harvesting is a passive land use that can co-exist with sheep grazing. The Proposed Development will support the growth of the renewable energy market, as well as providing for diversification for on-farm income, and more broadly diversification of employment and economic opportunities within the Greater Hume LGA.
To minimise the fragmentation and alienation of resource lands	Sheep grazing activities will continue throughout the life of the Proposed Development and will not result in the fragmentation of land currently used for grazing.
To minimise conflict between land uses within this zone and land uses within adjoining zones	The Proposed Development is located on land entirely zoned as RU1, and land adjacent to the Site boundary is also zoned RU1. The Proposed Development allows for the continuation of grazing activities, therefore conflicts with the RU1 zones are not anticipated. Land located south of the Site is zoned as RU4 Primary Production Small Lots. The objectives of the RU4 zone are • To enable sustainable primary industry and computable land uses • To encourage and promote diversity and employment opportunities in relation to primary industry enterprises, particularly those that require smaller lots or that are intensive in nature • To minimise conflict between land uses within this zone and land uses within adjoining zones. The Proposed Development supports the objectives of the RU4 zone by providing diversification of rural enterprises and providing diversified employment in the Greater Hume LGA.

Objective	Proposed Development
To maintain the rural landscape character of the land	The Proposed Development will allow for continuation of sheep grazing, and vegetation screening will provide an opportunity to enhance the rural landscape.

A land use conflict analysis based on the DPI's *Living and Working in Rural Areas* handbook (Learmonth, Whitehead, Boyd & Fletcher, 2007) is presented in Table 8-26, with the resulting assessment outcomes for issues of land use conflict presented in Table 8-27.

Table 8-26: Land use conflict risk assessment matrix

		Likelihood of a dispute or conflict arising over the land use or activity		
		Very Likely	Likely	Unlikely
Likely consequences and impacts associated with a dispute or conflict arising over the land use or activity	Major consequences and impacts likely	High	High	Medium
	Modest or periodic consequences and impacts likely	High	Medium	Low
	Minimal consequences and impacts likely	Medium	Low	Low

Table 8-27: Land use conflict analysis

Issue	Assessment	Issue Management
Catchment management	Low	The Proposed Development would have no impact on natural resources of surrounding agricultural properties (Section 8.5). Most water required to support the Proposal will be sourced offsite from contractors who hold an appropriate water licence. A small volume of water will be reused onsite from dewatering activities during construction and rainfall collection. The Developer will be only extracting water from existing creeks and farm dams under existing Water Sharing Plan licences for construction and/or operational activities (Section 8.9).
Dogs	N/A	
Drainage	Low	The Proposed Development was assessed to not significantly change the hydrological regime, including drainage patterns, within the Site and no hydrological or hydraulic effects on neighbouring lands are anticipated (Section 8.9).
Dust	Low	Construction activities could cause short term dust accretion on adjoining trees and pastures, although this risk is limited by mitigation measures proposed (Section 8.5). There would be nil to minimal impact on agricultural production or domestic activities on neighbouring properties.
Fencing	Low	The Landholding is already fenced, however a perimeter fence up to 2.5 m high will be constructed around the main components of the Proposed Development. All fences will be maintained to avoid the possibility of livestock straying onto the solar farm from adjoining properties, or out of the solar farm area to adjoining properties if grazing is to occur in the solar array.
Fire	Medium	The Site contains BPL according to the Greater Hume Shire Bushfire Prone Land Map. However, the overall nature of the Site in combination with the Proposed Development

Issue	Assessment	Issue Management
		poses a low risk, both in terms of fire originating onsite and escaping onto neighbouring land or fire that originates offsite entering the Site (Section 8.10). To manage the risk of fire at the Site, a suite of mitigation measures are proposed to reduce and manage the risk of fire, and to reduce the impact of any fires within or surrounding the Proposed Development (Section 8.10), including: • Design and installation principles and features • Asset protection zones and other design features that will be developed in consultation with relevant fire management agencies (including the NSW RFS) • Fuel load reduction • Fire management and emergency response strategies will be included in appropriate management plans and, where relevant, will be prepared in consultation with and distributed to NSW RFS and NSW Fire and Rescue • Safety protocols.
Lights	Low	Construction activities will be undertaken predominantly during daylight hours from 7am – 6pm Monday to Friday, 8am – 1pm on Saturday. During the operational phase, lighting will be restricted to the substation and support buildings and will be predominantly on-demand only. The low requirement for lighting, the distance from neighbouring properties and the use of vegetation buffers means that potential agricultural conflict is assessed as low (Section 8.6).
Noise	Low	Based on the predicted approximate noise impact radius, no noise sensitive receivers (NSRs) will be highly noise impacted during the construction phase (approximately 12 to 18 months), and only NSRs located within 550 m of the noisiest construction tasks (Worst-case prediction CONCAWE Category 6) will exceed the ICNG Noise Management Level of 50 dB(A) (Section 8.7). These noise impacts are considered to be acceptable with mitigation measures in place, including limiting construction activities to standard working hours (as detailed below) unless otherwise agreed in accordance with an approved management plan: • Monday to Friday, 7am to 6pm • Saturday, 8am to 1pm • No construction work is to take place on Sundays or public holidays. Noise during the operational phase is predicted to be insignificant. Noise during upgrading/repowering and decommissioning should generally be low, similar to or less than the impacts during construction.
Pesticides	Low	Pesticides will be used to control weeds at the site. Good management practices will be implemented to ensure that pesticide use is minimised (including the use of sheep to graze between the panel rows to manage vegetation loads where possible). The application of any pesticides will be in accordance with the *Pesticides Act 1999* and will be stored and handled in accordance with Safety Data Sheet requirements, such that only registered pesticides are to be used, based on label instructions that are designed to minimise impacts on surrounding land. The distance of the Proposed Development from neighbouring properties means the potential conflict associated with pesticides is assessed as low.
Pollution	Low	Fuels and lubricants will be used on site. These potential contaminants will be managed within bunded areas, according to relevant management plans (Sections 8.5 and 8.9). There is no clear evidence that the leaching of toxic elements from solar panels during the operational phase is an environmental issue in Australia or abroad (Robinson and Meindi, 2019). Although there are a number of materials used in the manufacture of

Issue	Assessment	Issue Management
		Panels that are considered toxic, "*for intact PV panels, leaching of these elements is unlikely to occur*" because they are encased in a number of protective layers as explained below (Robinson and Meindi, 2019). During the manufacturing process of a solar panel, the PV cells are typically encapsulated in a clear hardened resin with strengthened glass protecting the front side, as well as a back side made from a polymer such as Tedlar PVF material (Clean Energy Review, 2019). The completed panel is then further protected by an aluminium frame. These features protect the panel from the environment including extremes in temperature, rainfall, hail and humidity (Clean Energy Review, 2019). A robust design, combined with a standard 25 year warranty (DNV-GL, 2017) ensures that the likelihood of cell material being exposed to the environment is very low. Indeed, discussions with manufacturers on this point support this view with one Australian manufacturer stating that: "*In a high quality module, the encapsulant prevents the deterioration and emission of these elements from the module*". Nonetheless, procedures would be adopted to ensure that: firstly, panels are unlikely to become structurally compromised; and secondly, if panels do become compromised, potential environmental effects will be avoided (See Section 8.11 on panel selection, inspection and recycling).
Roads	Low	Potential impacts to road surface conditions and traffic safety are low, and will be managed by upgrading of intersections and/or maintaining roads along the proposed haulage route (Section 8.8 and Appendix H). The proponent has applied to the NSW Department of Industry – Lands and Water's crown land department for a crown road licence over the crown roads within the Site under Part 5 of theCLM Act.
Straying livestock	Low	See fencing.
Theft and vandalism	Low	The location of the Proposed Development means that the risk posed by theft/vandalism is considered low. The solar farm would be off limits to the general public, with main components enclosed by an appropriate security fence (approximately 2.5 m high) and access will be regulated for staff through identification requirements. Once operational, all access points will be gated. The Site security system will include sensor lighting and may also include CCTV at several locations around the Site (Section 4.1.6).
Visual amenity	Low	The Proposed Development is assessed to generally have insignificant to low levels of visibility impact on public and private viewpoints, however one residence is assessed as highly impacted and two residences are assessed as moderately impacted. Mitigation strategies have been developed to minimise visual impacts in addition to the Proponent's draft landscaping plan commitments (Section 8.6).
Weeds and pests	Low	The risk from priority weeds and pests is low but would be subject to ongoing monitoring and management to be undertaken by the Proponent (Section 8.2 and 8.5)

Most land use conflicts have been assessed as low. Land use conflict analysis indicates that conflict over visual amenity and bushfire hazards may pose a medium risk. The adoption of mitigation measures to reduce these potential conflicts are discussed in Sections 8.6 and 8.10 respectively and Section 9.

The Proposed Development will have an initial life span of approximately 30 years and will not involve permanent changes to the landscape. The size of the Development Footprint (334.2 ha) accounts for 0.06% of all land within the Greater Hume LGA and will not compromise, substantially reduce or significantly diminish the availability of agricultural land for primary production purposes within the LGA. Furthermore, due to sunshine harvesting being a passive land use, the Proposed Development will not reduce or permanently impact the inherent soil fertility for agricultural use, or compromise the capacity for immediate neighbours to conduct existing or proposed primary production in the immediate vicinity. Therefore, impacts of the Proposed Development on agricultural production at a regional level are not significant. Relative impacts on land mapped as IAL are very minimal and the Proposed Development is co-located with existing grid connection therefore lowering impacts by not requiring new transmission and connection infrastructure.

8.5.3.2 Construction

Erosion

Large scale bulk earthworks are not anticipated to be required for construction of the Proposed Development. However, general construction activities would include excavation and trenching, and have the potential to result in soil erosion (including wind erosion from stockpiles), decreased stability and sedimentation due to localised temporary removal of groundcover and the disturbance of the soil profile.

Areas of the Site mapped as part of the Yarra Yarra soil landscape unit is classified as Class 6 land. For this soil landscape unit, the water erosion hazard is severe (Class 5) (Table 8-23), however it should be noted that the assessment was based on a 'bare earth' scenario and does not account for groundcover and the main driver in this landscape unit within the Site is the presence of dispersive subsoils. The Proposed Development will involve minimum disturbance to the subsoil, with trenches for the LV and MV cables having a total permanent on ground impact of 0.25 ha. Trenches will be excavated to a maximum depth of 500 mm and the disturbance zone will be up to 4 m wide. During trenching, topsoil and subsoil will be stockpiled separately and backfilling will ensure the topsoil and subsoil are reinstated in the correct order, as the topsoil acts as a chemical and physical barrier against water erosion. Backfilling of trenches and rehabilitation of the groundcover will be progressive, thus reducing the area and duration of bare earth exposed to rainfall. The water erosion hazard of these soils will be greatly reduced by installation and monitoring of sediment and erosion controls during the construction period.

Within the solar array, soil disturbance would be limited to the location of the piles driven, screwed or ballasted to the ground to support and orientate the PV panels, and trenching for cable installation. As such, most of the groundcover will be retained across the Site. Where groundcover is removed during construction, it will be progressively rehabilitated throughout the construction period starting immediately after disturbance, thus reducing the area and duration of the water erosion hazard. Consequently, soil disturbance from localised excavation activities will be relatively small, isolated and temporary.

The piling process is quick, causes little soil disturbance and is usually completed by a small tracked machine that moves systematically along a pre-set GPS coordinate route. The panels are then fitted by hand to a tracking system that sits on top of the piles. Components for this phase of the installation process are usually distributed alongside the rows by small light vehicles. Therefore, while there will be movement of materials across the Site during construction the activities are unlikely to cause compaction that would result in a reduction in soil quality.

Where the ground surface is disturbed for the operation and maintenance building, inverters, access tracks, the temporary construction compound, laydown and parking areas there is greater potential for increased runoff of water and/or soil erosion. Footings, access tracks and hardstand areas that would require compaction and/or foundations would reduce soil permeability, leading to increased run off and potentially concentrated flows, which could result in soil erosion. Soil compaction from equipment will be small, due to the small and discrete footprint of the light equipment required for panel installation.

The Site is located in an area with a high wind erosive power. However, the mean annual rainfall at the Site (>700 mm) indicates the land within the Site has a greater capacity to maintain surface cover and wet soil, reducing the opportunity for soil detachment and movement from wind blowing across the surface. Soil sampling undertaken south of the Site, as part of the Jindera Rural Residential survey, indicates that the soil surface is expected to be hard set when dry (e.g. Barker, 1983), which is a general soil quality of Sodosols and Chromosols, and it should be noted hard setting soil are common throughout Australia (Eberbach and Black, n.d.). However, groundcover at the Site is high, providing protection of the soil surface. Douglas Partners (2019) noted that due to the silty nature of the surface soils, they can be very fragile and produce bull dust. This will be a source of dust in areas where soils are reworked or trafficked during construction.

Dust particles, which have the potential to cause short term dust accretion on adjoining trees and pastures where mitigation measures are not in place, may be released as a result of a range of activities associated with the Proposed Development including:

- Vegetation clearing
- Earthworks
- Stockpiles
- Rock crushing
- Mobile concrete batching plant operation
- Loading and unloading of material
- Haulage on unsealed roads.

This risk is limited by mitigation measures proposed in Table 8-28 and there would be nil to minimal impact from this dust on agricultural production or domestic activities on neighbouring properties.

Minor creeks and tributaries pass through, or are adjacent to the Site with some waterway crossings required to be constructed. Implementation of appropriate control measures is required to ensure that potential direct and indirect impacts on these water bodies are managed during, and post construction from runoff erosion.

Contamination

Fuels and lubricants will be used on site during construction activities and may pose a potential contamination risk to soils in the event of a spill. These chemicals may alter soil properties and can impact negatively on soil health and consequently plant growth or if absorbed by plants/animals could potentially enter the food chain with adverse impacts. Contaminants in the soil can be mobilised during rainfall events which may potentially spread contamination through the soil profile, or into surface or groundwater potentially impacting aquatic habitats.

Biosecurity risks

Pre-construction and construction activities allow for the opportunity for priority weeds and pests to invade or spread, and impact livestock and other agricultural activities. Pathways for spread of weeds, pests and pathogens include increases in vehicle movements on and off rural properties. This risk is increased if new access points are created, potentially contaminated vehicles, plant and machinery move across multiple properties and through disturbance of topsoils during access track construction and trenching (NSW DPI, 2013). Potential impacts to livestock includes increased risk of straying, particularly if gates are left open or fences need to cut or replaced, or stress from rapid vehicle movements and sudden noises (NSW DPI, 2013).

8.5.3.3 Operation

Once constructed (i.e. during the operational phase), it is proposed that the balance of land would continue to be used for agricultural purposes such as sheep grazing. sheep grazing will continue within the Site to control vegetation beneath the solar array (Figure 2-1), with grasses sown for ground cover and grazing fodder in disturbed areas, allowing for the continuation of existing agricultural activities, resulting in only a minor net change to the existing land-use.

Climate and Photovoltaic Heat Island Effect

Whilst solar PV panels are designed to capture the energy of sunlight and transform it into electricity, studies have shown that solar farm installations may exhibit an increase of between 1 - 5°C in the local microclimate, depending on existing climatic conditions and groundcover vegetation (Baron-Gafford *et al*., 2016; Fthenakis & Yu, 2013). The Photo-Voltaic Heat Island (PVHI) effect is more pronounced in arid regions (approximate increases of 5°C) compared to temperate conditions (approximate increase of 2-3°C) and is further reduced by the level of groundcover vegetation directly underneath the solar PV panels due to evapotranspiration and reduced re-radiating heat from the soil (Baron-Gafford *et al*., 2016). Studies suggests that solar PV panels with unsuitable groundcover vegetation beneath them contribute to further heat increases due to the bare earth re-radiating heat beneath the panels. This, in addition to re-radiated heat from the upper surface of a solar PV panel, can create a significant increase in heat both above and below the solar PV panel installation. However, efforts to co-locate agriculture and solar farms (so called “agrivoltaic” systems) show benefits in land use capacity and the management of increased temperature on site (Hassanpour Adeh, Selker & Higgins, 2018; Baron-Gafford *et al*., 2016).

GSF is located within a temperate climate and is intended to co-locate C3 pasture species to facilitate agricultural operations concurrently on site. The presence of groundcover vegetation beneath the solar PV panels will significantly reduce the potential for re-radiant heat beneath the panels, whilst also providing a better growth environment for the pasture species. The ability to co-locate ensures the land will be used at a high potential.

Increases in air temperature may be detectable in the air column directly above the solar PV panel installations (up to 2.5 m) and through the mitigations of a temperate climate and a vegetated base layer, will likely reach a theoretical maximum of 2°C (above ambient). In addition, areas of elevated air temperature will be dispersed by prevailing winds in the region, which are from the west, in the direction of relatively few residents.

As such PVHI is not expected to have any impact of nearby residents as the heat increases seen in these systems do not persist beyond 30 m from panel arrays in cases of temperatures of up to 5°C and are not maintained overnight. Wind speed and patterns have been shown to change due to the production of warm buoyant air above solar PV panels, though these changes are weak averaging less than 2 m/s. The effect of this at GSF will be negligible due to prevailing high wind speeds (Hassanpour Adeh *et al*., 2018).

Erosion

Operational impacts to soil would be minimal as operation and maintenance activities would not result in additional soil disturbance and groundcover would be reinstated and maintained across the Site. However, there is potential for concentrated runoff to occur during significant rainfall events as a consequence of:

- Compacted and impervious access tracks
- Water movement and concentration associated with runoff from PV panels.

This potential for concentrated flows could result in the erosion of the access tracks and localised soil erosion below the panels. The potential for wind and water erosion during operation is considered to be to low due to areas of soil disturbance being progressively rehabilitated with ground cover grasses post construction disturbance.

There is potential for increased runoff volumes and peak discharge rates, particularly in areas that have been gravelled or paved. However, In the Proposed Development, the areas under the solar panels, and in the space between rows will be revegetated with pasture species, and groundcover will be maintained for the life of the Proposed Development. If there is well maintained grass cover underneath the solar panels, changes to runoff will not have a great effect on the total volumes of runoff and peak discharge rates (Cook & McCuen, 2013).

Sheep grazing may be undertaken in the Site for ongoing production purposes and to control groundcover and weed around the PV arrays, minimising land use conflicts. Soil under PV panels may receive less rainfall falling directly on it, however this is considered to be less apparent with the adoption of tracking solar arrays which move through a daily range that exceeds 100 degrees.

Solar PV panels have effects on the soils beneath them which vary based on climate and existing environment. Areas with low levels of groundcover vegetation show increases in re-radiant heat which can settle underneath the solar PV panel installations, resulting in increased soil temperatures, evaporation and evapotranspiration rates, despite being shaded. However, this effect is much more pronounced in arid climates.

Soil moisture at GSF is not expected to be influenced by potential increased temperatures beneath the solar PV panels. This is due to the Site being subject to a temperate climate with retained groundcover, which will reduce re-radiant heat, and the soils being shaded. Depending on climate and season, shading from the solar PV panels may reduce soil temperatures by 0-2°C thereby reducing evaporation and soil moisture loss (Robinson *et al*., 2018).

Evapotranspiration rates are likely to be less than in surrounding areas due to shading and reduced air movement. Furthermore, all perennial pasture species identified at the Site are C3 and are adapted to growing in shady conditions, hence cover and composition are not expected to decline under the PV array. In addition to this, reduced evaporation will potentially increase the amount of moisture available to C3 species. Following PV array installation, areas disturbed will be reseeded with long-term pasture species such as Phalaris and Tall Fescue. If bare areas develop, this can be addressed by selection of more shade tolerant pasture species for planting.

The rare and occasional cultivation activities currently undertaken on infrequent occasions will cease in the Site following construction and during operations, reducing soil disturbance until decommissioning. This will improve soil structure and reduce erosion potential.

Contamination

As discussed in the section above, fuels, lubricants and herbicides will be used for maintenance activities, and pose a potential contamination risk to soil, surface and groundwater as a consequence of misuse or a spill event. These potential contaminants will be managed within bunded areas, according to the Management Plans

There is no clear evidence that the leaching of toxic elements from solar panels during the operational phase is an environmental issue in Australia or abroad (Robinson and Meindi, 2019). Although there are a number of materials used in the manufacture of Panels that are considered toxic, "*for intact PV panels, leaching of these elements is unlikely to occur*" because they are encased in a number of protective layers as explained below (Robinson and Meindi, 2019). During the manufacturing process of a solar panel, the PV cells are typically encapsulated in a clear hardened resin with strengthened glass protecting the front side, as well as a back side made from a polymer such as Tedlar PVF material (Clean Energy Review, 2019). The completed panel is then further protected by an aluminium frame. These features protect the panel from the environment including extremes in temperature, rainfall, hail and humidity (Clean Energy Review, 2019). A robust design, combined with a standard 25 year warranty (DNV-GL, 2017) ensures that the likelihood of cell material being exposed to the environment is very low. Indeed, discussions with manufacturers on this point support this view with one Australian manufacturer stating that: "*In a high quality module, the encapsulant prevents the deterioration and emission of these elements from the module*".

Nonetheless, procedures would be adopted to ensure that: firstly, panels are unlikely to become structurally compromised; and secondly, if panels do become compromised, potential environmental effects will be avoided (See Section 8.11 on panel selection, inspection and recycling).

Biosecurity Risks

If left unmanaged, pest and feral animal populations have the potential to increase and negatively impact agricultural production and the local ecosystems. Fencing around the perimeter of the Site as part of the Proposed Development will help prevent animal ingress and egress.

8.5.3.4 Decommissioning

At the end of the project life, the Proposed Development shall be decommissioned, with the objective of returning the land capability to its pre-existing agricultural capacity. At the conclusion of the life of the project, the Proposed Development would be decommissioned in order to permit the resumption of other agricultural activities. It is important to note that the IAL is not lost, such as in the case of rural residential subdivision, and following the project decommissioning the land will again be available for agriculture. Furthermore, due to sunshine harvesting being a passive land use, the Proposed Development will not reduce or permanently impact the inherent soil fertility for agricultural use, or compromise the capacity for immediate neighbours to conduct existing or proposed primary production in the immediate vicinity. In comparison to solar farms, the 2018 IAL document says that rural residential subdivision poses a great risk to the IAL (and cited Jindera).

Potential impacts associated with decommissioning will be generally similar to those for construction as there will be a need for some local excavation and the operation of heavy equipment. However, it is anticipated that decommissioning impacts would be less significant than during construction. Reasons for this include:

- There shall be no further vegetation clearing
- Access tracks and footings for infrastructure will not need to be constructed
- The majority of subsurface infrastructure will remain in place.

Following decommissioning, the Site will be returned to agricultural activities, minimising long term land use impacts and mitigating impacts to agricultural capacity.

No long-term impacts to agricultural capacity are anticipated from the Proposed Development.

8.5.4 Mitigation Measures

8.5.4.1 Land use

Potential land use conflict management measures, where required, are outlined in Table 8-27.

8.5.4.2 Soils and Land Resources

Potential adverse impacts will be managed through the development management plans and with the mitigation measures outlined in Table 8-28.

Table 8-28: Mitigation measures for land and soil impacts

Impact	Environmental safeguard	Timing*		
		C	O	D
Erosion	An Erosion and Sediment Control Plan would be prepared, implemented and monitored during the construction and decommissioning of the proposal	✓	✓	✓
	Construction and/or installation of erosion and sediment control structures shall be in accordance with the specifications provided in the Blue Book.	✓	✓	✓
	Regular inspection and programmed maintenance of erosion and sedimentation controls will be undertaken and documented in a register of inspections and actions.	✓	✓	✓
	Cable trenches will be constructed in accordance with relevant regulations and ground conditions. Trenches will be excavated and filled progressively to ensure they are left open for the shortest period possible. Surface conditions will be returned to pre-disturbance conditions and groundcover rehabilitated as soon as practicable to prevent the formation of preferential flow pathways.	✓		
	Management of erosion generated by traffic shall include a driving code of practice, installation of appropriate drainage controls, inspection and maintenance of unsealed road surfaces and dust management strategies.	✓	✓	✓

Impact	Environmental safeguard	Timing*		
		C	O	D
	Appropriate stockpile management to ensure air and water erosion is minimised, soil health, organic matter and structure are retained and weed infestation minimised.	✓		✓
	Account for climatic events during construction • If heavy rainfall is predicted the Site should be stabilised and works modified to prevent erosion for the duration of the wet period Works methods shall be modified during high wind conditions if excess dust is generated.	✓		
	Where sodic soils are identified in areas to be disturbed by trenching activities, soil ameliorating additives will be considered (such as the use of Gypsum or alternatives as guided by soil testing results during detailed design).	✓		
	Maintaining access tracks in good condition and ensuring that associated drains and/or sedimentation traps are monitored and maintained will ensure that the potential erosion associated with the tracks is minimised.	✓	✓	✓
	Maintaining the vegetation cover below the panels will assist in reducing the potential for scouring and erosion.	✓	✓	✓
	To minimise the potential for erosion in the areas beneath the panels an inspection program following significant rainfall events would be implemented and stabilisation works would be undertaken as required.	✓	✓	✓
Land Use Conflicts	The solar array would be designed to ensure there is sufficient space between panels to allow establishment and maintenance of groundcover and weed control activities.	Design		
	Where practicable, the existing pasture composition will be retained. Where establishment fails in disturbed areas or under the panels agronomic advice may be sought to determine alternative management options for groundcover to protect soil from erosion in addition to the above erosion measures.	✓	✓	✓
	Underground cables will be buried to a depth greater than 500 mm (where practicable and impediments are absent).	✓		
	All infrastructure above a depth of 300 mm below ground level and internal access tracks will be removed upon decommissioning (unless landholders wish to retain these).			✓
	Areas used for temporary construction compound and laydown areas during construction will be restored to original condition or revegetated with grasses suitable to achieve the ground cover and erosion minimisation goals.	✓	✓	✓
	Pest and feral animal management strategies will be implemented to control vertebrate pest populations within the Site and minimise their spread to and from the Site.	✓	✓	✓
	Weed management strategies will be implemented aim at preventing and minimising the spread of weeds to and from, and within the Site. These include controlling any existing weed infestation prior to construction activities and implementing weed hygiene protocols.	✓	✓	✓
Contamination	To avoid release to the environment, all hazardous materials (fuels, lubricants, herbicides, etc.) will be disposed of site in accordance with NSW EPA guidelines.	✓	✓	✓
	Onsite refuelling shall occur in an area that is located greater than 100 m from the nearest drainage line and within an impervious bunded area.	✓	✓	✓

Impact	Environmental safeguard	Timing*		
		C	O	D
	Machinery will be inspected regularly to ensure no oil, fuel or lubricants are leaking from the machinery	✓	✓	✓
	Potential soil contamination will be managed by the implementation of a spill response procedure.	✓	✓	✓
Dust	Modify working practices by limiting construction activities during periods of high winds (greater than 20 km/hour).	✓	✓	✓
	Modify activities if dust is observed leaving the Site towards nearby sensitive receptors. May require use of a water truck.	✓		✓
	Limit the extent of clearing and excavation.	✓		✓
	Stage clearing and excavation activities to minimise total areas of cleared ground.	✓		✓
	Minimise the number and volume of stockpiles on-site and the number of work faces on stockpiles.	✓		✓
	Implement progressive groundcover rehabilitation and revegetation.	✓	✓	✓

***** C = Construction, O = Operation and D = Decommissioning

8.6 Visual Impact

8.6.1 Introduction

The purpose of the visual impact assessment is to identify and describe the existing landscape character and identify visual amenity receptors and, as a consequence of the introduction of the Proposed Development, to assess potential visual impacts (including glint and glare). The SEARs for the visual component include:

- *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.*

The assessment considers how mitigation measures could be implemented to reduce the effect of any identified impacts. A full copy of the visual impact assessment, including a glint and glare assessment, can be found in Appendix F.

The visual impact assessment quantifies visual impact ratings for receivers based only on the visibility of the Proposed Development and does not account for any potential cumulative impacts. Cumulative visual impacts are discussed in Section 8.13 and Appendix F.

The assessment adopts a conservative approach, identifying potential receptors based on the broader Site, and potential impacts, based on a maximum indicative solar panel area, rather than considering individual components within the Development Footprint. Key visual components associated with the Proposed Development include:

- Installation of PV solar panels (the 'PV array') providing a combined output of approximately 200 MW
- On-site inverters and electrical connection infrastructure
- Construction and operational support buildings, perimeter fencing and vehicular access tracks.

The assessment area boundaries vary depending upon which of the following assessments are being considered (Figure 8-13):

- Landscape Character Assessment Area – covers the Site and its surrounds, out to a distance of 2 km
- Visual Amenity Assessment Area – focuses on an area out to 5 km from the Site, beyond this the visual change would be of such a low nature that impacts would be negligible.

8.6.2 Existing Environment

The Proposed Development lies between Drumwood Road and Ortlipp Road, around 4 km north east of Jindera and 20 km north of Albury in southern NSW. The landscape is relatively flat with minor undulations and of rural nature, mainly supporting agricultural enterprises and rural residences (although there are no residences within the Site itself). It is typical of other landscape types found in surrounding areas, as well as landscapes within the wider regional context of the South Western Slopes part of the Riverina Region.

Nearby areas of public visual amenity include Table Top Mountain, and Benambra National Park located within 20 km to the east and north-east of the Proposed Development; however, their location combined with distance and vegetation screening would limit the opportunity for views toward the Proposed Development. A number of historic buildings are located within 5 km of the Site including "Drumwood" homestead and outbuildings located on the south side of Drumwood Road, and the nationally recognised Pioneer Museum and Wagners Store contained within the Pioneer Museum Group buildings, located approximately 2.3 km south west of the site within the urban area of Jindera (Section 8.4).

The Site is located in a predominantly flat landscape, where elevation ranges between 200 - 220 m above sea level AHD, with a small rise in the centre of the Site. Shallow flat depressions meander through the Site, draining water to several farm dams. The topography of the site falls generally north and east at relatively flat grades while the few slopes on site are best described as gently undulating. Land within the Site and Visual Amenity Assessment Area has been historically cleared for grazing and residential purposes and most has been sown with improved pastures. There are patches of remnant vegetation along roadsides, paddock edges, lower lying areas along drainage lines and scattered throughout paddocks. It is due to this low relief and current vegetation presence surrounding the land that the solar panel infrastructure should be largely screened from direct views.

The hydrology of the Site is typified by ephemeral low order drainage lines. Several drainage lines intersect each other upstream of the Site to form Kilnacroft Creek, which is classed as a third order stream (Strahler, 1952) as it passes through the centre of the Site. Dead Horse Creek, also a third order stream, passes through a small area in the far north of the Site.

Immediately adjoining the Proposed Development are a number of unsealed minor roads subject to low volumes of local traffic including Ortlipp Road, Drumwood Road, Lindner Road and Blight Road (East and West, which are only used by the 1 and 3 residences that are on each, respectively). Within the 5 km Visual Impact Assessment Area other roads include Jindera town roads and the sealed local collector roads Walla-Walla-Jindera Road, Dights Forest Road, Urana Road, Glenellen Road, and Gerogery Road which also support relatively low volumes of local and district traffic. Residences within the majority of the Visual Impact Assessment Area, including two owned by participating host landholders, are scattered and rural, while the village of Jindera comprises a mixture of urban, peri-urban and rural residential development.

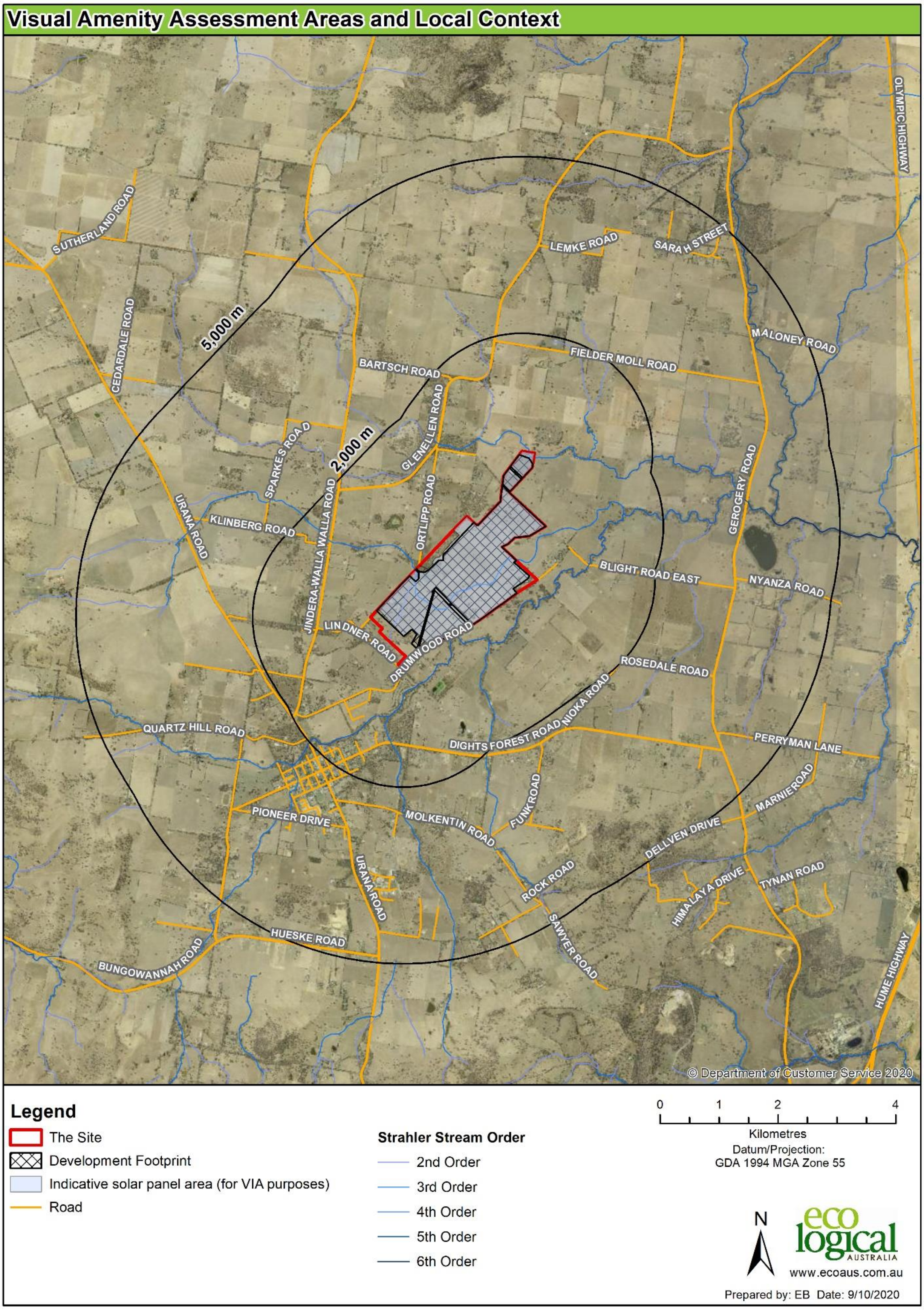

Figure 8-13: Visual Amenity Assessment Areas and Site context

8.6.2.1 Landscape Character

The landscape character of the Site and the majority of the surrounding area is classified as one Landscape Character Unit (LCU), however the wider 2 km Landscape Character Assessment Area also contains a second LCU. These are described below:

- LCU1 is dominated by predominantly flat to gently undulating agricultural land. The LCU is rural, with dwellings scattered across the wider landscape, and includes the locality of Glenellen. Due to historic clearing for grazing and cropping, vegetation cover is generally low except for within road reserves, in isolated patches in paddocks and within gardens surrounding residences. A representative image of LCU1 is shown in Figure 8-14.
- LCU2 comprises the village of Jindera which lies in the south-west of the wider 5 km Visual Impact Investigation Area. This LCU is a more urbanised area containing just over 400 private dwellings and businesses including several local heritage-listed places. Vegetation is retained along parts of Bowna Creek and cultivated in parks and gardens. A representative image of LCU2 is shown in Figure 8-15.

Figure 8-14: Typical views of LCU1, showing flat rural landscape and cleared vegetation across the Site.

Figure 8-15: Typical views of LCU2 viewed from Urana Road. Source: Google Street View (2011).

8.6.2.2 General visibility

The Proposed Development has a relatively confined area of visibility due to level topography and areas of remaining woody vegetation. Solar farms generally seek out relatively flat areas associated with plains, valley floors and foothills. The Site is generally most visible from the cleared paddocks to the north east and elevated areas to the south east of the Proposed Development. Views from these locations are generally buffered by distance and vegetation.

The Site has approximately 3 km of direct road frontage to Ortlipp Road and the Drumwood Road. Topography and vegetation in adjoining public areas, including Jindera Golf Course, naturally obscures potential views of the Site. Distant views and glimpses of the Site are possible from Blight Road East, Walla-Walla-Jindera Road, Dights Forest Road, Urana Road, Lindner Road, Glenellen Road, and Gerogery Road.

8.6.3 Potential Impacts

8.6.3.1 Landscape character impact assessment

The landscape impact assessment considers the direct and indirect impacts of the Proposed Development on the two LCUs associated with the Site, identified within the 2 km Landscape Character Assessment Area. The assessment takes into account the relationship between 'visual sensitivity' (the ability of a landscape character area to absorb a development) and the 'magnitude of visual change' to determine the potential impact of the Proposed Development on each LCU. The assessment does not take into account potential cumulative impacts, which are discussed in Section 8.13 and Appendix F.

Landscape Character Unit 1

The visual sensitivity of LCU1 has been assessed as **low**, for although it is an attractive rural landscape, it is of a type and scale that is widespread in the local area and which does not display particular defining qualities of note. LCU1 is not covered by a designated landscape classification such as a State Forest, National Park or a World Heritage Area.

The magnitude of visual change to LCU1 during the construction and operation of the Proposed Development is considered to be **moderate**, as the introduction of a commercial-scale solar farm involves a moderate scale land form change and vegetation clearing in a landscape already impacted by intensive agriculture. The magnitude of visual change decreases with distance from the Site, as shielding from the topography of the landscape and vegetation interact to reduce views of the Proposed Development, such that, it is no longer the defining feature.

Based on these findings, the overall impact on the landscape character within LCU1 is assessed as **low**.

Landscape Character Unit 2

The visual sensitivity of LCU2 is assessed as **moderate**, as it comprises the township of Jindera. LCU2 is not covered by a designated landscape classification such as a State Forest, National Park or a World Heritage Area.

The magnitude of visual change to LCU2 during the construction is considered to be **insignificant** because the combination of distance and screening from the Proposed Development would reduce GSF's visibility to where it would likely not be seen from the town at all. The magnitude of change during operation is considered to be **insignificant** as the Site will likely not be visible due to the combination of distance, a biodiversity retention area and potential screening options. The overall impact on the landscape character within LCU2 is assessed as **insignificant**.

As part of decommissioning, all above-ground infrastructure would be removed, and the Site would be returned to agricultural production, resulting in an **insignificant** visual change due to residual changes to either LCU.

8.6.3.2 Visual Amenity Impact Assessment – Viewshed analysis

Zone of Visual Impact (ZVI) mapping has been generated to understand the potential extent of the visibility of the Proposed Development within the Visual Amenity Assessment Area (5 km). During field investigations, it was confirmed that due to the mitigating effect of distance, combined with topography and vegetation, visual impacts beyond 5 km are considered to be negligible, and are not considered further.

With all models, the heat maps are likely to overestimate potential visibility as they do not consider the effect of perspective from the viewpoint (i.e. it assumes all houses face the Proposed Development and that you can see parts of the array obscured by other parts of the array). The assessment does not take into account potential cumulative impacts, which are discussed in Section 8.13 and Appendix F.

Bare Earth Digital Terrain Model

A bare earth ZVI heat map for a 5 m high Development Footprint based on the digital terrain model (DTM) is presented in Figure 8-16. The ZVI clearly illustrates that within the gently undulating topography that characterises the landscape, theoretical visibility is high. Furthermore, the heat map, stratified by the percentage of the Development Footprint potentially visible from any given viewpoint, clearly demonstrates areas of increased theoretic visibility associated with elevated parts of the landscape, particularly to the north and south east of the Site.

The bare earth DTM is useful to identify areas that are definitely not subject to visual impact from the Proposed Development because it significantly overstates potential visibility of the Site, as no allowance is made for potential visual screening from vegetation and existing built structures.

Surface Model

A surface model ZVI ‘heat map’ for a 5 m high Development Footprint is presented in Figure 8-17. Unlike the DTM, the surface model incorporates screening effects of both retained boundary vegetation within the Site, as well as vegetation and built structures within the wider landscape. This provides a more realistic indication of potential visibility than the DTM, however it may sightly underestimate visibility from nearby viewpoints as it does not incorporate partial visibility through buffers (such as through stands of vegetation).

Using the surface model, the amount of locations with potential visibility of the Development Footprint, and the percentage of the Development Footprint potentially visible from these locations, is significantly reduced (Table 8-29).

Surface model with existing commitments

Through the extensive and ongoing consultation process, the Proponent has identified several commitments developed in consultation with adjoining landholders aimed at reducing potential impacts on social amenity. Regarding visual impacts, these commitments include:

- The adoption of a residential setback for properties located along Lindner Road (approximately 200-250 m, with increased distance for where Lindner and Drumwood Road meet)
- The retention of existing vegetation around the periphery of the Site
- Establishment of vegetated buffer strips (vegetation screens) along parts of the site boundary intended to grow densely and to height taller than the panel array.

The nature and effect of these commitments is shown in Figure 8-18. This approach has a small effect on overall visibility of the Proposed Development in the broader landscape, but has a major effect of reducing visibility to the receptors adjacent to the Proposed Development.

Figure 8-16: Bare earth ZVI for 5 m tall panel array

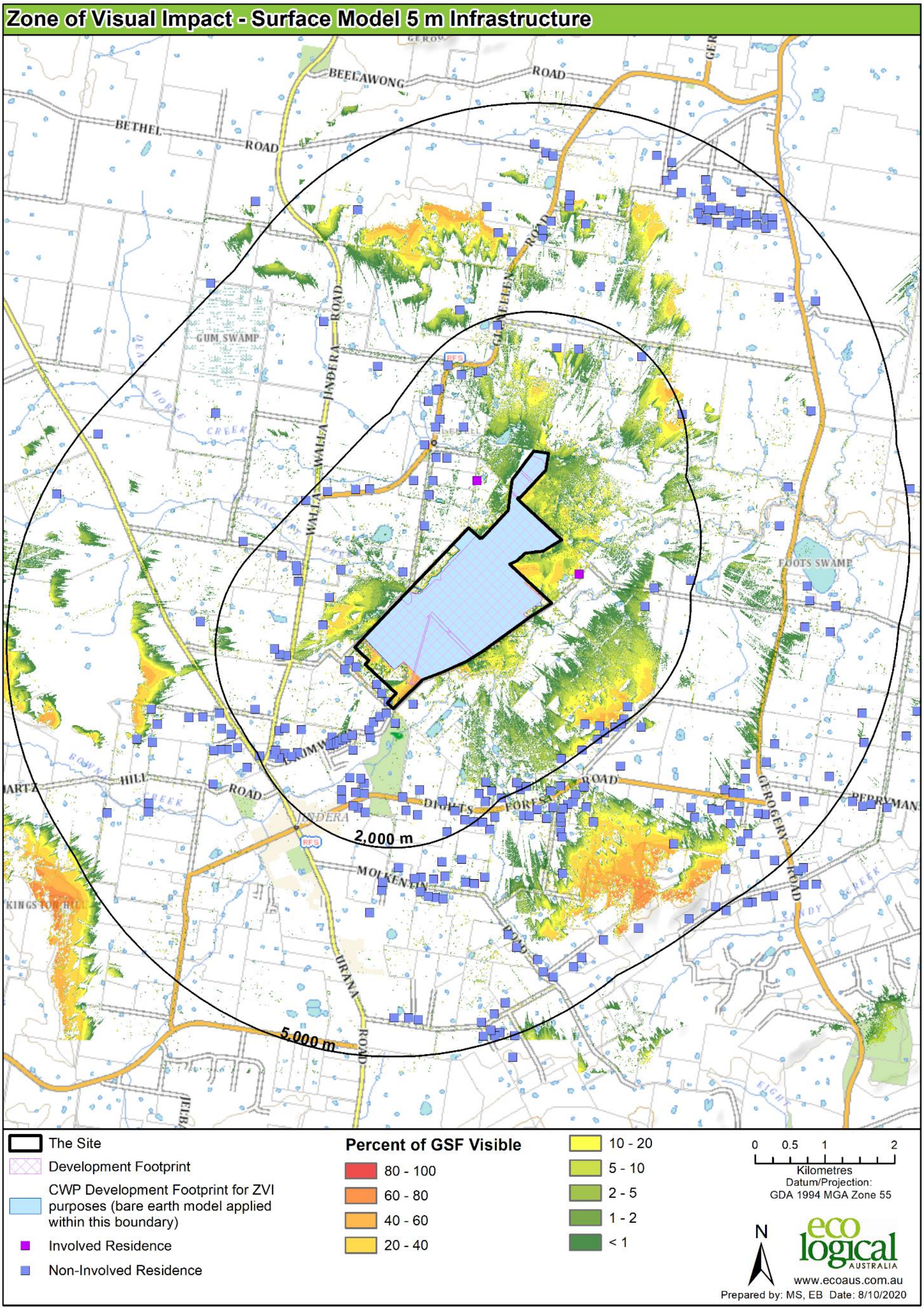

Figure 8-17: Current state surface layer ZVI for 5 m tall panel array

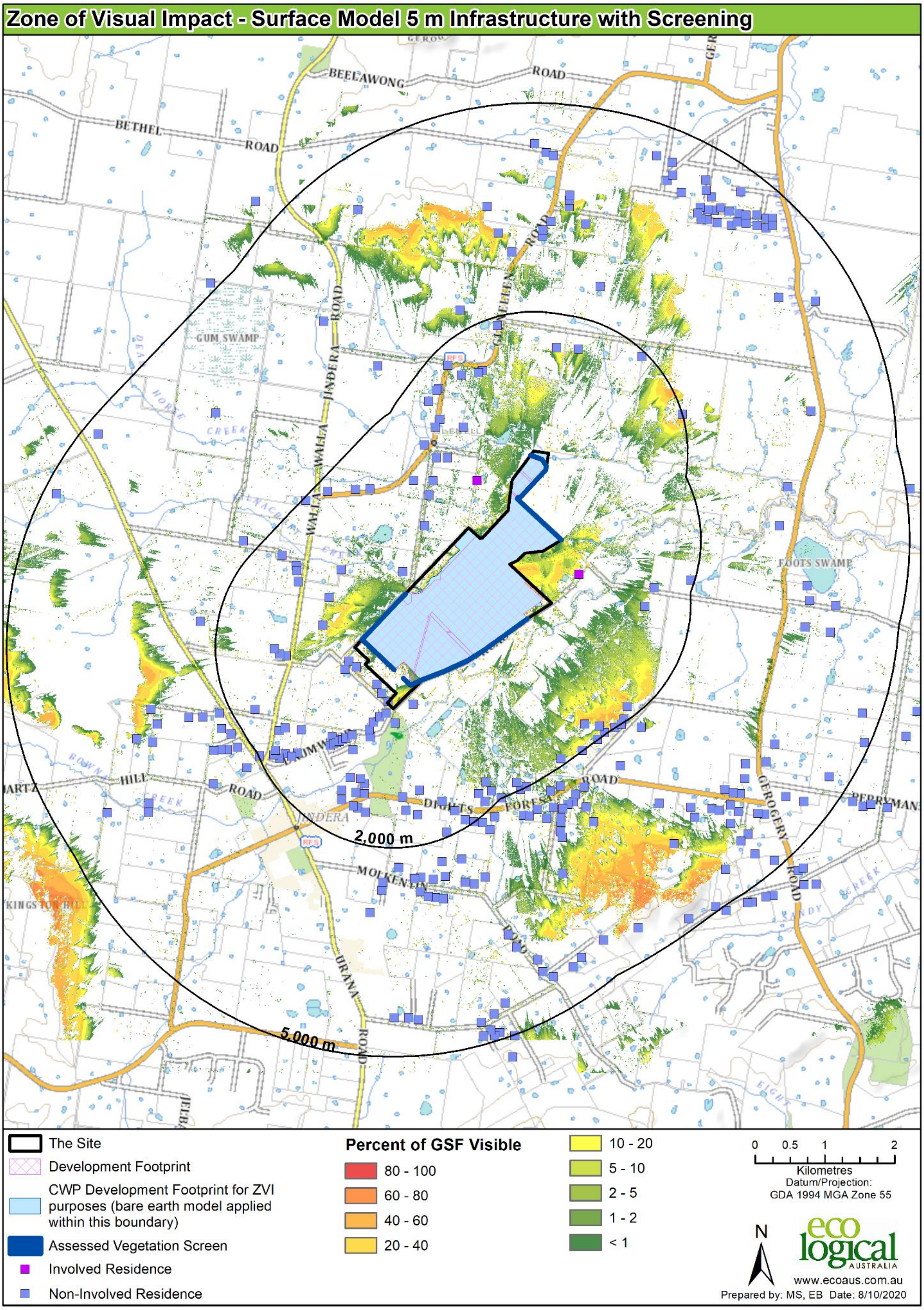

Figure 8-18: Existing commitments surface layer ZVI for 5 m tall panel array

8.6.3.3 Visual Amenity Impact Assessment – Residential viewpoints

Desktop spatial assessment identified 277 residences and/or potential dwellings within 5 km of the Proposed Development. Of these, 97 were located within 2 km of the Proposed Development. ZVI analysis using a bare earth DTM identified 66 of these locations as non- impacted and indicates that the Proposed Development is theoretically visible from 211 potential receptors.

Under the digital surface model, the number of identified residences with potential views of some part of the Proposed Development is reduced to 52, of which 7 are located within 2 km of the Proposed Development and 45 between 2 km and 5 km of the Proposed Development (Table 8-29; Figure 8-17).

In addition to significantly reducing the number of residences from which the Proposed Development is visible, existing vegetation and infrastructure also reduced the average extent of the solar farm visible when compared to the bare earth DTM (decreasing the average proportion of the visible Development Footprint) from a combined average site visibility per receptor of 46% of the Development Footprint to 12% (Table 8-29).

Incorporating the Proponent's agreed setback and screening commitments reduces the number of potentially impacted residences within 5 km from 52 to 50 (Table 8-29; Figure 8-18), and is likely to improve the effectiveness of landscape screening associated with existing vegetation within the landscape.

Table 8-29: Effect of existing landscape screening and proposed visual buffering within the Site

	Number of impacted dwellings			Average proportion of Site visible (%)		
Distance from Site	No existing landscape screening (i.e. 'bare earth)	Existing landscape screening (i.e. 'surface model')	Existing landscape screening plus proposed vegetative screening	No existing landscape screening (i.e. 'bare earth)	Existing landscape screening (i.e. 'surface model')	Existing landscape screening plus proposed vegetative screening
0 - 2 km	84	7	7	43	18	18
2 - 5 km	127	45	43	48	11	11
Combined	211	52	50	46	12	12

Potential visual impacts to individual residences are assessed in Table 8-30 and the resultant impacts shown in Figure 8-19. Generally, impacts to visual amenity associated with GSF are assessed as low or insignificant; however, one residence is assessed as highly impacted and two properties are assessed as moderately impacted. In these cases, targeted consultation (integrated with other potential impacts to amenity, where relevant) with landholders regarding potential visual screening options has been undertaken to identify acceptable levels of impact and situation-specific mitigation strategies. General ongoing consultation with other impacted landholders has also been undertaken.

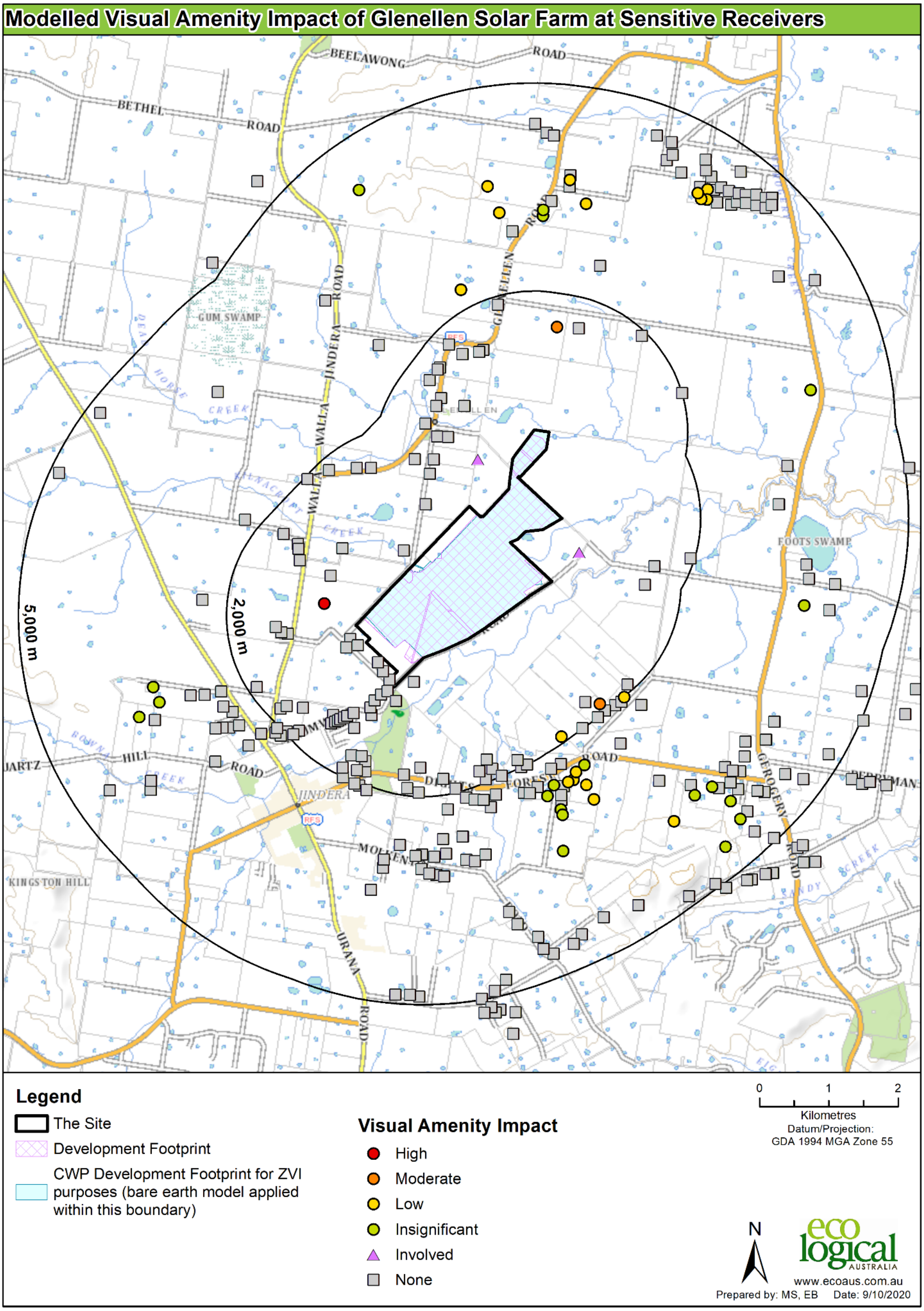

Figure 8-19: Visual amenity impact assessment on residential viewpoints

Table 8-30: Summary of impacts to visual amenity and recommendations

Viewpoint	Distance to GSF (m)	Direction from GSF	Percent of GSF visible	Visual sensitivity	Magnitude of change	Visual Amenity impact	Recommendation
WWJ016	615	West	50	High	High	High	Targeted consultation
FMO001	1514	North	21	Moderate	Moderate	Moderate	Targeted consultation
NIK011	1853	South	49	Moderate	Moderate	Moderate	Targeted consultation
NIK010	1912	South	7	Moderate	Low	Low	Nil
NIK004	2002	East	53	Low	Moderate	Low	Nil
GLE014	2280	North	17	Low	Low	Low	Nil
DFR036	2436	South	7	Insignificant	Insignificant	Insignificant	Nil
DFR026	2442	South	1	Insignificant	Insignificant	Insignificant	Nil
DFR037	2451	South	10	Low	Low	Low	Nil
DFR028	2515	South	17	Low	Low	Low	Nil
DFR027	2527	South	10	Low	Low	Low	Nil
DFR024	2534	South	1	Insignificant	Insignificant	Insignificant	Nil
DFR038	2688	South	19	Low	Low	Low	Nil
DFR030	2797	South	3	Insignificant	Insignificant	Insignificant	Nil
DFR033	2876	South	3	Insignificant	Insignificant	Insignificant	Nil
DFR034	2925	South	29	Low	Moderate	Low	Nil
GLE017	3087	North	6	Insignificant	Insignificant	Insignificant	Nil
GLE027	3172	North	40	Low	Moderate	Low	Nil
GLE018	3173	North	6	Insignificant	Insignificant	Insignificant	Nil
URA012	3217	West	1	Insignificant	Insignificant	Insignificant	Nil
URA013	3223	West	13	Low	Insignificant	Insignificant	Nil
LEM001	3335	North	27	Low	Low	Low	Nil
DFR035	3346	South	12	Low	Insignificant	Insignificant	Nil
URA015	3571	West	12	Low	Insignificant	Insignificant	Nil
GLE023	3575	North	46	Low	Moderate	Low	Nil
GLE021	3639	North	23	Low	Low	Low	Nil
GRD009	3714	East	1	Insignificant	Insignificant	Insignificant	Nil
DFR044	3734	South	1	Insignificant	Insignificant	Insignificant	Nil
DFR045	3811	East	1	Insignificant	Insignificant	Insignificant	Nil
GRD001	3821	East	2	Insignificant	Insignificant	Insignificant	Nil

Viewpoint	Distance to GSF (m)	Direction from GSF	Percent of GSF visible	Visual sensitivity	Magnitude of change	Visual Amenity impact	Recommendation
DFR039	3853	South	45	Low	Moderate	Low	Nil
114	4015	North	20	Low	Low	Low	Nil
113	4056	North	23	Low	Low	Low	Nil
116	4060	North	22	Low	Low	Low	Nil
DFR062	4143	East	4	Insignificant	Insignificant	Insignificant	Nil
73	4179	North	21	Low	Low	Low	Nil
202	4284	North	1	Insignificant	Insignificant	Insignificant	Nil

8.6.3.4 Visual Amenity Impact Assessment – Public Viewpoints

Public viewpoints within 5 km of the Proposed Development area are restricted to public roads. During field investigations it was confirmed that the Proposed Development would be potentially visible from the following roads:

- Drumwood Road
- Ortlipp Road
- Lindner Road
- Blight Road West
- Blight Road East
- Urana Road
- Walla Walla Jindera Road
- Glenellen Road
- Dights Forest Road
- Gerogery Road.

Surface model ZVI mapping (Figure 8-17) indicates that potential views from all roads are generally limited due to existing vegetation within the road corridor, and that this effect will be enhanced through existing commitments to vegetative buffer screen around the site periphery (Figure 8-18). While it may be possible to catch glimpses of the solar array from other roads beyond 5 km from the Proposed Development, such glimpses are considered to be insignificant.

Visual impacts on public roads are shown to be low or insignificant (Table 8-31) therefore, additional mitigation strategies for public viewpoints are not recommended.

Table 8-31: Summary of impacts to visual amenity and recommended mitigation strategies

Viewpoint	Distance to GSF	Visual sensitivity	Magnitude of visual change	Visual Amenity impact
Drumwood Road	0 m	Low	Moderate	Low
Ortlipp Road	0 m	Low	Moderate	Low

Viewpoint	Distance to GSF	Visual sensitivity	Magnitude of visual change	Visual Amenity impact
Blight Road West	0 m	Insignificant	Moderate	Insignificant
Lindner Road	200 m	Low	Insignificant	Low
Walla Walla Jindera Road	1,000 m	Low	Low	Insignificant
Blight Road East	1,100 m	Insignificant	Low	Insignificant
Glenellen Road	1,100 m	Insignificant	Insignificant	Insignificant
Dights Forest Road	1,600 m	Insignificant	Insignificant	Insignificant
Urana Road	2,300 m	Insignificant	Insignificant	Insignificant
Gerogery Road	3,400 m	Insignificant	Insignificant	Insignificant

8.6.3.5 Other considerations

Night lighting

There is no requirement to light the solar farm at night. The only facilities with provisions for night lighting will be associated with the operations and maintenance compound and existing substation. Lighting at this location will be predominantly on-demand only. As such, it is recommended that night lighting be developed to minimise light spill and that vegetative screenings be established as an additional mitigation, if required.

Glint, glare and reflections

When the sun is reflected off a smooth surface, it can result in a glint (a quick reflection) or glare (longer reflection). In both cases, the intensity of light will depend upon the reflectiveness of the surface from which the sun is being reflected. Solar farms are not considered to be reflective, since PV panels are designed to absorb as much sunlight as possible and convert it into electricity. Solar panels feature low-iron glass that is designed to minimise reflection and maximise the transmission of light through the glass. Low-iron glass reflects between 4% and 7% of light (Spaven Consulting, 2011). SunPower, (2009), as referenced by Pager Power, (2018 – Appendix D of this report) established that the reflectivity of a PV solar panel is similar to or less than those of still water and significantly less than reflections from glass and steel. Additionally, NGH, (2010) reported that PV panels are no more reflective than areas of vegetation such as grasslands, crops and forested areas associated with rural landscapes, and far less reflective than standing water such as water in dams, rivers and lakes.

Glint and glare effects can only ever occur when the weather is clear and sunny. In the scenario where a solar reflection is possible towards a road user or resident in a surrounding dwelling, the individual will also be looking in the general direction of the sun. This means the sun and solar reflection will be visible simultaneously. The sun is a significantly brighter source of light. Additionally, at any one location, only a particular area of solar panels will produce a solar reflection towards it. Note that not all receptors will experience a solar reflection at the same time.

Pager Power advise that reflections are technically possible immediately after sunrise until no later than 8 am towards 10 surrounding dwelling receptors to the south and west of the Proposed Development. It is, however, concluded that the impact is not significant. Visual impact assessment for these residences indicates that WWJ016 (Dwelling 2 in the Glint and Glare Appendix) which has a high assessed visual impact could receive solar reflections from various sections within the panel area, most often from the western portion. The other residences with potential solar reflections are completely screened from the Proposed Development, therefore, no impact is anticipated.

Detailed assessment of potential glint, glare and reflections is provided in Appendix F.

Air traffic

The nearest public airport is Albury Airport, located approximately 15 km south of the Site. Concerns regarding glare from solar farms has focussed on solar facilities on, or within 10 km of airfields. Distance to Albury airport far exceed this distance, and as such specific aviation modelling is not considered warranted (Appendix F).

Spaven Consulting (2011) conclude that off-airfield ("*en route*") facilities are unlikely to present glare problems to pilots. Their reasoning includes that aircraft in the *en route* phase of flight will be at higher angles of elevation than where glare occurs, and that pilots in the *en route* phase are already subjected to glare from a number of existing sources such as large assemblies of parked cars, major glasshouse facilities and large bodies of water. Further evidence of the limited risks posed by reflections from PV panels is the increasing installation of large solar arrays within airports in order to take advantage of large open areas and high local day-time electricity demand. Australian examples include Darwin Airport, Adelaide Airport, Alice Springs Airport, Newman (WA) Airport and Ballarat Airport (Solar Choice, 2013).

A commercial helicopter business, Forest Air, is situated in proximity to the Site. ORT009 (984 m north) marks the hangar, with the landing pads right in front of it on the northern side, and ORT001 (1133 m north) is the home/office building. Forest Air operate a training school and provide “a broad range of services from charter and scenic flights to aerial agriculture, firefighting and survey work” (Forest Air, 2018, http://www.forestair.com.au/). Communication with Forest Air revealed the helicopters generally use the 330 kV lines as a navigation routing aide and fly in/out to the east heading through 100-500 ft (approximately 30-150 m) to avoid houses noise impacts to houses.

Neither ORT009 nor ORT001 were assessed as likely to receive potential solar reflections, nor were they assessed as having their visual amenity potentially impacted. Once airborne, it is anticipated that potential glare impacts can be adaptively managed through adjustments to flight paths and direction. Consultation with Forest Air has commenced during the preparation of this EIS and will continue during the design phase will assist to identify and manage potential concerns.

Road traffic

Reflected light from the solar farm is theoretically possible towards approximately 400 m of Walla Walla Jindera Road which has a moderate density of traffic expected. A solar reflection to that part of the road would be in the early morning from a bearing of more than 50 degrees beyond the direction of travel. Theoretically this reflection could last for up to 10 minutes, however in reality road users would be expected to be travelling at (up to) 100 km/h and so effects would be fleeting for an observer in a vehicle travelling through the solar reflection zone.

The overall expected impact upon road users with respect to safety is conservatively classified as low where the reflecting solar panels are visible. Where the solar panels are not visible (which is the majority of the 400 m potentially affected stretch of road), there is no impact.

Decommissioning

At the conclusion of the operational phase of the Proposed Development, all above ground infrastructure associated with the solar farm shall be removed from site and the site rehabilitated to a condition to allow the resumption of agricultural activities. As such, all visual impacts post decommissioning are considered to be insignificant.

Cumulative visual impacts

The proposed JSF would be an approximately 130 MW_{DC} commercial scale PV solar farm located 310 m to the north-east of the GSF Site and 490 m from the GSF Development Footprint (Figure 8-20). Detailed assessment of potential cumulative visual impacts is provided in Section 8.13 and Appendix F.

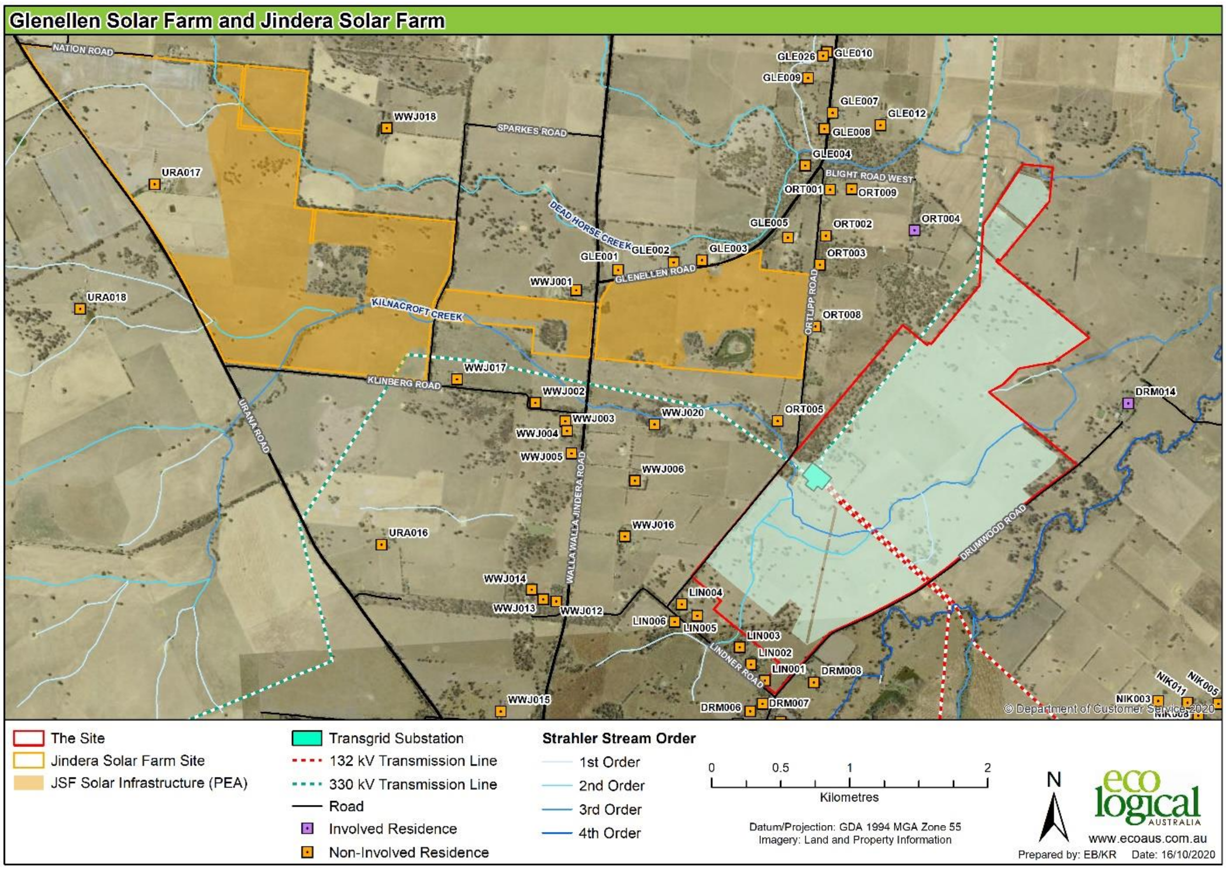

Figure 8-20: Location of Jindera Solar Farm and GSF

8.6.4 Mitigation Measures

The following mitigation measures (Table 8-32) will be implemented over the life of the project.

Table 8-32: Mitigation measures for visual amenity

Environmental safeguard	Timing*		
	C	O	D
Minimise vegetation clearing and earthworks and rehabilitate bare earth progressively.	✓	✓	
Implement existing commitment to establish perimeter vegetation screening.		✓	
Continued consultation with potentially impacted landholders will be undertaken to identify, where necessary, the location of additional mutually agreeable vegetation screening (observer-point) both pre and post construction.	✓	✓	
Continue to consult with Forest Air	✓	✓	
Where practicable use muted, low contrast colours for all supporting infrastructure, so that they blend into the landscape as far as possible.	✓	✓	
Where practicable select materials that minimise potential for reflectivity and glare.	✓	✓	
Minimise night lighting.	✓	✓	

***** C = Construction, O = Operation and D = Decommissioning

8.6.4.1 Draft Landscaping Plan

A draft landscaping plan was developed in consultation with potentially impacted adjoining landholders and has been adjusted in response to the findings of this assessment (Figure 8-21). The proposed vegetation buffers will augment existing vegetation retained within the buffer zone as well as that within the adjoin road reserve/landholding. Where appropriate, endemic native species shall be selected based on agreed performance criteria to provide complementary biodiversity outcomes.

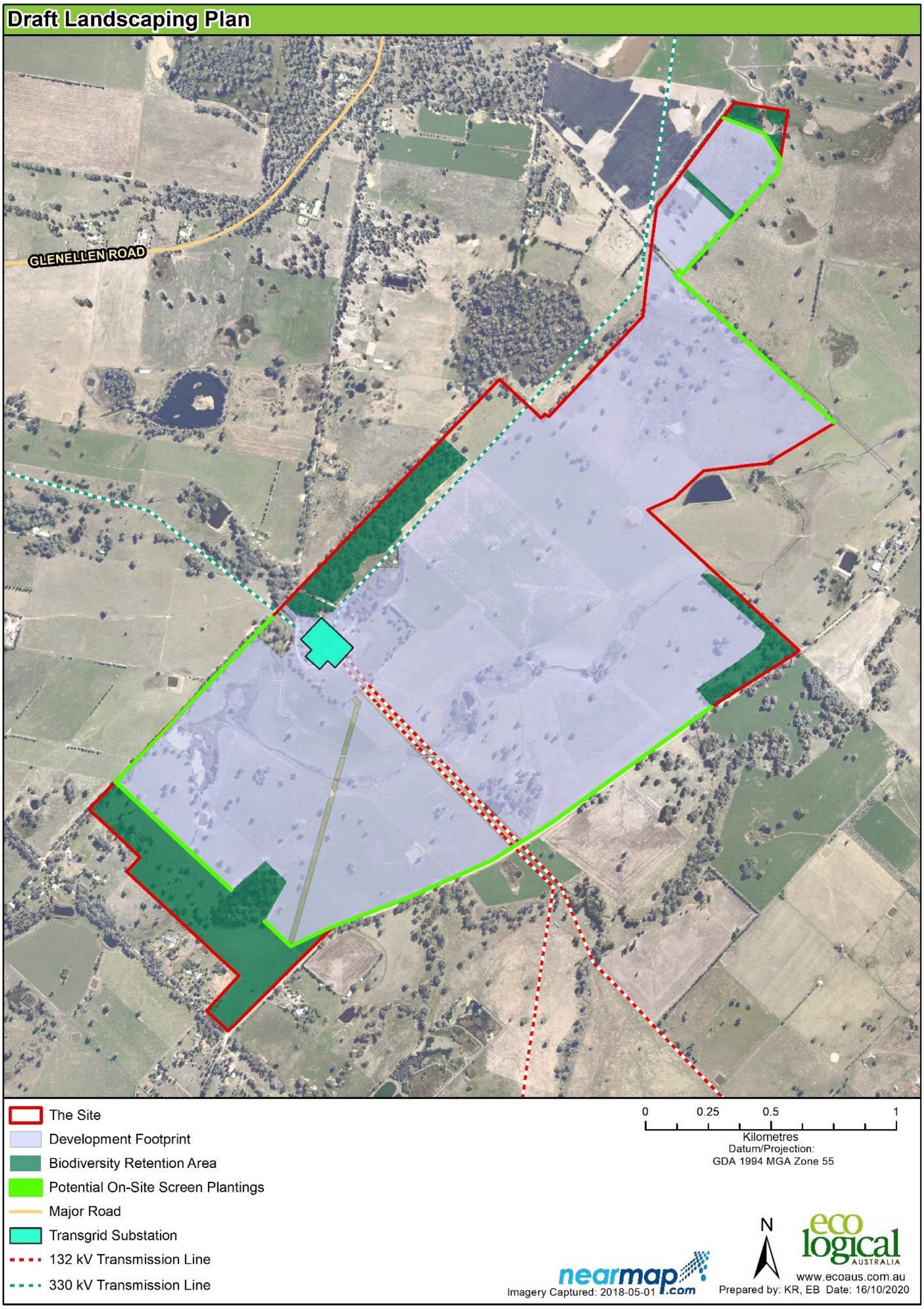

Figure 8-21: Draft landscaping plan

8.7 Noise

8.7.1 Introduction

This construction and operational noise impact assessment has been prepared to satisfy the SEARs for the proposal:

- *an assessment of the construction noise impacts of the development in accordance with the Interim Construction Noise Guideline (ICNG), operational noise impacts in accordance with the NSW Noise Policy for Industry 2017, and cumulative noise impacts (considering other operations in the area) and a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria.*

A full copy of the noise assessment is provided in Appendix G. This section provides a summary of the existing environment, methods, results and discussion of the noise impact assessment and the steps to be taken to mitigate potential impacts to nearby sensitive receptors and the environment.

The assessment includes the following:

- Construction noise assessment:
  - Identification of construction stages and associated activities including specialised machinery and equipment used during the works
  - Assessment in accordance with the ICNG (DECC, 2009)
  - Advice on practical and appropriate noise mitigation and management measures.
- Operational noise impact assessment:
  - Assessment of the potential impact of inverters, transformers and other noise generating equipment in accordance with the *NSW Noise for Industry Policy* (EPA, 2017)
  - Advice on practical and appropriate noise mitigation and management measures.

8.7.2 Existing Environment

The Site is located in a rural area with an acoustic environment that is dominated in most parts by natural sounds and noise associated with agricultural activities, generally characterised by low background noise levels, and having low road traffic noise from surrounding roads: Ortlipp, Lindner and Drumwood Roads. Occasional higher noise levels are likely produced during departures and arrivals from Forest Air helicopter business operating out of ORT001 and ORT009 to the north west of the Site. Consultation with the operators indicates that flight paths into and out of the helicopter base often traverse airspace above the Site.

Despite these occasionally raised noise levels, for this assessment the identified NSRs are expected to experience a similar acoustic environment with low background noise levels to represent a conservative approach. The background noise levels of the area have therefore been estimated by referring to Appendix A of Australian Standard AS 1055.2[6]. The Standard provides estimated average background noise levels for different residential areas in Australia, which may be used as a guideline.

[6] AS 1055.2:1997. Acoustics - Description and measurement of environmental noise - Application to specific situations

In accordance with Appendix A of AS 1055.2 (extract attached in Appendix G), the noise area category R1 (category with lowest background noise levels) is relevant to the Site and assessment. The corresponding average background noise levels for Category R1 are summarised in (Table 8-33).

Table 8-33: Average background noise levels for a noise area category R1

Time Period	Hours	Average Background Noise Level, (L_{90}) in dB(A)
Day	from 0700 to 1800 (Monday to Saturday) and 0900 to 1800 (Sundays and Public Holidays)	40
Evening	from 1800 to 2200	35
Night	from 2200 to 0700 (Monday to Saturday) and 2200 to 0900 (Sundays and Public Holidays)	30

8.7.2.1 Noise Sensitive Receivers

Residential properties within one kilometre of the Development Footprint have been identified as shown in Figure 8-22. These are referred to as Noise Sensitive Receivers (NSRs) and have been the subject of the noise impact assessment to determine whether, and analyse how, they may potentially be adversely impacted by noise from the construction and operation of the Proposed Development. These NSRs are as follows:

- NSRs between 200 metres and 500 metres away from the Development Footprint are ORT005, LIN003, LIN005, DRM008, LIN002, LIN004, LIN001, and ORT004
- NSRs between 500 metres and one kilometre away from the Development Footprint are LIN006, DRM014, WWJ016, DRM007, ORT008, DRM006, DRM015, WWJ006, DRM005, WWJ020, ORT003, ORT002, DRM004, and ORT009.

Noise impacts at receivers located further away than the assessed NSRs will be lower due to increased distance attenuation. As such, if noise impacts are found to be acceptable at the above identified NSRs, with or without noise mitigation measures, it can be inferred that compliance with the noise criteria is also expected further away, such that noise impacts would be acceptable at all sensitive receivers more than one kilometre from the Development Footprint.

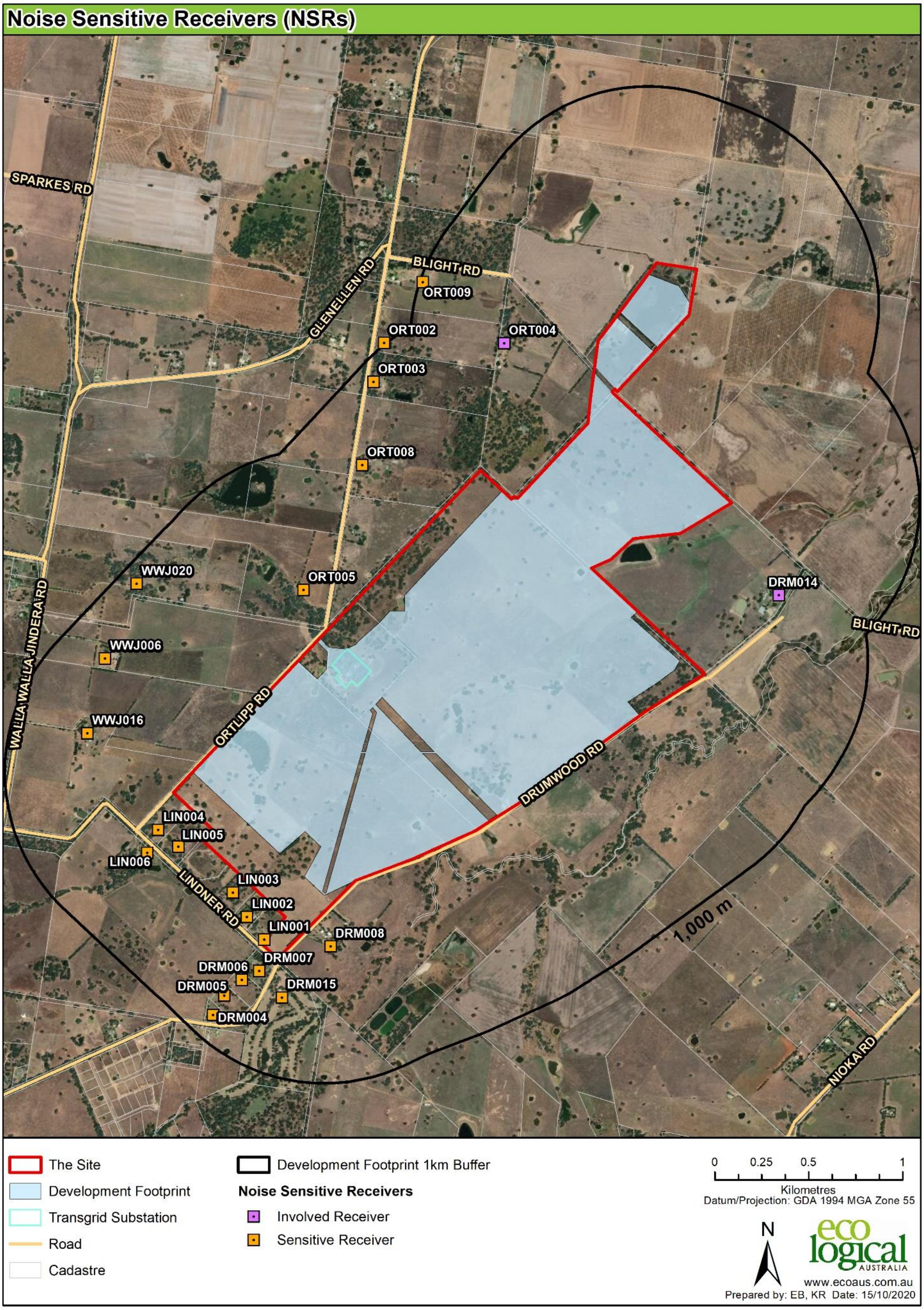

Figure 8-22: Location of noise sensitive receivers

8.7.3 Potential Impacts

8.7.3.1 Construction Noise

The noise impact of construction activities for each applicable construction phase has been predicted for a worst-case scenario. The noise prediction has been based on the following:

- Plant and equipment source sound power level information given in Table 8-34
- Distance attenuation
- Atmospheric, meteorological and ground noise attenuation using the CONCAWE8 method, where applicable.

The main construction processes, associated equipment and sound power levels are presented in Table 8-34.

Table 8-34: Summary of construction process, equipment and noise sources

Construction Process	Equipment	% Usage	Sound Power Level, dB(A)	Reference[7]
Site Clearing Works	*Earthworks construction machinery* 27 weeks			
	D9 Dozer	75%	102	Ref. No. 1, Table 2 in DEFRA[8]
	20T Excavator	50%	103	Ref. No. 3, Table 2 in DEFRA
	35T Excavator	50%	101	Ref. No. 15, Table 2 in DEFRA
	Scraper	75%	95	Ref. No. 8, Table 2 in DEFRA
	Pad Foot Roller	50%	105	Ref. No. 37, Table 2 in DEFRA
	Water Cart	100%	93	Ref. No. 45, Table 2 in DEFRA
	Moxy	75%	114	Ref. No. 31, Table 2 in DEFRA
	Front End Loader	75%	103	Ref. No. 28, Table 2 in DEFRA
	Tree Removal - 27 weeks (ad hoc)			
	Wood Chipper (tub grinder)	100%	113	Ref. No. 71, Table 4 in DEFRA
	D9 Dozer	75%	102	Ref. No. 1, Table 2 in DEFRA
	Tractor	50%	105	Ref. No. 34, Table 2 in DEFRA
Access Road Construction	*Earthworks construction machinery* - 20 weeks			
	Grader	75%	106	Ref. No. 37, Table 2 in DEFRA
	Water Cart	100%	93	Ref. No. 45, Table 2 in DEFRA
	Drum Roller	75%	106	Ref. No. 37, Table 2 in DEFRA

[7] DEFRA – Department for Environment Food and Rural Affairs (DEFRA), 2005. Update of noise database for prediction of noise on construction and open sites. Noise levels are given as a sound pressure level at 10 metres from the source. The sound pressure levels have been converted to sound power levels in the table.

AS 2436:2010. Guide to noise and vibration control on construction, demolition and maintenance sites.

[8] Department for Environment Food and Rural Affairs, DEFRA – Update of Noise Database for Prediction of Noise on Construction and Open Sites - 2005

Construction Process	Equipment	% Usage	Sound Power Level, dB(A)	Reference[7]
	13T Excavator	50%	101	Ref. No. 5, Table 2 in DEFRA
	20T Excavator	50%	103	Ref. No. 3, Table 2 in DEFRA
	Bobcat	75%	103	Ref. No. 28, Table 2 in DEFRA
	Scraper	75%	95	Ref. No. 8, Table 2 in DEFRA
	Access Track Road Base - 20 weeks			
	32T Truck and Dog	50%	105	Ref. No. 34, Table 2 in DEFRA
	Moxy	75%	114	Ref. No. 31, Table 2 in DEFRA
	Loader	75%	103	Ref. No. 28, Table 2 in DEFRA
	Crusher / Screener for quarry-based activities	50%	109	Ref. No. 15, Table 1 in DEFRA
	Scraper for placement of fill	75%	95	Ref. No. 8, Table 2 in DEFRA
Civil Construction of Benches	*Construction Vehicles* - 10 weeks			
	D9 Dozer	75%	102	Ref. No. 1, Table 2 in DEFRA
	20T Excavator	50%	103	Ref. No. 3, Table 2 in DEFRA
	35T Excavator	50%	101	Ref. No. 15, Table 2 in DEFRA
	Scraper	75%	95	Ref. No. 8, Table 2 in DEFRA
	Pad Foot Roller	75%	106	Ref. No. 37, Table 2 in DEFRA
	Water Cart	100%	93	Ref. No. 45, Table 2 in DEFRA
	Foundation Compound – 10 weeks			
	32T Truck and Dog	50%	105	Ref. No. 34, Table 2 in DEFRA
	Moxy	75%	114	Ref. No. 31, Table 2 in DEFRA
Construction / Installation Activities	*Site Fencing* - 20 weeks			
	Bobcat	75%	103	Ref. No. 28, Table 2 in DEFRA
	Utes and Trailer	50%	105	Ref. No. 34, Table 2 in DEFRA
	Telehandler	50%	96	Ref. No. 35, Table 2 in DEFRA
	Tractor	75%	107	Ref. No. 34, Table 2 in DEFRA
	Concrete Truck	75%	107	Ref. No. 34, Table 2 in DEFRA
	Small Excavator	50%	101	Ref. No. 5, Table 2 in DEFRA
	Site Offices - 4 weeks for both Mobilisation and Demobilisation			
	Flatbed Truck	50%	105	Ref. No. 34, Table 2 in DEFRA
	Crane (slew or Franna)	75%	103	Ref. No. 48, Table 5 in DEFRA
	Forklift	75%	94	Ref. No. 57, Table 4 in DEFRA
	Telehandler	75%	97	Ref. No. 35, Table 2 in DEFRA
	Hiab Truck	50%	105	Ref. No. 34, Table 2 in DEFRA
	Concrete Foundations - Ad hoc			

Construction Process	Equipment	% Usage	Sound Power Level, dB(A)	Reference[7]
	Concrete Truck	50%	105	Ref. No. 34, Table 2 in DEFRA
	Concrete Pump	75%	94	Ref. No. 24, Table 4 in DEFRA
	Sand Cart	75%	107	Ref. No. 34, Table 2 in DEFRA
	Water Cart	100%	93	Ref. No. 45, Table 2 in DEFRA
	Piling Works - 30 weeks			
	Vermeer PD10 or Equivalent	100%	96	Ref. No. 6, Table 3 in DEFRA
	Pre-drilling works- 15 weeks			
	Utes and Trailers	50%	105	Ref. No. 34, Table 2 in DEFRA
	Tractors	75%	107	Ref. No. 34, Table 2 in DEFRA
	Excavators	50%	103	Ref. No. 3, Table 2 in DEFRA
	Tracking System Installation - 40 weeks			
	Telehandlers	75%	97	Ref. No. 35, Table 2 in DEFRA
	Tractors & trailers for deliveries	75%	107	Ref. No. 34, Table 2 in DEFRA
	PV Module Installation - 40 weeks			
	Telehandlers	75%	97	Ref. No. 35, Table 2 in DEFRA
	Tractors & trailers for deliveries	75%	107	Ref. No. 34, Table 2 in DEFRA
	Forklifts	75%	94	Ref. No. 57, Table 4 in DEFRA
	Onsite Logistics - 40 weeks			
	Telehandlers	75%	97	Ref. No. 35, Table 2 in DEFRA
	Bobcat	75%	103	Ref. No. 28, Table 2 in DEFRA
	Side loaders	50%	101	Ref. No. 28, Table 2 in DEFRA
	Tractors & trailers	75%	107	Ref. No. 34, Table 2 in DEFRA
	Forklifts	75%	94	Ref. No. 57, Table 4 in DEFRA
	Cable and Trenching - 35 weeks			
	Vermeer Trenchers	75%	102	Ref. No. 64, Table 4 in DEFRA
	Utes / Tractors (for MV cable) with Cables Reeler	50%	105	Ref. No. 34, Table 2 in DEFRA
	Sand Carts	75%	107	Ref. No. 34, Table 2 in DEFRA
	20T Excavator	50%	103	Ref. No. 3, Table 2 in DEFRA
	Telehandler	75%	97	Ref. No. 35, Table 2 in DEFRA
	Backhoe	75%	95	Ref. No. 8, Table 2 in DEFRA
	Grader	75%	106	Ref. No. 37, Table 2 in DEFRA
	MR Truck	75%	114	Ref. No. 31, Table 2 in DEFRA
	Front End Loader	75%	103	Ref. No. 28, Table 2 in DEFRA
	D7 Dozer (for clearing)	75%	102	Ref. No. 1, Table 2 in DEFRA

Construction Process	Equipment	% Usage	Sound Power Level, dB(A)	Reference[7]
	OHL Construction - 25 weeks			
	EWP	75%	105	Ref. No. 59, Table 4 in DEFRA
	Telehandler	75%	97	Ref. No. 35, Table 2 in DEFRA
	Drill Rig	75%	112	Ref. No. 35, Table 6 in DEFRA
	Concrete truck	50%	112	Ref. No. 31, Table 2 in DEFRA
	20T Excavator	75%	105	Ref. No. 3, Table 2 in DEFRA
	HR Tuck and Hiab	75%	93	Ref. No. 28, Table 3 in DEFRA
	Mobile Crane	50%	112	Ref. No. 31, Table 2 in DEFRA
	D7 Dozer (for clearing)	75%	102	Ref. No. 1, Table 2 in DEFRA
Deliveries	*Piling Machines* - 2 weeks			
	Low Loader or Side loader semis with pile rigs in 40' containers	50%	101	Ref. No. 28, Table 2 in DEFRA
	Main Equipment (Tracking, Piers, Modules, Inverters) – 6 months			
	Typically, A-B-Double	50%	112	Ref. No. 31, Table 2 in DEFRA
	Gravel / Access Track Road Base - 25 weeks			
	Typically, A-B-Double	50%	112	Ref. No. 31, Table 2 in DEFRA
	Sand - 35 weeks			
	Typically, A-B-Double	50%	112	Ref. No. 31, Table 2 in DEFRA
	Mobile Crane – Ad-hoc as needed			
	180T Mobile Crane	50%	112	Ref. No. 31, Table 2 in DEFRA
	Waste Collection - 30 weeks (Approximately 20 Trucks weekly)			
	Waste Collection Trucks	50%	112	Ref. No. 31, Table 2 in DEFRA

* DEFRA – Department for Environment Food and Rural Affairs (DEFRA), 2005. Update of noise database for prediction of noise on construction and open sites. Noise levels are given as a sound pressure level at 10 metres from the source. The sound pressure levels have been converted to sound power levels in the table.
AS 2436:2010. Guide to noise and vibration control on construction, demolition and maintenance sites.

The impact of each construction phase has been predicted based on the following assumptions:

- Noise source modelled as follows:
  - One point source for each construction phase
  - All plant and equipment for each construction phase are operating simultaneously at the same location
  - Total sound power level for each construction phase is calculated based on sound power level information and percentage use of each plant and equipment given in Table 8-34
- Distance attenuation, as follows:
  - Average impact scenario – Due to the transient and changing nature of construction works, the location of the noise source can be assumed to be in the middle of the site for each construction phase on average. This scenario provides an indication to the average impact

on the receivers. Impact is typically maximum when the construction works are closest to the receivers on one side of the Site, and minimal when works are on the other side of the Site away from receivers
    - Worst-case impact scenario – Maximum impact is experienced when construction works occur at the closest boundary of the construction works to each respective receiver. Maximum impact will however be for a short duration until the activities move to a different location. Assessing the maximum impact ensures the right mitigation methods are implemented
- Atmospheric, meteorological and ground attenuation using the CONCAWE[9] method (over 100 metres separation distance between source and receiver), as follows:
    - Category 6 – A worst-case condition which conservatively predicts the propagation of noise from source to receiver, including the effects of temperature inversions and favourable winds onto the noise
    - Category 4 – A neutral meteorological condition, where the resulting noise levels are neither elevated or reduced.

For the construction noise assessment, the noise impact radius for each construction phase has been predicted based on the above methodology. The predicted noise levels have then been compared to the following noise targets during recommended standard hours for construction of Monday to Friday 7am to 6pm and Saturdays 8am to 1pm with no work on Sundays or public holidays:

- ICNG noise management level of 50 dB(A)
- ICNG highly noise affected limit of 75 dB(A).

The predicted construction impact for the noisiest construction task shows that the ICNG highly noise affected limit of 75 dB(A) is exceeded at any receivers located less than 40 metres from the boundary of the Development Footprint. The closest identified NSR, ORT005, is 244 metres from the Development Footprint (Figure 8-23). Therefore, no receiver is predicted to be highly noise affected.

Based on the predicted approximate noise impact radius, receivers located within 550 m of the noisiest construction tasks (Worst-case prediction CONCAWE Category 6) will exceed the ICNG Noise Management Level of 50 dB(A). Areas of the Development Footprint within 550 m of NSRs are highlighted in Figure 8-23.

[9] CONCAWE is a noise prediction method developed for assessing environmental noise propagation, drawn from both acoustic theory and extensive field noise measurements. The CONCAWE predictions consider atmospheric, meteorological and ground attenuation. *The propagation of noise from petroleum and petrochemical complexes to neighbouring communities. Report no.4/81, 1981*

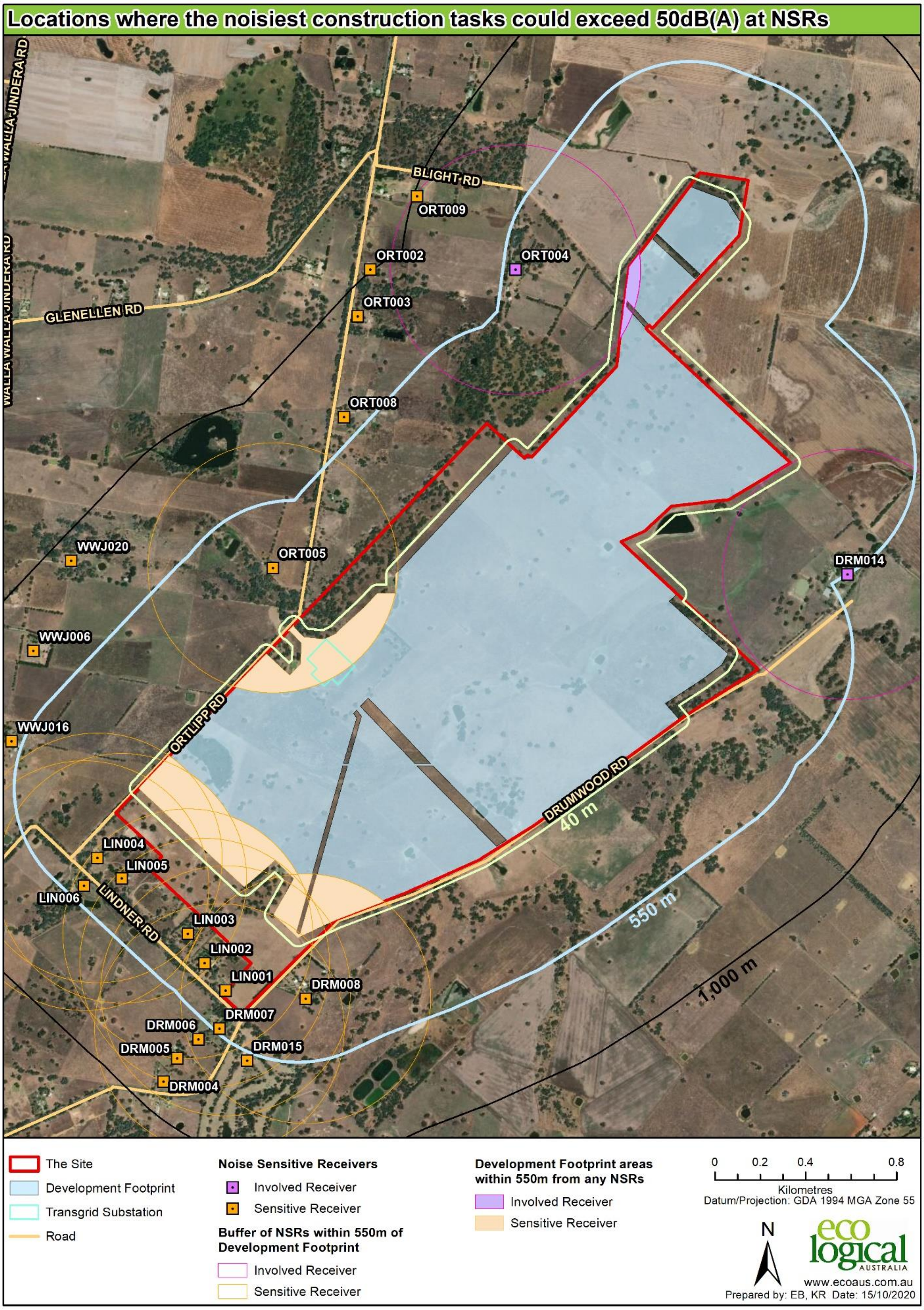

Figure 8-23: Areas of the Development Footprint within 550m of NSRs

The approximate duration of impact for each impacted receiver has been predicted based on the duration of each construction task and the total area of the construction work (Development Footprint). The results are summarised in (Table 8-35).

Table 8-35: Impacted receivers

<table>
<tr><th>Construction Process</th><th>Construction Task</th><th>Duration</th><th>Impacted Receivers</th><th>Approximate Duration of Impact in Working Days (based on worst-case prediction CONCAWE Category 6)</th></tr>
<tr><td rowspan="2">Site Clearing Works</td><td>Earthworks construction machinery</td><td>27 weeks</td><td>ORT005
LIN003
LIN005
DRM008
LIN002
LIN004
LIN001
ORT004</td><td>8
4
2
2
2
2
1
1</td></tr>
<tr><td>Tree Removal</td><td>27 weeks (ad hoc)</td><td>ORT005
LIN003
LIN005
DRM008
LIN002
LIN004</td><td>Receivers will be impacted for tree removal located within 400 metres of the receivers.
Each tree removal work is not expected to last for more than a couple of hours.
Noise impact of tree removal work located more than 400 metres from the receivers is predicted to be less than the ICNG Noise Management Level of 50 dB(A).</td></tr>
<tr><td rowspan="2">Access Road Construction</td><td>Earthworks construction machinery</td><td>20 weeks</td><td>ORT005
LIN003
LIN005
DRM008
LIN002
LIN004</td><td>2
1
1
1
1
1</td></tr>
<tr><td>Access Track Road Base</td><td>20 weeks</td><td>ORT005
LIN003
LIN005
DRM008
LIN002
LIN004
LIN001
ORT004</td><td>6
3
2
1
1
1
1
1</td></tr>
<tr><td rowspan="2">Civil Construction of Benches</td><td>Construction Vehicles</td><td>10 weeks</td><td>ORT005
LIN003</td><td>1
1</td></tr>
<tr><td>Foundation Compound</td><td>10 weeks</td><td>ORT005
LIN003
LIN005
DRM008</td><td>3
1
1
1</td></tr>
</table>

Construction Process	Construction Task	Duration	Impacted Receivers	Approximate Duration of Impact in Working Days (based on worst-case prediction CONCAWE Category 6)
			LIN002	1
			LIN004	1
			LIN001	1
			ORT004	1
Construction/ Installation Activities	Site Fencing	20 weeks	ORT005	2
			LIN003	1
			LIN005	1
			DRM008	1
			LIN002	1
			LIN004	1
	Site Offices	4 weeks for mobilisation and for demobilisation	ORT005	1
			LIN003	1
	Concrete Foundations	Ad hoc	ORT005	Impact is predicted to be of short duration, typically less than a day.
	Piling Works	30 weeks	-	-
	Pre-drilling works	15 weeks	ORT005	1
	Tracking System Installation	40 weeks	ORT005	1
	PV Module Installation	40 weeks	ORT005	1
	Onsite Logistics	40 weeks	ORT005	1
	Cable and Trenching	35 weeks	ORT005	15
			LIN003	8
			LIN005	5
			DRM008	5
			LIN002	4
			LIN004	4
			LIN001	1
			ORT004	1
			LIN006	1
	OHL Construction	25 weeks	ORT005	10
			LIN003	6
			LIN005	4
			DRM008	3
			LIN002	3
			LIN004	3
			LIN001	1
			ORT004	1

Construction Process	Construction Task	Duration	Impacted Receivers	Approximate Duration of Impact in Working Days (based on worst-case prediction CONCAWE Category 6)
			LIN006	1
Deliveries	Piling Machines	2 weeks	-	-
	Main Equipment (Tracking, Piers, Modules, Inverters)	6 months	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004	3 1 1 1 1 1
	Gravel (Access Track Road Base)	25 weeks	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004	3 1 1 1 1 1
	Sand	35 weeks	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004	4 1 1 1 1 1
	Mobile Crane	Ad-hoc as needed	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004	Impact is predicted to be exceeded for works within 400 m of receiver. Impact is predicted to be for short durations, typically for a couple of hours. As the works move further away more than 400 m from the receiver, impact is predicted to be less than the ICNG Noise Management Level of 50 dB(A).
Waste Collection		30 months (Approximately 20 Trucks weekly)	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004	Impact will be of very short duration for a couple of hours a day at receiver located within 400 m of the works. As the works move further away more than 400 m from the receiver, impact is predicted to be less than the ICNG Noise Management Level of 50 dB(A).

Note: * Atmospheric, meteorological and ground attenuation corrections are 0 dB for NSRs located within 100 m of the source.

The construction noise prediction method represents a scenario where all the plant and equipment for each construction task have been assumed to be operating at the same time and location with the source noise levels adjusted for percentage usage. This method allows an assessment of maximum impact, but also represents impact for a short duration of time. Due to the construction methods adopted for solar farm construction, plant and equipment are expected to operate at one location only for a short period of time and then move on the next location, away from the boundary of the Development Footprint. For instance, sensitive areas located on the western boundary of the Site will be less impacted from works conducted on the eastern boundary of the Site, and vice versa.

Furthermore, plant and equipment are usually spread out across the Development Footprint conducting specific tasks. The impact of one plant or equipment will be considerably less as compared to the cumulative impact of all plant and equipment, as presented in this assessment. The approximate impact duration given in Table 8-35 represents maximum duration and is to be used as a guide only.

Although the construction noise is expected to be audible and there is likely to be some degree of adverse impact, as is typical with construction projects in proximity to people by incorporating noise control measures, the noise impact to residents and other NSRs surrounding the Site can be significantly reduced. Construction noise from the Proposed Development will be managed through a construction noise and vibration management plan to minimise the adverse impact to acceptable levels and manage community concerns and expectations.

8.7.3.2 Construction Vibration

The risk of vibration caused by the construction works onto nearby buildings is considered highly unlikely due to the type of activities taking place and the high levels of vibration required to cause damage. The greatest risk of vibration causing an adverse impact to the residents is by causing discomfort or fear of damage to their premises.

As such, it is recommended to set a conservative building damage vibration criterion so that in the unlikely event that the criterion is exceeded, the construction works can be stopped, and the vibration damage established. If no damage is observed and after the resident's concerns have been allayed, the works can resume. The recommended vibration criterion for building damage is set in accordance with BS 7385 at 5 mm/s PPV.

For reference, the safe working distances for vibration causing plant which may be used during the construction activities have been taken from the *Transport Infrastructure Development Corporation Construction Noise Strategy (Rail Projects) 2007* and are summarised in Table 8-36. Table 8-36 indicates that the use of large vibratory roller may exceed human comfort criteria if used within 100 m of a residence. All other plant is considered unlikely to exceed criteria.

Table 8-36: Recommended safe working distances for vibration causing plant

Plant Item	Rating/Description	Safe working distance (m)	
		Cosmetic Damage[1]	Human response[2]
Vibratory Roller	<50 kN (1-2t)	5	15 – 20
Vibratory Roller	<100 kN (2-4t)	6	20
Vibratory Roller	<200 kN (4-6t)	12	40
Vibratory Roller	<300 kN (7-13t)	15	100
Hydraulic Hammer	300 kg – 5 to 12t excavator	2	7
Hydraulic Hammer	900 kg – 12 to 18t excavator	7	23

[1] – BS7385, [2] – AS2670

8.7.3.3 Construction Traffic Noise

During the construction period, as described in Section 8.8, up to 45 heavy vehicles, 40 light vehicles and 13 buses are forecast to be required daily. There is potential that peak truck movements could be as high as 60 to 100 vehicles in some situations such as due to weather delays, logistical delays, where the construction schedule pace is increased, or where a particular campaign or work-front requires a higher frequency of truck movements for a shorter duration. Typical construction traffic will consist of deliveries, low loader trailers, truck and dog and waste collection trucks. The proposed construction traffic ingress and egress route to the Site is via the Hume Highway, Olympic Highway, Main Street (Gerogery Road), Glenellen Road, Walla Walla Jindera Road, Lindner Road (western) and Ortlipp Road (southern).

The closest receivers to the proposed access route are approximately 25 m from the boundary of the access road. Typical heavy vehicles associated with deliveries have an approximate maximum pass-by noise level of 81 dB L_{Amax} at 10 m (Source: DEFRA database, Table 2, Ref. 33 Articulated Dump Truck). This translates to a maximum noise level incident at the façade of that closest receiver of 73 dB L_{Amax}.

As all traffic movements associated with the Proposed Development will occur during daytime hours (6am – 6pm), sleep disturbance is not expected. With an average of approximately 90 heavy vehicle pass-by events per day (approximately 7.5 pass-by events per hour) from delivery trucks occurring during a 12-hour construction period from 6am – 6pm, it follows that the impact will be relatively minor at the closest receivers to the access road. In addition, it should be noted that 73 dB L_{Amax} is a maximum noise level, and as such, the noise will be at this level only for a very short duration, and each pass-by will be over in a matter of seconds. Therefore, the risk of an adverse noise impact being caused to residents is considered low and can be mitigated through vehicle design, maintenance and traffic management procedures.

Other construction related traffic is not expected to result in an adverse noise impact to residents.

8.7.3.4 Operational Noise Assessment

For noise emissions generated on the Site resulting from the operational activities at the Proposed Development, the relevant noise criteria are defined in the NSW Industrial Noise Policy (INP).

The INP offers guidelines to minimise noise impacts to NSRs not associated with the development (EPA, 2017). Project noise target levels (PNTLs) are determined and set at the boundary of relevant NSRs. The INP states:

> *The intrusiveness of an industrial noise may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the LAeq descriptor), measured over a 15-minute period does not exceed the background noise level measured in absence of the source by more than 5dB.*

The INP recommends methods for determining background noise level. At the planning and approval stage, the long-term method is used which is designed to ensure that the criterion for intrusive noise will be achieved for at least 90% of the time periods (day/evening/night), known as the Rating Background Level (RBL).

Potential noise generating operational activities at GSF will generally be limited to:

- Noise from the operation of inverter stations (Including transformers)
  - When the solar farm is fully operational, noise from the inverter stations may impact upon nearby receivers. The inverter stations emit noise only while generating electricity (daylight hours) and are expected to be located within the module layout area away from potential receptors
- Solar PV module washing on an as-needed basis:
  - The solar modules are to be periodically washed to remove any excess dirt, dust or other matter (i.e. bird droppings), which may prevent sunlight from effectively reaching the solar cells and subsequently reducing the electricity production output. The solar panels are anticipated to be cleaned via means of water spray from a water truck driven through the informal roadways constructed on-site. No chemicals will be added to the water to ensure minimal impact to the surrounding environment through runoff
- Vegetation (fuel load), weed and pest management:
  - Weed and vegetation control will be conducted throughout the Site for the duration of operations. Weed control is likely to consist of any or all of the following methods: biological (sheep grazing), mechanical or manual, or chemical methods. Site conditions are to be evaluated prior to the selection of the management method to ensure the method employed is the most appropriate to the environmental conditions of the Site
- Fence, access road and control room management
- Equipment maintenance and inspection:
  - Responding to automated electronic alerts based on monitored data, including actual versus expected tolerances for system output and other key performance metrics
- Security detail:
  - To ensure safety and security at the Site, a perimeter fence up to 2.5 m will be installed around the perimeter of the Proposed Development in accordance with the Proponent's requirements to ensure entry into the Site is controlled. Site access arrangements will be regulated for staff through identification requirements. Once operational, all access points will be gated. The Site security system may also include sensor lighting and CCTV at several locations around the Site to act as a deterrent to possible nefarious activity. The lighting is designed not to react to birds and animals etc
- Communicating with customers, transmission system operators, and other entities involved in facility operations.

For each operation phase, the expected equipment and associated sound levels are summarised in Table 8-37.

Table 8-37: Summary of operational activities and associated noise generating equipment

Operations Phase	Task	Equipment	% use per day	Sound Power Level, dB(A)	Reference*
Noise from Inverter Stations	-	Inverters, Transformers	100	92	Data provided by Eco Logical
Solar module washing	Water spraying	Water Truck	75	107	AS 2436

Operations Phase	Task	Equipment	% use per day	Sound Power Level, dB(A)	Reference*
		Water Pump	75	93	Ref. No. 45, Table 2 in DEFRA
Vegetation, weed, and pest management	Mechanical method	Truck	75	107	AS 2436
		Pump	75	93	Ref. No. 45, Table 2 in DEFRA
Equipment maintenance and inspection	Insignificant noise impact				
Security detail	Insignificant noise impact				
Communicating with customers, transmission system operators, and other entities involved in facility operations	Insignificant noise impact				

Note: *

DEFRA – Department for Environment Food and Rural Affairs (DEFRA), 2005. Update of noise database for prediction of noise on construction and open sites. Noise levels are given as a sound pressure level at 10 metres from the source. The sound pressure levels have been converted to sound power levels in the table.

AS 2436:2010. Guide to noise and vibration control on construction, demolition and maintenance sites.

Noise generated by machinery during upgrading/repowering and decommissioning is likely to be similar to or less than predicted construction noise. However, any technological advancements between now and 30 or 60 years hence could alter the level of noise resulting from those activities away from any current predictions for noise levels. Therefore, noise impact assessment for upgrading/repowering and decommissioning, if necessary, should be deferred until greater certainty of machinery requirements can be obtained.

The assessment involves predicting minimum buffer distances for the equipment to meet the NSW Noise Policy for Industry criteria. The predicted buffer distances consider plant and equipment source sound power level information given in Table 8-37 and uses the same methodology as for assessing construction with the exemption of distance attenuation which is modelled for operational impacts as follows:

- Average impact scenario (Solar module washing and vegetation, weed, and pest management tasks only):
    - Due to the transient and changing nature of maintenance works, the location of the noise source can be assumed to be in the middle of the Site for each task on average. This scenario provides an indication to the average impact on the receivers. Impact is typically maximum when the maintenance works are closest to the receivers on one side of the Site, and minimal when works are on the other side of the Site away from receivers
- Worst-case impact scenario:
    - Maximum impact is experienced when tasks occur at the closest boundary of the Site to each respective receiver. Assessing the maximum impact ensures the right mitigation methods are implemented.

Noise from the inverter stations are required to meet the PNTLs of 35 dB(A). Based on the sound levels given in Table 8-37, the radius of impact of one inverter station is 260 m.

ORT005 is located at 244 m from the Development Footprint and is the only receiver which is at risk of being impacted if the inverter stations are located within the impact radius. It is recommended to consider the relative location of ORT005 when setting the final locations of the stations.

These results indicate that to meet the INP during both day and night under the worst-case conditions that a buffer distance of 260 m should be maintained between the nearest inverter and the NSR. If these separation distances cannot be achieved, additional mitigation options may be considered.

Operational noise impact to the identified NSRs has been predicted and compared to the daytime PNTL of 40 dB(A) $L_{Aeq,day}$. Based on the sound levels given in Table 8-37, the radius of impact for the operational activities is approximately 150 m. No receivers have been identified with 150 m of the Development Footprint. Therefore, impact from operational activities is predicted to be insignificant.

8.7.3.5 Cumulative Noise Impacts

There is the possibility that construction of the Proposed Development will overlap with that of other major projects in the region. The potential for cumulative noise impact is discussed further in Section 8.13.

8.7.4 Mitigation Measures

8.7.4.1 Construction noise

The key strategy for managing construction noise impacts shall be the adoption of ICNG standard hours for construction for residential properties where noise impacts are apparent. These are:

- Monday to Friday – 7 am to 6 pm
- Saturday – 8 am to 1 pm
- No construction work on Sundays or public holidays.

Opportunities for practical physical noise control are few given the transient and constantly moving nature of the construction work. However, the following table provides a list of management measures can be employed to help minimise construction noise impact onto residential premises. Potential adverse impacts will be managed through the development management plans and with the mitigation measures outlined in Table 8-38.

Table 8-38: Mitigation measures for construction noise and vibration impacts

Impact	Environmental safeguard	Timing*		
		C	O	D
Construction Noise	ICNG standard hours for construction will be adopted for residential properties where noise impacts are apparent. These are: • Monday to Friday – 7 am to 6 pm • Saturday – 8 am to 1 pm No construction work on Sundays or public holidays.	✓		✓
	If required and practicable, use mobile noise barriers/enclosures during certain construction work, such as around stationary work activities and plant.	✓		✓

Impact	Environmental safeguard	Timing*		
		C	O	D
	Informing and consulting residents and interested parties, as far as practicable, regarding impending or current events that may cause high levels of noise and how long they are expected to take. This will use the most appropriate form of local media and may include social media.	✓		✓
	Provide a complaints telephone number prominently displayed where the works are taking place and on any media.	✓		✓
	If necessary, respite hours when noisy works will not take place will be agreed with residents.	✓		✓
	Investigate complaints when received to establish the cause, and where possible implement a corrective action.	✓		✓
	Minimising the operating noise of machinery brought on to the Site.	✓		✓
	Where appropriate, obtaining acoustic test certificates for machinery brought on to the Site.	✓		✓
	Undertake noise monitoring at the start of a new noisy activity so noise levels can be investigated should a complaint be received.	✓		✓
	If there is excessive noise from any process, that process will be stopped and if possible that noise attenuated to acceptable levels. Where there is no alternative the process will be rescheduled to non-sensitive hours.	✓		✓
	Ensuring that plant is well maintained and in good working order and not causing unnecessary noise, such as damaged mufflers on plant, and ensuring plant is not left idling when not in use.	✓		✓
	All access hatches for plant to be kept closed.	✓		✓
Construction Vibration	In addition to Construction Noise mitigation measures above, where residential dwellings are located within 100 m of construction works and a 10 tonne vibratory/foot roller is expected to be used, it is recommended to use a smaller vibratory/foot roller to suit the required buffer distance.	✓		✓
Construction Traffic	Driver actions and behaviours to minimise potential traffic noise impacts will be included in the traffic management plan.	✓		✓
	Site inductions will include traffic management requirements relating to noise mitigation.	✓		✓
	Designated on-site parking areas will be located away from NSRs and car-pooling will be encouraged.	✓		✓
Operational Noise	Implement sound reduction strategies if invertor/NSR separation distances cannot be met.		✓	
	The operator will maintain effective relationships with NSRs and work in a proactive manner to minimise operational noise impacts.		✓	

* C = Construction, O = Operation and D = Decommissioning

8.8 Transport

8.8.1 Introduction

The transport assessment was undertaken in accordance with the requirements of the SEARs which include:

- *an assessment of the peak and average traffic generation, including over-dimensional vehicles and construction worker transportation*
- *an assessment of the likely transport impacts to the site access route (including Walla Walla Jindera Road, Lindner Road and Ortlipp Road), site access point, rail safety issues, and Crown land, particularly in relation to the capacity and condition of the roads*
- *a cumulative impact assessment of traffic from nearby developments*
- *a description of any proposed road upgrades developed in consultation with the relevant road and rail authorities (if required)*
- *a description of the measures that would be implemented to mitigate any transport impacts during construction*
- *demonstration of consideration of potential cost-sharing of road upgrades with Jindera Solar Farm.*

This includes a Traffic Impact Assessment as well as an independently prepared Road Safety Audit associated with both the construction and operational phases of the Proposed Development (Appendix H). The impacts for decommissioning have not been prepared as future traffic volumes, and road conditions as they are likely to exist in 30 years cannot be accurately determined or assessed. However, the impacts are anticipated to be similar to those identified for the construction phase.

The scope of the transport aspects investigated included:

- Likely traffic generation and impacts
- Access arrangements for staff and deliveries
- Assessment of the implications and recommendations arising from the independently prepared Road Safety Audit
- Identification of any roads or intersections which need to be upgraded, in addition to mitigations for pavement impacts
- Assessment of the outcomes of the Road Safety Audit
- Traffic Impact Assessment.

To inform the proposed transport arrangements, the Proposed Development has been assessed against the following guidelines and planning documents:

- RMS (RTA) Guide to Traffic Generating Developments Version 2.2 (2002)
- RMS (RTA) Road Design Guide (as amended)
- Austroads Guide to Road Safety: Part 6; Road Safety Audit Third Edition (2009)
- RMS (RTA) Traffic Control at Work Sites Version 5 (June 2018).

8.8.2 Existing Environment

The Site is located 20 km north of Albury in southern NSW. Direct access to the Site is via Ortlipp Road.

The construction haulage routes will be from either southern Victorian, with access to the southern ports, or via NSW ports. In either case, the majority of material delivery traffic will be via the Hume Highway. The proposed haulage from the Hume Highway to the Site during construction is illustrated in Figure 8-24.

The proposed haulage from the Hume Highway to the Site during construction is:

- Exiting Hume Highway onto Olympic Highway
- Turning left from Olympic Highway onto Main Street (Gerogery Road)
- Turning right from Gerogery Road onto Glenellen Road
- Turning left from Glenellen Road onto Walla Walla Jindera Road
- Turning left from Wallla Walla Jindera Road onto Lindner Road
- Turning left from Lindner Road onto Ortlipp Road
- Turning right into the Site from Ortlipp Road.

The proposed exit route from the Site is the same as the access route, that is:

- Exiting the Site, turning left onto Ortlipp Road
- Turning right from Ortlipp Road onto Lindner Road
- Turning right from Lindner Road onto Walla Walla Jindera Road
- Turning right from Walla Walla Jindera Road on to Glenellen Road
- Turning left from Glenellen Road onto Gerogery Road and then turning right onto Olympic Highway
- Entering onto Hume Highway from Olympic Highway.

The proposed haulage route is approved for B-double trucks up to 26 m in length under the RMS NSW Combined Higher Mass Limits and Restricted Access Vehicle Map (RMS, 2018). A possible alternative route is via Hume Highway and Wagga Road, then onto Gerogery Road. This route has a 15 tonne limit restriction, however this route could be used by staff vehicles, buses and small construction vehicles.

The proposed construction haulage route from the Hume Highway, as outlined above, has been developed with the specific intent of minimising traffic, social amenity, safety and cumulative impacts as far as possible to the township of Jindera. Correspondence from Greater Hume Shire Council in late August 2020 indicates that its preferred transportation route is a different route - via Urana Road and through the township of Jindera, and then by Walla Walla Jindera Road, onto Lindner Road and then Ortlipp Road before entering the Site (Figure 8-25). This alternative route has been considered by the Project's transport specialists and - while it is noted that Greater Hume Shire Council has provided advice to utilise this route - is not preferred by the Project Proponent as it may potentially cause additional unnecessary impacts to the township of Jindera from the proposed GSF. These additional impacts may include:

- Social, public safety and amenity impacts – the alternative transportation route provided by Greater Hume Shire Council would direct construction traffic through the township of Jindera, increasing heavy vehicle traffic through the township by an average of 50 vehicle trips per day. It is noted that Council upgraded Urana Road in Jindera in 2014 to ‘create a safer street environment for residents, businesses, tourists and visitors and improve safety and access for vehicles and pedestrians' (Border Mail, 2014). This increase in heavy vehicle traffic will bring additional heavy vehicles along Urana Street, and into the proximity of:

- School
- Recreational reserve
- Hotel
- Churches
- Retail (e.g. IGA, Post Office)
- Community Hub
- Pioneer Museum
- Light industrial estate

Associated impacts from this additional transport may generate public safety concerns, as well as create the potential for additional vehicle noise, intersection congestion and traffic flow delays. Via community consultation, GSF notes that traffic impacts have been raised as a specific community concern. Transportation through Jindera may be considered to be in direct conflict with this community expectation and with wider community views that the unique community aesthetic of central Jindera township should be protected.

- Cumulative impacts – if the alternative transportation route provided by Greater Hume Shire Council is considered for all proposed solar farm developments in the locality, the cumulative impacts upon the Jindera township would be well beyond the additional 50 heavy vehicles per day during construction. If construction of the proposed JSF and GSF were to be undertaken concurrently or overlap at any stage of the construction period, this would add to the already high traffic volumes along Urana Street by approximately 105 heavy vehicles and 265 light vehicles / buses. Whilst it is considered that construction of all projects may not be undertaken at the same time, prolonged exposure of the township to additional heavy vehicles passing through may compound the potential social, public risk and amenity impacts.

Based upon these potential additional impacts from the alternative transport route provided by Greater Hume Council, the current proposed route outlined above is still the preferred option for haulage to and from the GSF, and potential impacts have been addressed within this EIS.

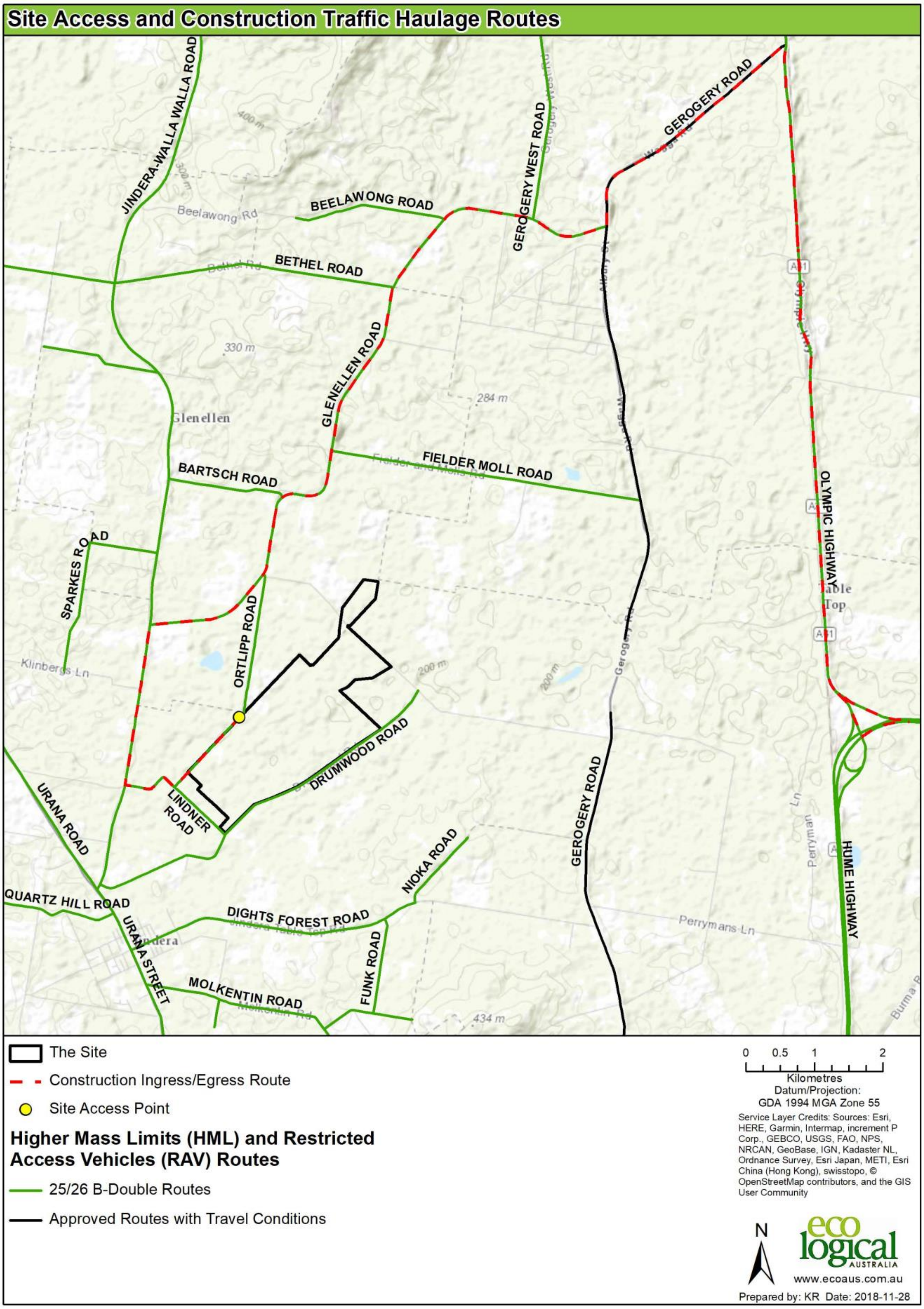

Figure 8-24: Proposed inbound and outbound construction traffic routes

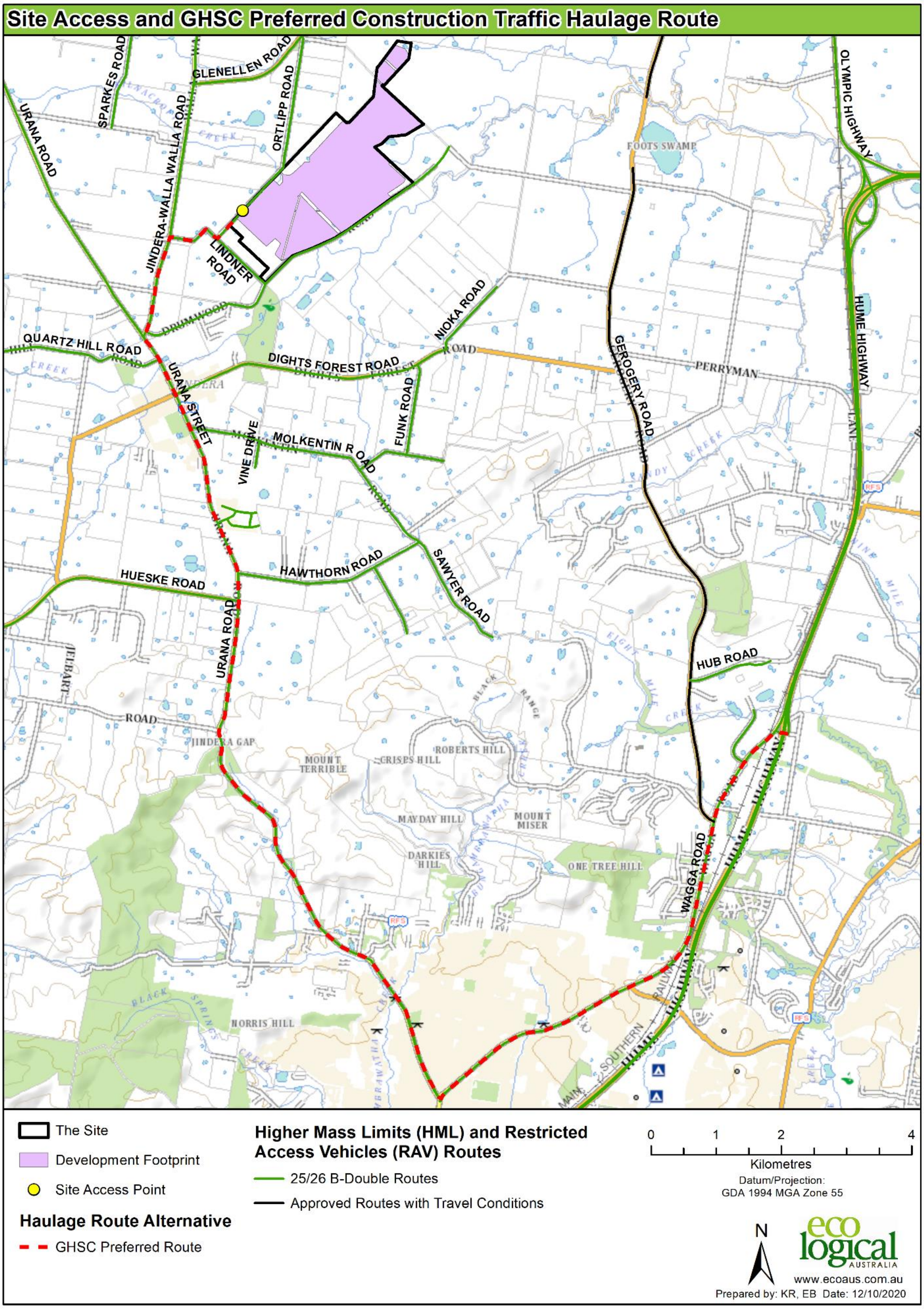

Figure 8-25: Greater Hume Shire Council recommended transportation route

The characteristics and classifications of these roads are provided in Table 8-39.

Table 8-39: Road classifications

Road	Speed Limit*	Lanes	Classification	Authority
Hume Highway	110 km/h	4 (divided asphalt road)	National	RMS
Olympic Highway	100 km/h	2 (undivided, asphalt road, 7 -8 m wide)	State	RMS
Wagga Road**	100 km/h	2 (undivided, asphalt road, 7 -8 m wide)	Regional	RMS/Greater Hume Shire
Gerogery Road	100 km/h	2 (undivided, asphalt road, 7 -8 m wide)	Regional	RMS/Greater Hume Shire
Glenellen Road	100 km/h	1 (undivided, asphalt road, 5 - 7 m wide)	Rural	Greater Hume Shire
Walla Walla Jindera Road	100 km/h	2 (undivided, asphalt road, 7.5 m wide)	Rural	Greater Hume Shire
Lindner Road	100 km/h	1 (undivided, gravel road, 5 -6 m wide)	Rural	Greater Hume Shire
Ortlipp Road	100 km/h	1 (undivided, gravel road, 5 -6 m wide)	Rural	Greater Hume Shire

* The posted speed limit on the Olympic Highway, Wagga Road and Gerogery Road is 100 km/h. The other roads noted above are not sign posted and are therefore assumed to have a rural speed limit of 100 km/h.

** Possible alternate route only

The intersection between Hume Highway and Olympic Highway is a seagull intersection. The intersection is properly lane marked with acceleration and deceleration lanes in both directions.

The intersection of Olympic Highway and Main Street (Gerogery Road) is a T-intersection with Olympic Highway as the major road. All other intersections along the proposed haulage route are priority-controlled intersections.

The NSW RMS have provided records of traffic counts on Hume Highway 4 km north of Albury. A breakdown of traffic counts is provided in Table 8-40.

Table 8-40: Average daily traffic counts for Hume Highway (Station ID: ALBSTC)

Location	Average daily traffic counts for Hume Highway by Year*		
	2016	2017	2018
Hume Highway – northbound	5,745 (28.16%)	5,848 (29.77%)	6,006 (29.04%)
Hume Highway – southbound	5,710 (28.98%)	5,884 (30.35%)	6,101 (29.54%)
Hume Highway – Total	**11,455 (28.57%)**	**11,732 (30.06%)**	**12,107 (29.29%)**

* Heavy vehicles volume is shown in brackets

Daily traffic flows recorded on the Hume Highway are within the capacity of the existing road infrastructure leaving spare capacity to accommodate additional traffic. The local roads are used by residents to access their properties. Existing traffic flows on the local roads within the vicinity of the Site are generally low and considered negligible in comparison to the Hume Highway.

Records of road traffic crashes within the vicinity of the Site were obtained from the NSW RMS. The records cover the five-year period from 01/01/2013 to 31/12/2017. Copies of the records are attached to the Road Safety Audit (Appendix H). There was one crash reported within this period at the Walla Walla Jindera Road and Jindera Road intersection. The crash involved a driver veering off the road and hitting a barrier/guide rail and there were no casualties reported.

8.8.3 Potential Impacts

Construction and operational access for staff and material deliveries to the Site shall be from the Hume Highway via Olympic Highway and the local road network, as described in Section 8.8.2. Access into the Site itself will be as identified in Figure 8-26. An additional emergency exit location shall be identified on Drumwood Road (to be confirmed at detail design).

Staffing arrangements during construction will depend on the staging of the development. Staffing figures are based on a 12-month construction period, however, depending on staging and resourcing this could extend to 18 months. Peak staffing estimates are provided in Table 8-41.

Table 8-41: Staffing estimates

Stage	Duration	Peak Staff (estimated)	Standard Hours of Work
Construction	12 months (indicative pending detail design)	200 (peak)	Monday to Friday 7.00am to 6.00pm Saturday 8.00am to 1.00pm No work on Sunday or public holidays.
Operation	30 years	Up to 10 full time positions would operate and maintain the plant	Monday to Friday 7.00am to 6.00pm

Material deliveries will depend on day to day construction requirements. Heavy vehicles into the Site are estimated to be up to 50 vehicles per day during construction activities (during a timeframe of up to 18 months). There is potential that peak truck movements could be as high as 60 to 100 vehicles in some situations such as due to weather delays, logistical delays, where the construction schedule pace is increased, or where a particular campaign or work-front requires a higher frequency of truck movements for a shorter duration. The construction traffic will consist of low loader trailers, truck and dog, and waste collection trucks. Overall non-material delivery related construction traffic movements during construction will be up to 40 light vehicles and 13 buses daily. It is expected that two construction staff would share a single light vehicle, however car-pooling and use of buses will reduce these daily movements.

One over-dimensional vehicle may be required over a 5-day period for the transportation of the transformer to Site during construction. Should over-dimensional vehicles be required, the proponent will investigate the procedures and requirements for special permits for oversized loads in the traffic management plan and in liaison with Transport for NSW.

Figure 8-26: Location of proposed access at the Site

Four other major projects are proposed, or have recently been approved, located within 50 km of the Proposed Development, including the proposed JSF (130 MW) located approximately 5.5 km north east of Jindera.

The JSF EIS (NGH Environmental, 2019) states that the proposed JSF access would be constructed off Urana Road and Walla Walla Jindera Road, with emergency and maintenance only access from Klinberg Lane and Ortlipp Road. The construction phase of the proposed JSF is anticipated to commence in 2020 and is expected to take approximately 12-18 months, following which the JSF is expected to operate for 30 years. If the Proposed Development and proposed JSF construction periods overlap, there is potential cumulative traffic impacts on Glenellen Road and Walla Walla Jindera Road. However, this would likely only be a proportion of the JSF traffic as part of the JSF site fronts Urana Road, which would be used for access to and from the south (NGH Environmental, 2019).

Other concurrent major projects would not use the local road network within vicinity of the Proposed Development, hence cumulative traffic impacts would be restricted to State roads, and the Hume Highway which has capacity for additional traffic flows if required.

During the operational phase of GSF, traffic will enter and exit the Site via Ortlipp Road. Large trucks will use the haulage route used in the construction phase. Additional vehicle movements associated with the operational phase up to 10 vehicles per day, (except during rare occurrences of up to 30 vehicles) are considered negligible.

8.8.4 Mitigation Measures

The independent road safety audit (Appendix H) identifies concerns regarding a lack of guardrails on culverts, uneven surfaces and a lack of warning/hazard signage. Further detail of the audit findings and mitigation measures accepted by the Traffic Engineer are provided in Table 8-42. General mitigation measures are provided in Table 8-43.

Table 8-42: Audit findings and accepted recommendations

Location	Audit Finding	Mitigation measure
Intersections of Olympic Highway and Main Street, Gerogery Road and Glenellen Road, Glenellen Road and Ortlipp Road, Glenellen Road and Walla Walla Jindera Road, Walla Walla Jindera Road and Lindner Road, and Lindner Road and Ortlipp Road	There will be increased truck/construction traffic along the routes accessing the site. Many of the drivers will also be unfamiliar with this area too. There is an increased risk of crashes at the intersection along the route.	Consideration should be given to installation of advance warning sign or truck crossing signs throughout the inter sections along the route. Consideration should be given to enforcing speed limit of 60 km/h on Glenellen, Linder and Ortlipp Road.
Intersection of Gerogery Road and Glenellen Road.	The intersection will be used by materials delivery and staff vehicles to access the Site. There will be increased construction traffic and it is expected that heavy vehicles will be making right turns from Gerogery Road to Glenellen Road. There is a risk that vehicles might be waiting on the Glenellen Road to exit and trucks turning right might veer off into the ditch to avoid waiting	A guardrail should be installed at the intersection with reference to AUSTROADS Guide to Road Design – Part 6 Roadside Design, Safety and Barriers. The delineator is recommended to be installed at the ends of the guardrails.

Location	Audit Finding	Mitigation measure
	vehicles. There is a risk of vehicles crashing or veering into the ditch, resulting in serious injury.	
Guardrail along Gerogery Road	There is a guardrail present approximately 700m north of the Gerogery Road and Glenellen Road intersection. The guiderail is missing the guiding arrow at the end and seems to have insufficient height. The end of the guardrail has a bull nose treatment. There is a risk that with the increased traffic movements, trucks passing this bend may crash into the guardrail and veer off into the ditch.	Consideration should be given to review the guard rail in relation to current standards.
Culvert on Glenellen Road, near the intersection of Glenellen Road and Ortlipp Road.	The culvert is protected by a barrier on one side, but has no protection on the other side. There is a risk delivery trucks passing each other on the section of the route may veer over the culvert and in the ditch resulting in serious injury.	Consideration should be given to installing W-beam guiderails with delineators on both sides of the culvert. This would assist in preventing vehicles driving into the culvert should the drivers leave the main carriageway. Greater Hume Shire Council has installed guide posts on the sides of the roads and it would be up to Council to determine if further measures are required.
Intersection of Glenellen Road and Ortlipp Road	The intersection of Glenellen Road and Ortlipp Road may be used by heavy and staff vehicles. There is a risk that the intersection is not wide enough to pass a vehicle waiting to turn or an approaching vehicle on Ortlipp Road. The width of Ortlipp Road may not be wide enough and pose difficulty for passage of heavy vehicles. There is a risk of side swipe crash which may result in injury. There is slight grade when approaching the intersection from Ortlipp Road. Vehicles waiting to turn may roll back into vehicle behind and large trucks will take longer to exit as starting on an uphill grade. The insufficient width of the intersection may result in vehicles having a side swipe crash causing serious injury. Vehicles rolling back may result in a rear end crash.	Consideration should be given to conducting construction vehicle swept path at the intersection and localised widening to accommodate increased construction and heavy vehicles traffic.
Intersection of Walla Walla Jindera Road and Lindner Road	The intersection of Walla Walla Jindera Road and Lindner Road will be used by all construction vehicles and workers vehicles, as the main access to the solar farm. The main movements will be left turn from Walla Walla Jindera Road to Lindner Road and right turn from Linder Road to Walla Walla Jindera Road. There is some restricted sight distance from Lindner Road to the north (192m due to the brow of the hill). There is a risk that driver will enter or exit Lindner Road when there is insufficient sight distance to oncoming vehicles. This can result in a T-bone crash at this location leading to serious injury.	Consideration should be given to installation of advance warning sign or truck crossing signs.

Location	Audit Finding	Mitigation measure
Lindner Road and Ortlipp Road	Construction vehicles will be accessing the solar farm site from Lindner Road and Ortlipp Road intersection. The road surface of Lindner Road and Ortlipp Road has loose gravel, overgrown grass and is not completely sealed. There is an increased risk for vehicles turning right out on to Linder Road to skid on the surface especially when it is wet. The condition of the intersection may further deteriorate due to the passage of heavy and light vehicles. This can result in vehicles skidding out of control, resulting in a T-bone crash causing serious injury.	Consideration should be given to the development of a maintenance plan to maintain road conditions to a level suitable for the proposed access and for all vehicle types.
Linder Road between the Walla Walla Jindera Road intersection and the Lindner Road and Ortlipp Road intersection.	There are two sharp bends that currently have no traffic signage to alert drivers of the upcoming sharp bends. There is the risk drivers steering off the road while making the turn. This may result in a head on crash with a tree, resulting in serious injury.	Frangible hazard marker posts are recommended to be installed along the bends.
Site access off Ortlipp Road	The sole access point for the Proposed Development has an uneven surface with loose gravel and areas of ponding. There is a risk of light vehicles and motorcycles losing control when driving over this rough surface/pod or when swerving to avoid them. There is an increased risk of a side swipe crash resulting in injury.	The access point will require upgrade to accommodate heavy vehicles.

Table 8-43: Mitigation measures for transport

Impact	Environmental safeguard	Timing*		
		C	O	D
Intersection and road upgrades	The proponent should consult with Greater Hume Shire Council regarding the proposed safety upgrades on the local road network to allow for the construction and operation of the GSF. The safety upgrades would be subject to detailed design and constructed to the relevant Australian road design standards. Safety upgrades outlined above in Table 8-42, are envisaged to have no impacts upon environmental values within the road reserves, however, upon detailed design, if impacts are considered encroach upon these environmental values within the road reserve, additional biodiversity and heritage assessments would be required.	Design		
Oversized loads	Should transportation of oversize loads be required, the proponent will investigate the procedures and requirements for special permits for oversized loads in the traffic management plan and in liaison with Transport for NSW. The proponent should liaise with the Special Permits Unit in Glen Innes (contact 1300 656 371) early in the process to assess the appropriateness of the route and identify potential issues.	✓	✓	

***** C = Construction, O = Operation and D = Decommissioning

8.9 Water

8.9.1 Introduction

This water resources assessment has been developed in accordance with the requirements of the SEARs for the Proposed Development. The assessment included the following steps:

- Desktop assessment
- Field investigations
- Consideration of existing environmental conditions
- Flood modelling (Appendix I)
- Impact assessment
- Identification of mitigation and management measures.

The SEARs require:

- *an assessment of the likely impacts of the development (including flooding) on surface water and groundwater resources (including Bowna Creek and Dead Horse Creek, drainage channels, wetlands, riparian land, farm dams, 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*
- *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).*

Further details of OEH's requirements regarding water resources are provided in the SEARs (Appendix A) and are addressed, as relevant, in following sections. A summary of key responses to the SEARs is provided as a cross referencing table in Appendix J.

8.9.2 Existing Environment

The Proposed Development is located within the upper alluvial area of the Murray River, part of the Upper Murray River Catchment. This catchment includes all tributaries that flow into the Murray River upstream of Hume Weir, located to the east of Albury on the NSW/Victoria border (NSW DPI Water, 2018). The catchments urban centres include Khancoban, Corryong and Tumbarumba in the east and Jindera in the west. Downstream of Hume Dam is the Central Murray Catchment. This transitions into the Lower Murray Catchment at Wentworth in South Western NSW where the Murray and Darling Rivers meet, before flowing into the Southern Ocean.

The Proposed Development occurs in the area covered by the *Water Sharing Plan for the Murray Unregulated and Alluvial Water Sources 2011* which commenced on 30 January 2012 (NOW, 2012). The Site is located within the Hume Surface Water Source.

8.9.2.1 Surface Water

The Proposed Development is in the western portion of the Upper Murray River catchment and the Site comprises the following sub-catchment areas (Figure 8-27):

- 367.5 ha in the Kilnacroft Creek sub-catchment

- 18.7 ha in the Dead-Horse sub-catchment
- 12.3 ha in the Bowna Creek sub-catchment.

Kilnacroft Creek drains the central portion of the Site (Figure 8-28). The source of Kilnacroft Creek is located upstream of the Proposed Development and passes through the Development Footprint as a third order stream (Strahler, 1952). A small second order unnamed tributary enters Kilnacroft Creek from the south-west within the Development Footprint, before Kilnacroft Creek turns in a north-east direction, exiting the Site on its eastern boundary. Downstream of the Site, Kilnacroft Creek flows in a north-easterly direction for approximately 5 km, before joining Dead Horse Creek. Downstream of this, the channel is named Bowna Creek.

Dead Horse Creek intersects the Site in the north-east corner. At this point, Dead Horse Creek is a third order stream. Upstream of this point, Dead Horse Creek drains the rural landscape of the area. Downstream of the Site, Dead Horse Creek flows for approximately 5 km before joining with Kilnacroft Creek.

The channel of Bowna Creek flows along the southern boundary of the Site, and while the channel itself does not intersect with the Site, a small portion of its catchment resides within the Proposed Development (Figure 8-27, Figure 8-28).

All channels in the vicinity and within the Site are heavily influenced by in-channel farm dams and significantly modified riparian vegetation. The channels were dry during field investigations and appear to be largely ephemeral with minimal bank delineation and limited riparian vegetation. As such they resemble broader watercourses in grass-covered paddocks, rather than streams with defined bed and banks. There are also a number of farm dams throughout the Proposed Development, which hold small quantities of water following rainfall.

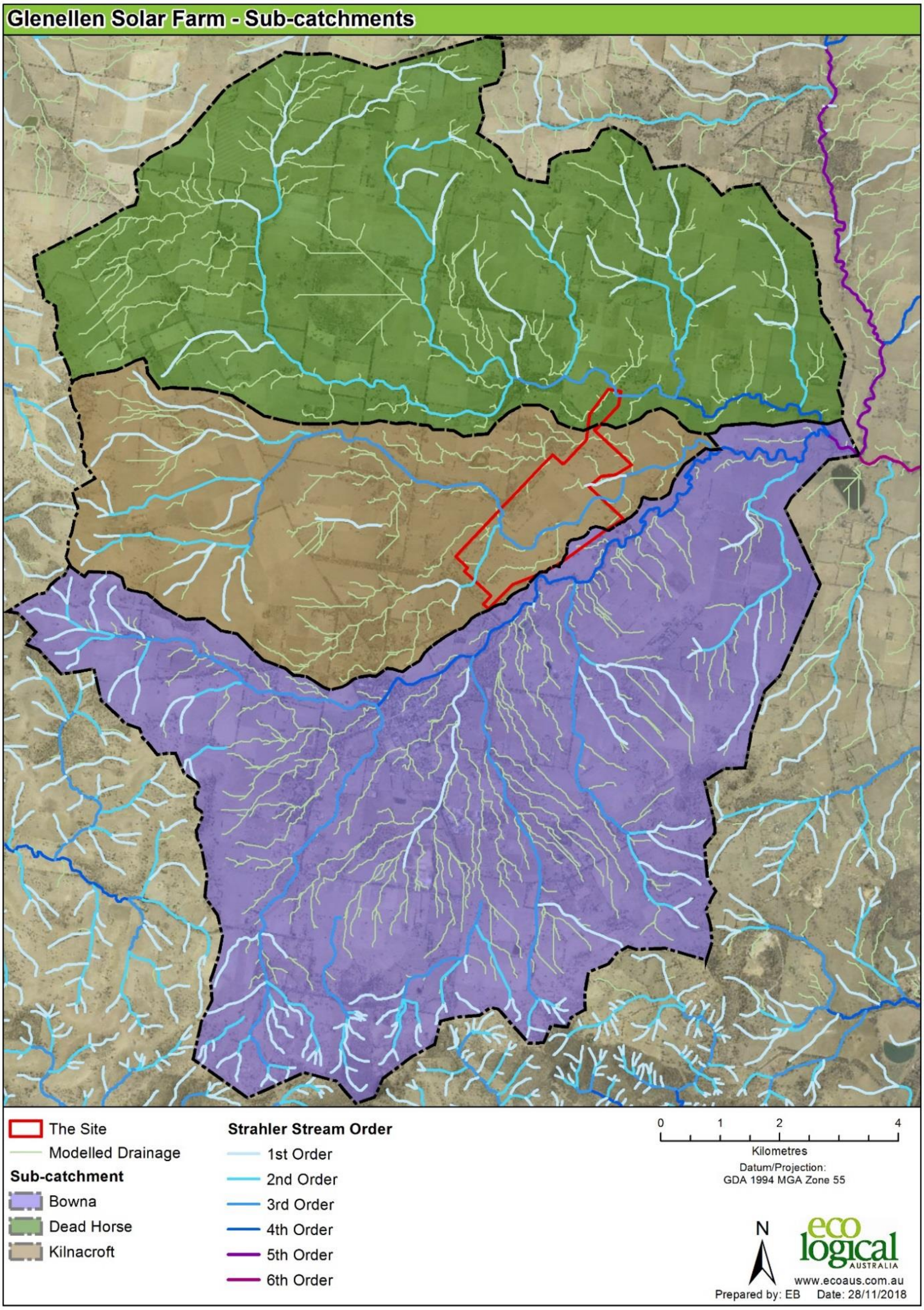

Figure 8-27: Location of the Site relative to the sub-catchments that drain it

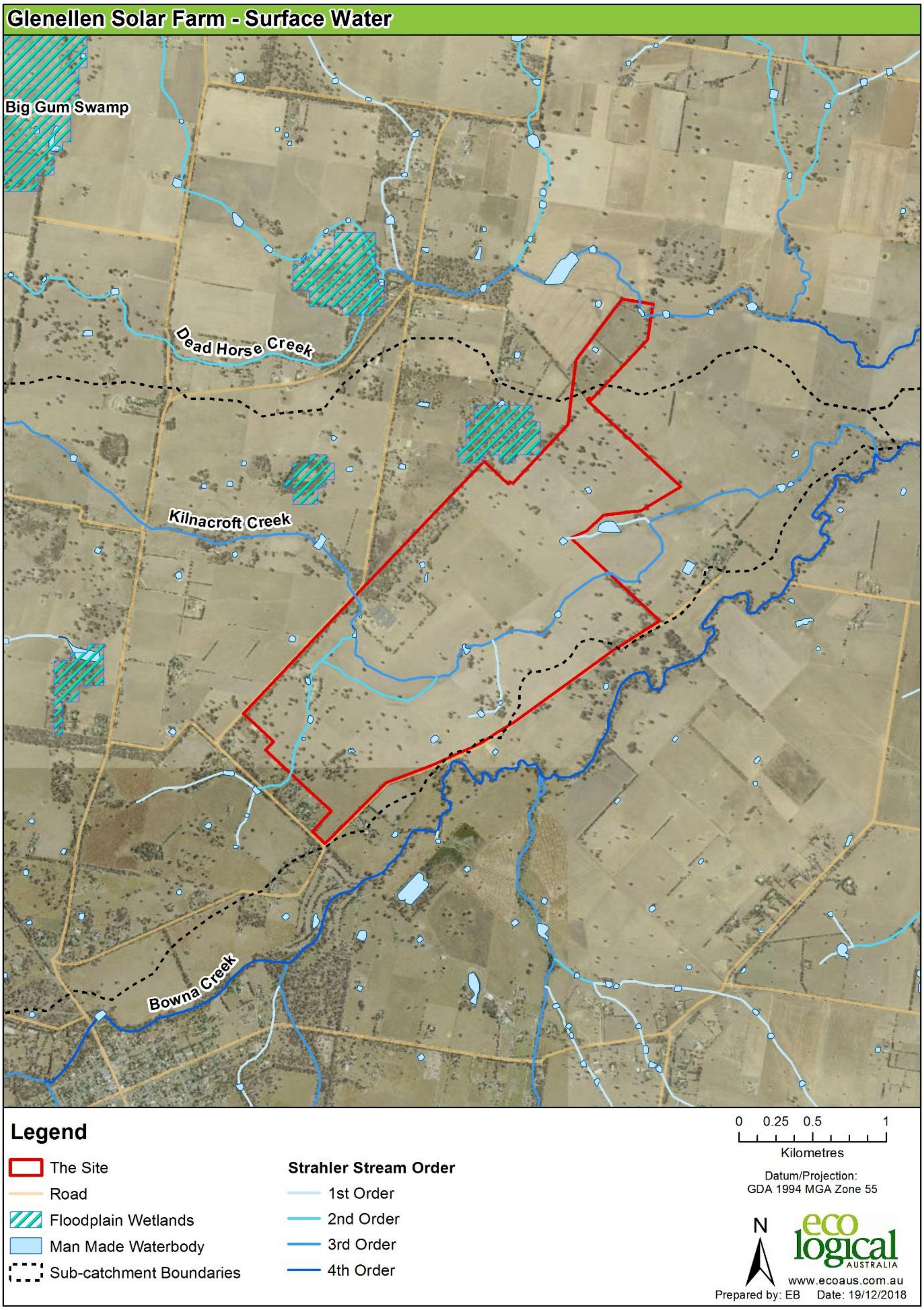

Figure 8-28: Surface water resources - drainage lines, wetlands, farm dams and Strahler Stream Order

8.9.2.2 Water Quality

Water Quality Objectives for Uncontrolled Streams within the Murray River (DECCW, 2006a) include:

- Maintaining or improving the ecological condition of waterbodies and their riparian zones over the long term
- Aesthetic qualities of waters
- Maintaining or improving water quality for activities such swimming, boating and wading
- Protecting water quality to maximise the production of healthy livestock
- Protecting the quality of waters applied to crops and pasture
- Protecting water quality for domestic use in homesteads, including drinking, cooking and bathing
- Protecting the quality of drinking water drawn from the raw surface and groundwater sources before any treatment: and
- Protecting water quality so that it is suitable for the production of aquatic foods for human consumption and aquaculture activities.

The current investigations were unable to identify any routine water quality monitoring that has been undertaken within or surrounding the Site. An assessment of regional water quality was undertaken as part of the assessment of the Basin Plan water quality targets by the NSW DPI Water for the period 2007 – 2012 (Mawhinney, W. and Muschal, M, 2015). This showed mixed results for several sites located within the Upper Murray (upland) Water Quality zone. These sites, located on the Tooma and Murray River upstream of Hume Weir, achieved an overall rating of good for water quality, very good for Total Phosphorus, Total Nitrogen, Dissolved Oxygen and pH, poor for turbidity measured in the laboratory and very poor for turbidity measured in the field. This assessment was undertaken based on water quality targets set by the Basin Plan, however, when compared to the Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines, all water quality variables were below the relevant guideline.

8.9.2.3 Hydrology

The nearest downstream flow gauging station is Bowna Creek at Yambla (401015), located approximately 6 km east of the Site, draining a catchment area of 280 km^2. Operational since 1974, the average monthly flow is 858 ML, with the highest average monthly discharge occurring during August (2,415 ML) and the lowest in April (90 ML).

Water access at the Proposed Development is in accordance with the *Water Sharing Plan for the Murray Unregulated and Alluvial Water Sources 2011 (Commenced 2012)*. River Flow Objectives for Uncontrolled Streams within the Murray River (DECCW, 2006b) include:

- Protect natural water levels in pools of creeks and rivers and wetlands during periods of no flows
- Protect natural low flows
- Protect or restore a proportion of moderate flows ('freshes') and high flows
- Maintain or restore the natural inundation patterns and distribution of floodwaters supporting natural wetland and floodplain ecosystems
- Mimic the natural frequency, duration and seasonal nature of drying periods in naturally temporary waterways
- Maintain or mimic natural flow variability in all streams

- Maintain rates of rise and fall of river heights within natural bounds
- Maintain groundwater within natural levels and variability, critical to surface flows and ecosystems
- Minimise the impact of instream structures.

8.9.2.4 Flooding

The overall topography of the Site and surrounding areas is generally undulating, sloping downward in a west-to-east direction, with mostly cleared and relatively flat areas within the Site (Figure 8-29). Localised, relatively high elevation areas are located within the north, south and south-west outside the boundary of the Site (Figure 8-29). Primary overland flow paths and catchment watersheds were delineated using the ArcHydro Tool within the ArcGIS ESRI software.

Flood modelling was then undertaken to assess the impacts of the Proposed Development using rain-on-grid water level modelling in HEC-RAS (Hydrologic Engineering Center's River Analysis System) software (U.S. Army Corps of Engineers, 2008; Appendix I). The modelling assesses the likely effects of the Proposed Development on flooding, and the potential impacts of any changes on the downstream environment. Such modelling provides an opportunity to examine likely flood behaviour and to form an opinion as to whether the Proposed Development is likely to have a significant impact on flood behaviour and downstream flood risks. Further details of the model configuration are presented in Appendix I.

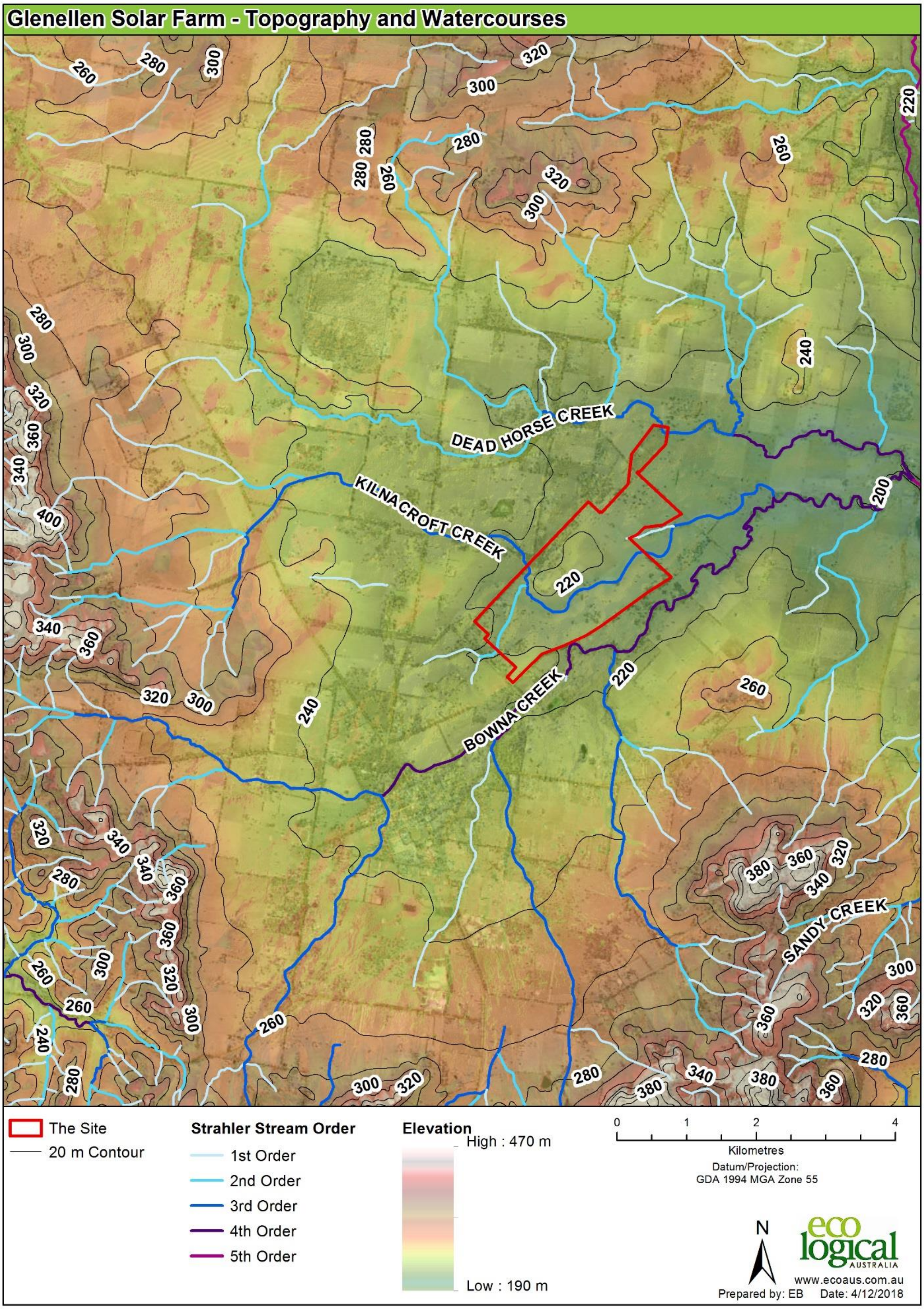

Figure 8-29: Topography and watercourse

Inundation extent maps for existing conditions were generated for 10% AEP, 5% AEP, 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP and 0.1% AEP (1 in 10-year, 20-year, 50-year, 100-year, 200-year, 500-year and 1000-year ARI respectively).

The Regional Flood Frequency Estimation Model (RFFE) (http://rffe.arr-software.org/, Ball *et al*., 2016) was applied as a comparison of predicted peak flow rates downstream of the Site. The RFFE model predicted a 1% AEP (100-year ARI) peak discharge of 199 m^3/s, with a lower confidence limit (5% confidence level) of 77 m^3/s. As a comparison, the HEC-RAS direct precipitation model yielded a discharge rate of 149 m^3/s at the same location, which is approximately 25% lower than the median RFFE prediction but lies within a reasonable range of values given the significant floodplain storage and out-of-bank flow in the upstream catchment.

Figure 8-30 through to Figure 8-36 shows the maximum inundation depths and extents for the selected events across the Site (represented by a red polygon) and surrounding area in existing conditions.

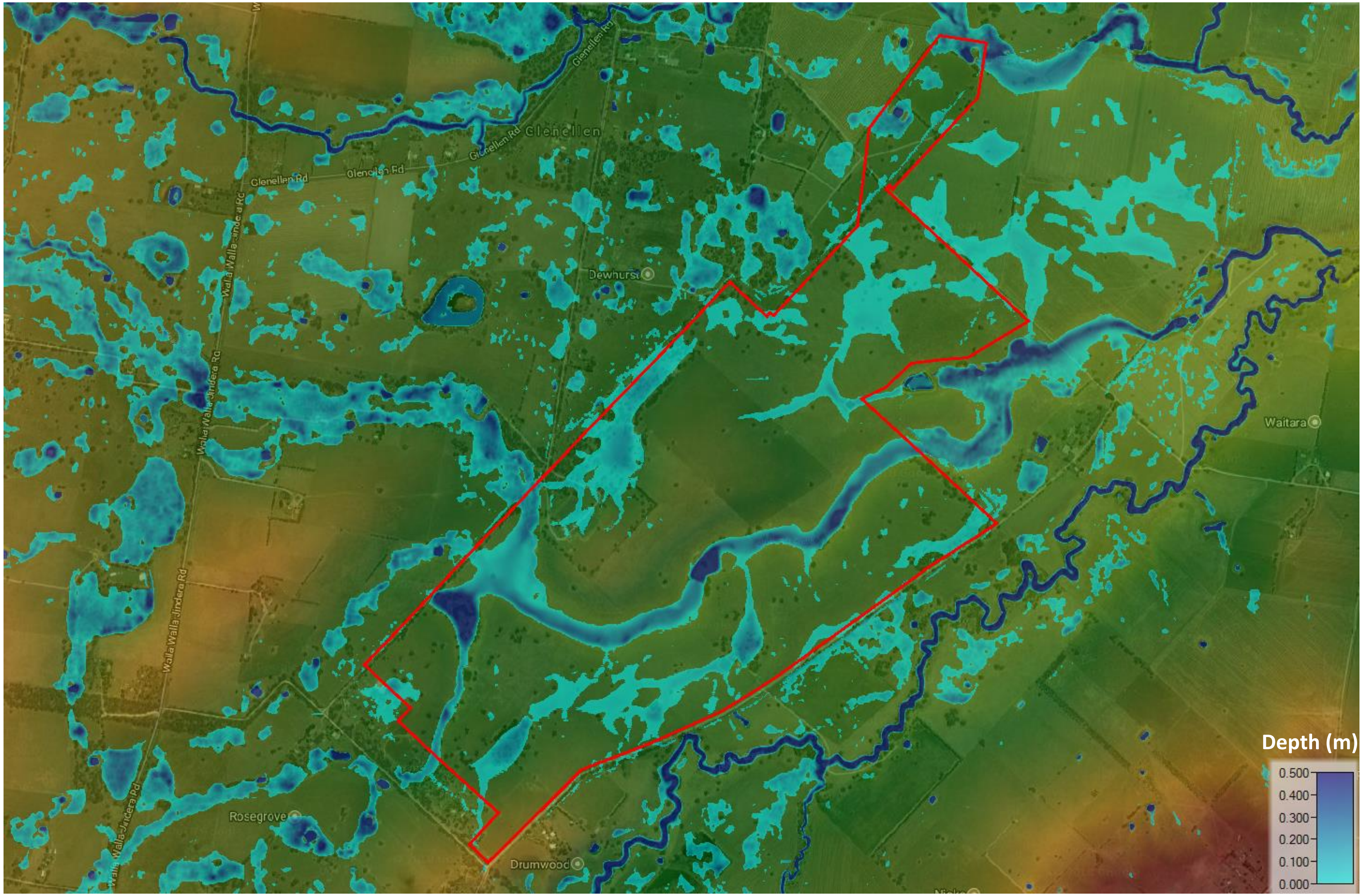

Figure 8-30: 10% AEP (10-year ARI) flood extent map for existing conditions

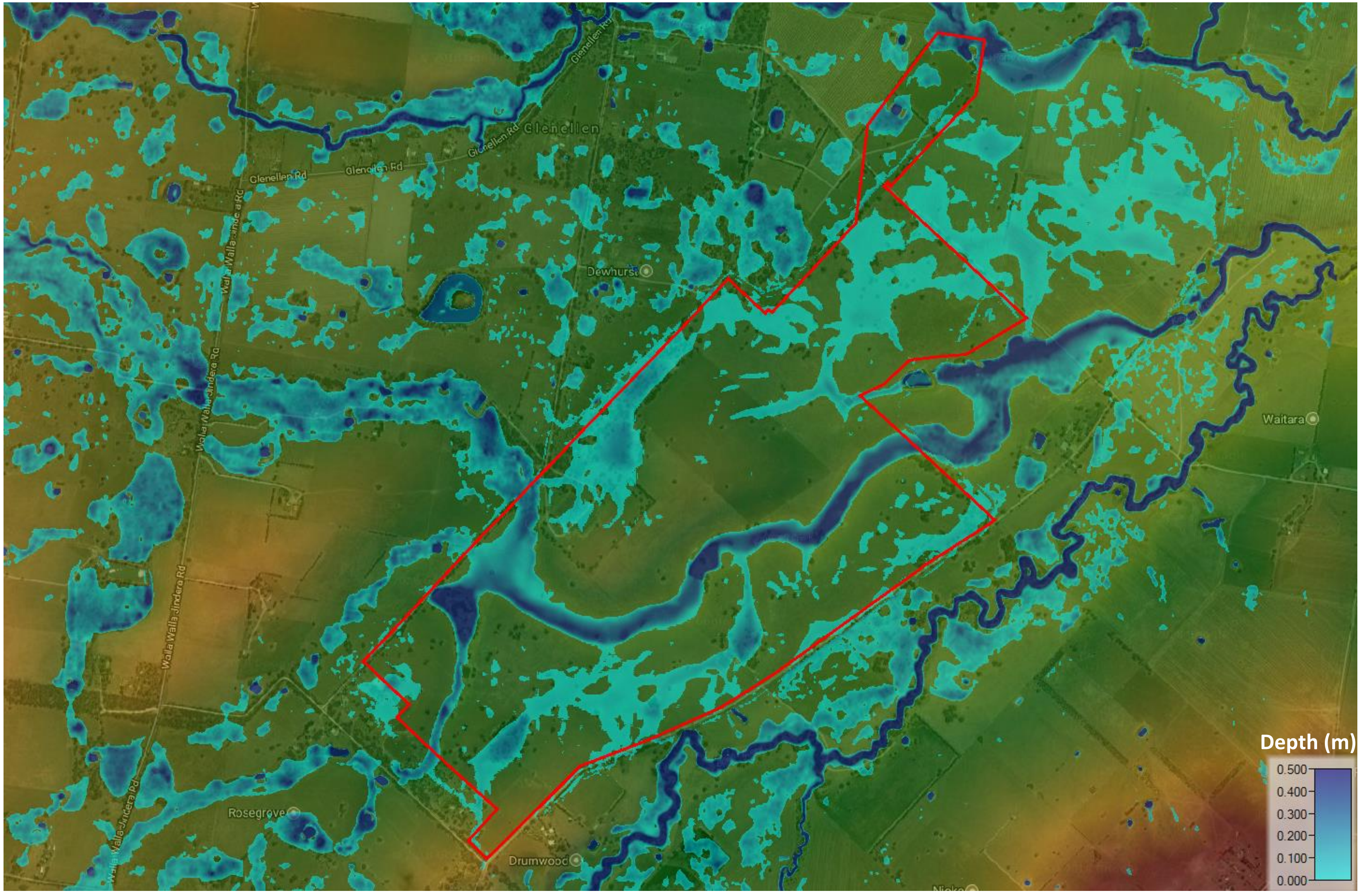

Figure 8-31: 5% AEP (20-year ARI) flood extent map for existing conditions

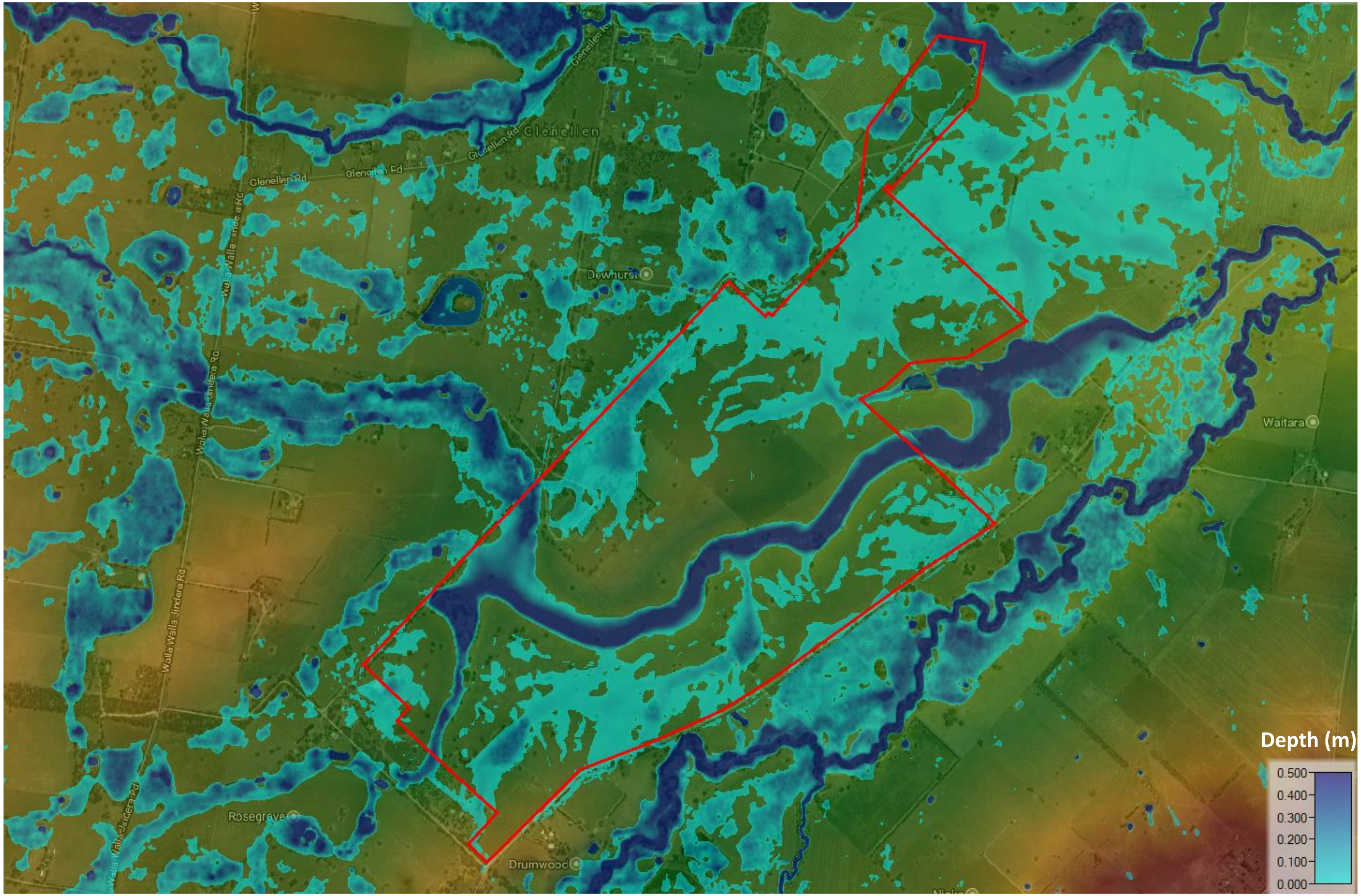

Figure 8-32: 2% AEP (50-year ARI) flood extent map for existing conditions

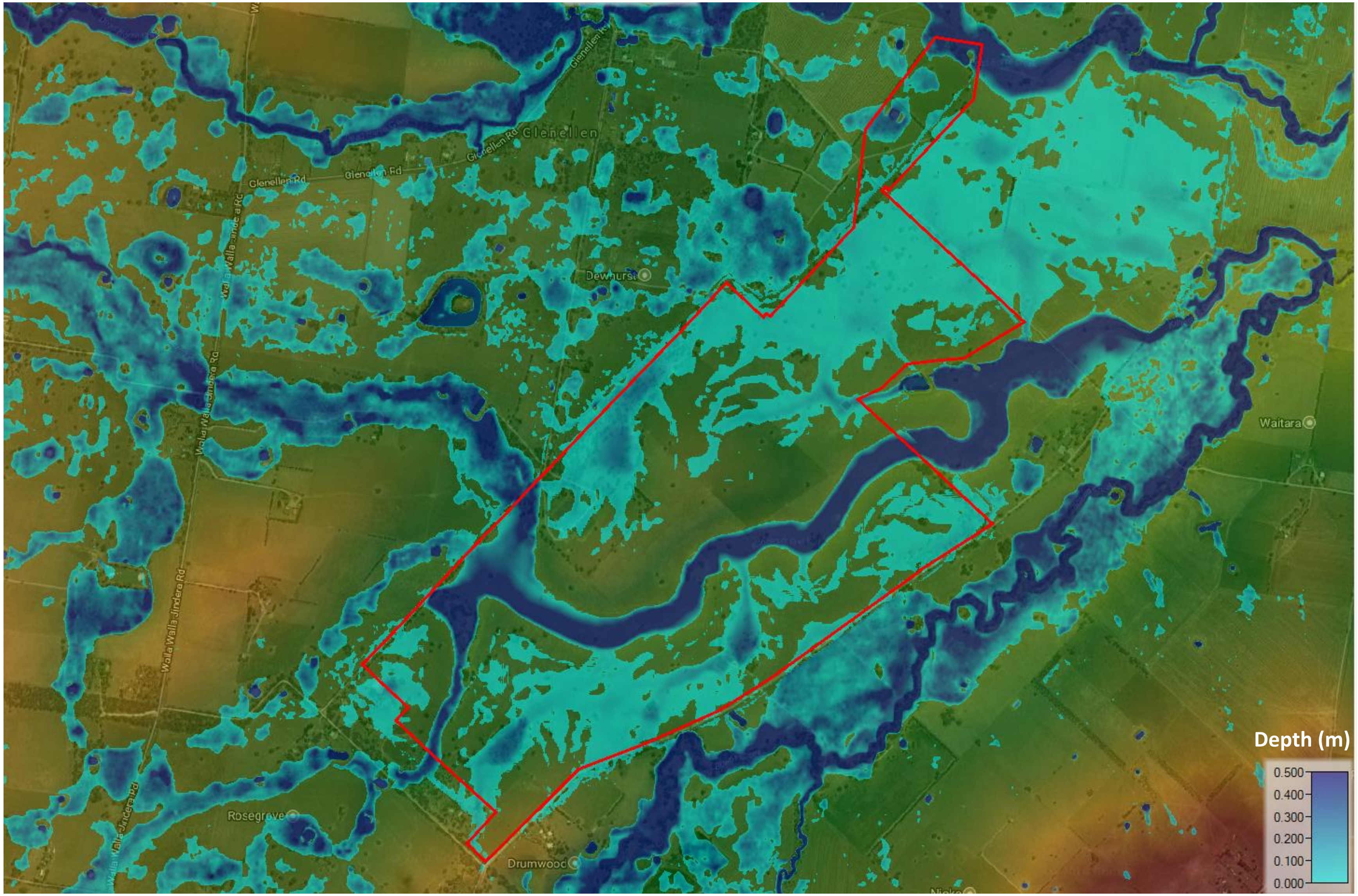

Figure 8-33: 1% AEP (100-year ARI) flood extent map for existing conditions

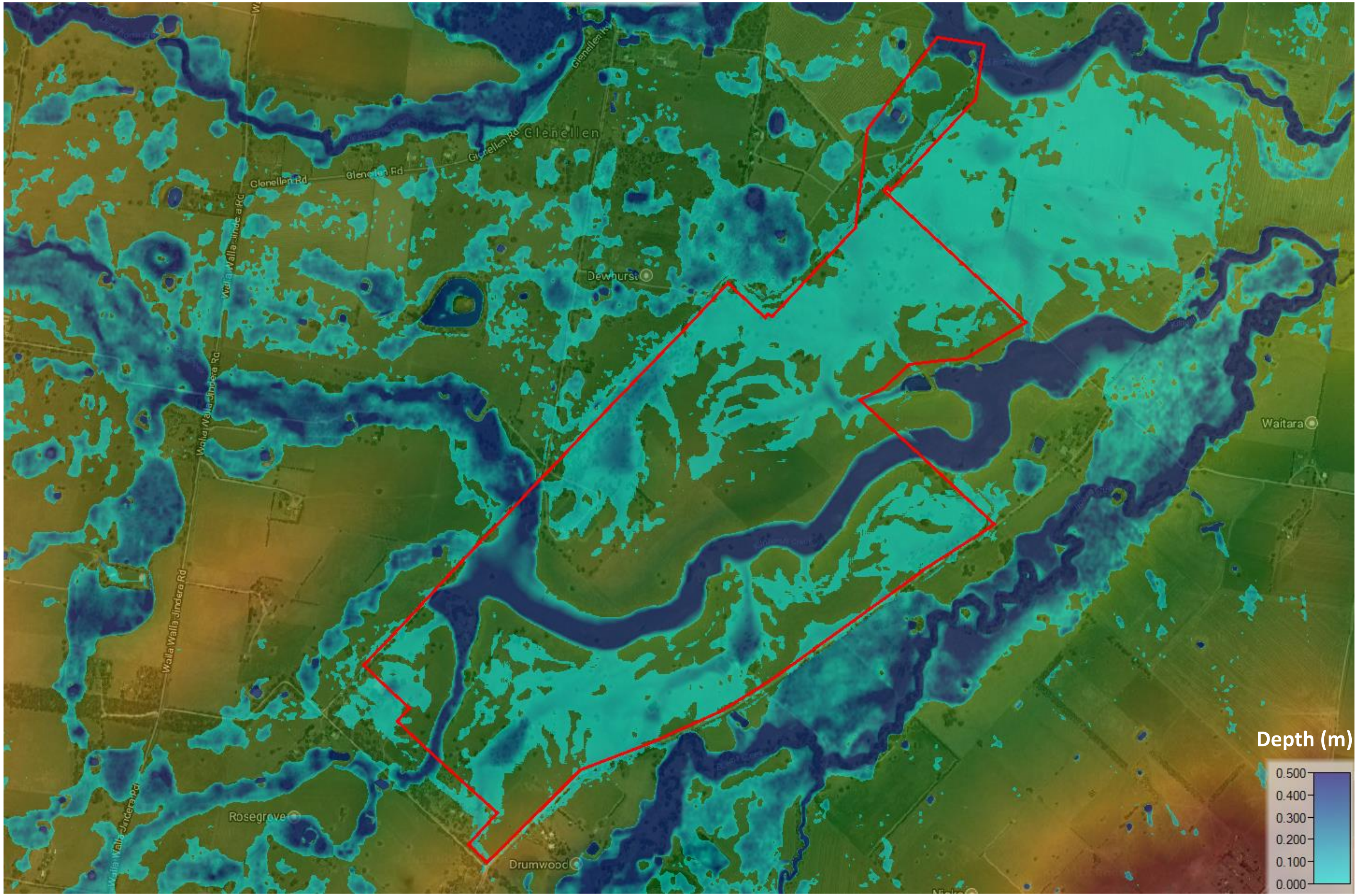

Figure 8-34: 0.5% AEP (200-year ARI) flood extent map for existing conditions

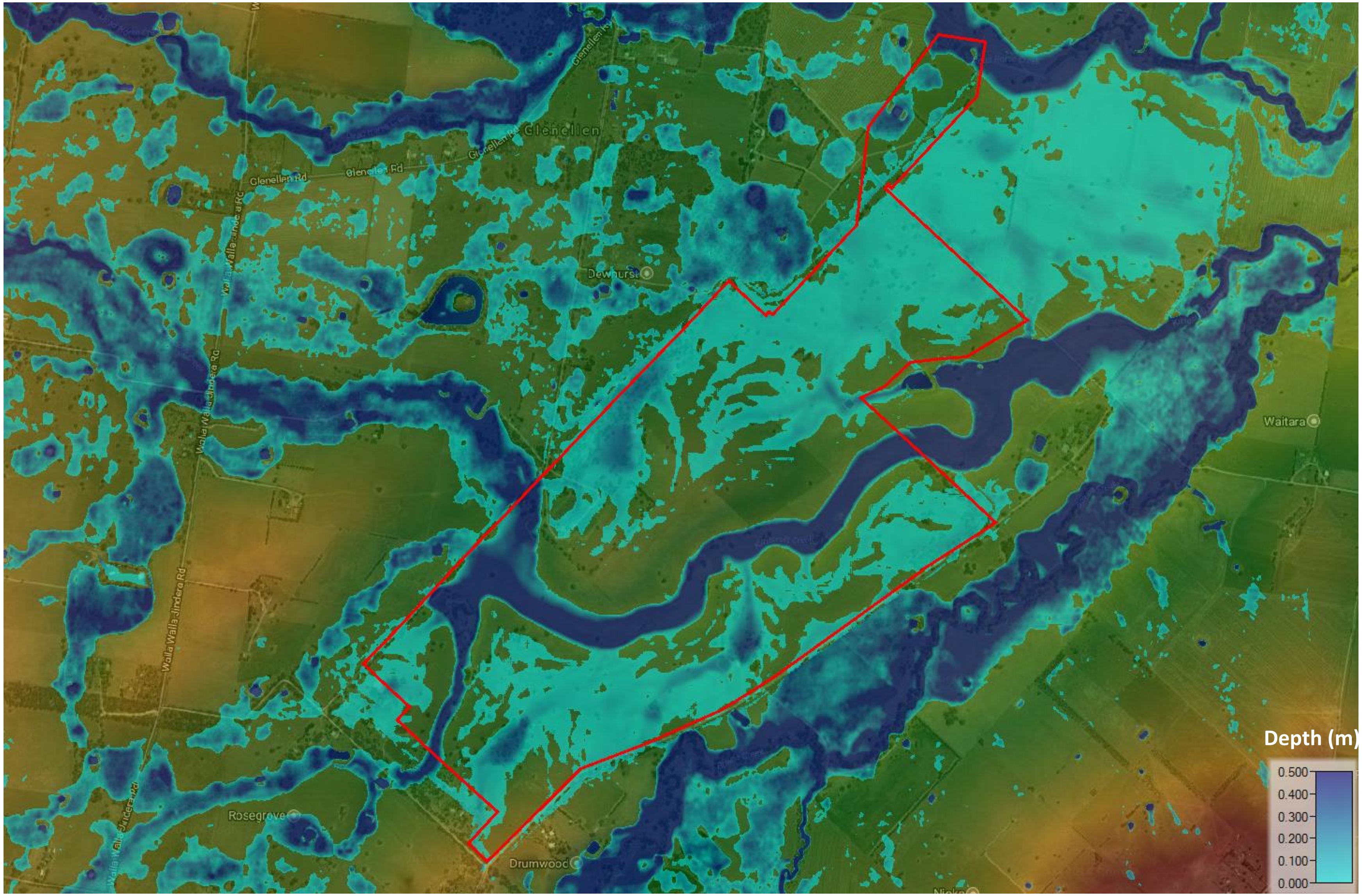

Figure 8-35: 0.2% AEP (500-year ARI) flood extent map for existing conditions

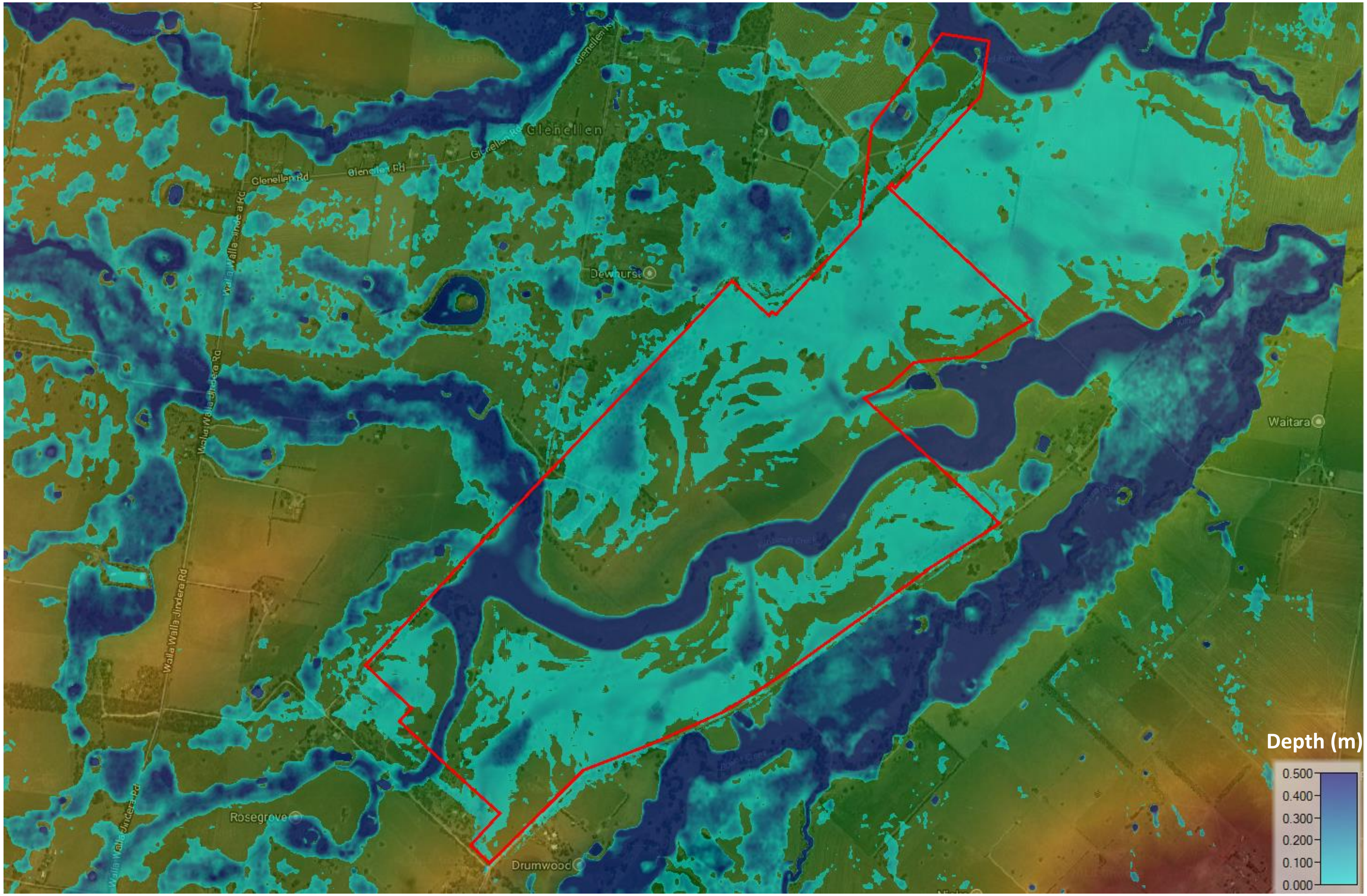

Figure 8-36: 0.1% AEP (1,000-year ARI) flood extent map for existing conditions

8.9.2.5 Groundwater

The Jerilderie 1:250,000 Geological Map (and associated geophysical survey) and Geoscience Australia's Region Surface Geology maps indicates the regional geology within the Site is largely poorly consolidated alluvial sediments, with underlying granites that are variably exposed. These regional lithologies are not known for significant mineral occurrences.

Much of the region is covered by alluvial deposits of sands, silts, clays and gravels, which have been derived from the well-developed sediment and granitic regolith typical for the area. The majority of the Site comprises of the Silurian Jindera Granite (part of the Jindera Suite), whilst a small band of the Cainozoic Shepparton Formation (unconsolidated clay, silt, sand and gravels) is present towards the north of the Site.

No hydrogeological studies have been undertaken within the Site. Therefore, the hydrogeological setting for the Proposed Development has been based on the available hydrogeological data from the WaterNSW real-time data website (WaterNSW, 2018) and the BoM Groundwater Explorer database (BoM, 2017), which identify a single groundwater source within the Site, described as "NSW Murray Darling Basin Fractured Rock Groundwater - Lachlan Fold Belt".

Interrogation of the WaterNSW website indicates no groundwater monitoring bores within the Site; however, a 5 km radius search for surrounding bores revealed 13 registered bores which access groundwater from the Lachlan Fold Belt fractured rock aquifer (Table 8-44 and Figure 8-37).

Table 8-44: Registered bore details near the Site

Bore #	Bore ID	E (m)	N (m)	Type	Total depth (m)	SWL* (mbgl)	Salinity (ppm)	Yield (L/s)
01	GW033260	496101	6030578	Unknown	24.4	-	-	-
02	GW027834	496051	6030578	Unknown	31.1	-	-	-
03	GW045999	494849	6027897	Stock, Domestic	57.9	-	-	0.08
04	GW003704	495325	6027035	Stock, Domestic	138.7	54.8	Fresh	0.25
05	GW505402	497062	6025934	Stock, Domestic	40.0	-	2,500	-
06	GW028093	497356	6025834	Stock	166.1	-	Good	-
07	GW048245	498158	6025342	Stock	5.5	-	-	-
08	GW048271	495404	6021428	Unknown	3.0	-	-	-
09	GW505515	492692	6020989	Stock, Domestic	132.0	36.5	-	-
10	GW044117	496606	6020781	Stock	3	-	Soft	-
11	GW027052	489618	6020529	General Use	58.5	-	-	-
12	GW068573	491822	6020453	Stock, Domestic	36.5	21.9	-	0.04
13	GW060971	495154	6019517	Stock, Domestic	41.5	-	-	-

*SWL = standing water level (within the fractured basalt aquifer).

Surrounding groundwater levels within the fractured rock aquifer are moderately deep, and range between approximately 54.8 mbgl north east of the Site, and 21.9 mbgl south of the Site.

Groundwater quality information was available for four registered bores within the proximity of the Proposed Development area. The available data describes water quality from the fractured basalt aquifer as “Good” and ‘Fresh” with one reporting a salinity level of 2,500 ppm, approximately 4,500 uS/cm (WaterNSW, 2018).

Available groundwater yield records suggest the surrounding fractured rock aquifer has low productivity, with all three registered bores containing yield data (Table 8-44) reporting groundwater yields of < 0.3 L/s.

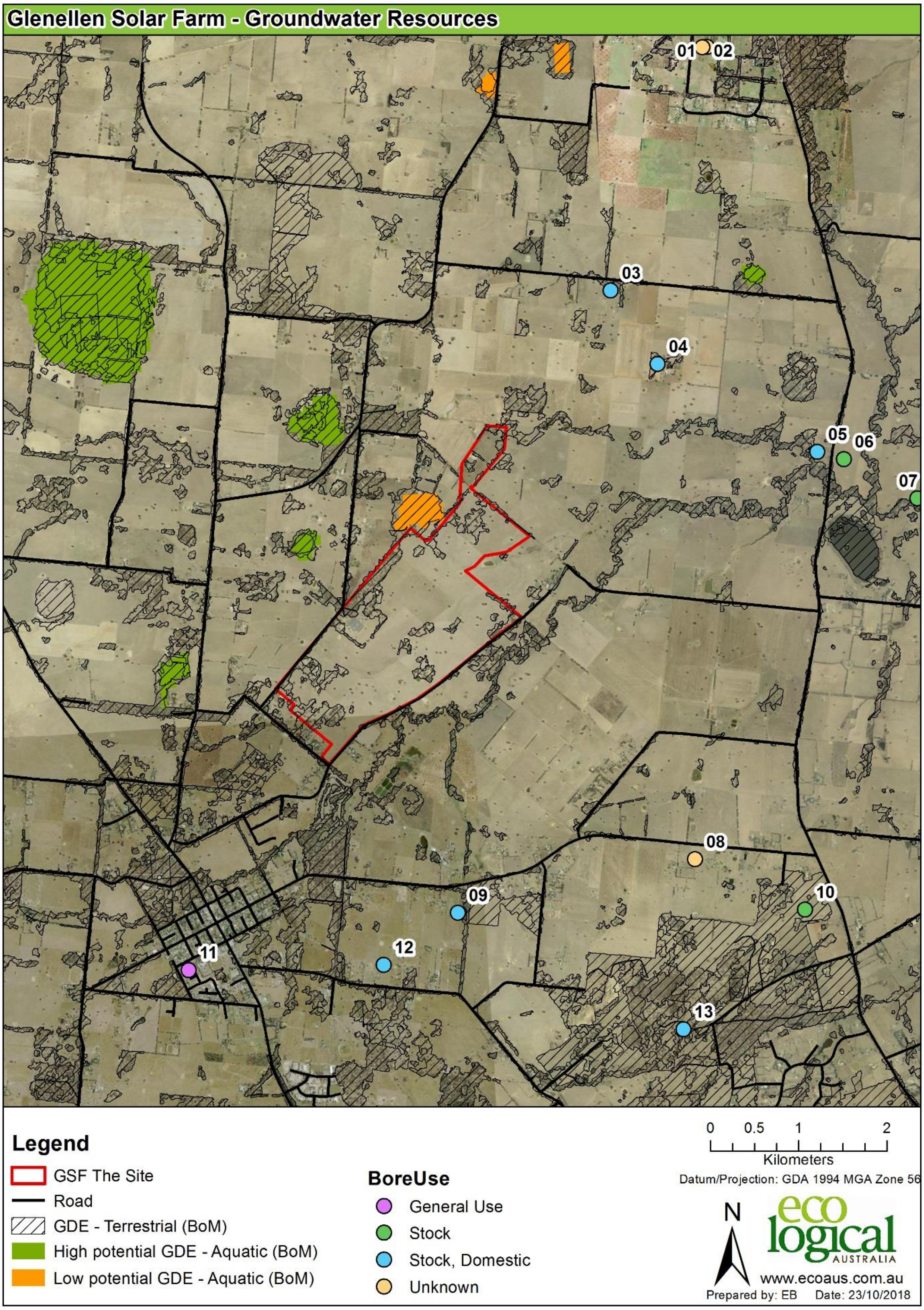

Figure 8-37: Groundwater resources. Labels represent Bore number outlined in Table 8-44. Source: WaterNSW, 2018; BoM, 2017.

8.9.2.6 Aquatic Ecosystems

Streams and waterways

Most waterways within the Site are ephemeral and were dry during the assessment period. Due to historic agricultural practices, they resemble broad open watercourses, rather than channels with a defined bed and bank. As such, they lack aquatic vegetation and are dominated by pasture grasses which are consistent with the surrounding paddocks. Pools persist in some higher order streams (i.e. 3rd order and above), and these pools become larger and more permanent downstream of the Site boundary. Within the Site, permanent water is located only within artificially deepened holes, or farm dams, along the watercourses. Notwithstanding their poor condition and ephemeral nature, these are classified as KFH under the FM Act (NSW DPI, n.d.a).

Riparian land

The Site includes 2nd and 3rd order streams (Strahler, 1952). Riparian vegetation and the riparian zones generally throughout the Site are substantially degraded, having been cleared, grazed, and modified to support agricultural activities. The Natural Resources Access Regulator (NRAR) recommends a Vegetated Riparian Zone (VRZ) width based on the watercourse order as classified under the Strahler system for ordering watercourses in order to prevent degradation of riparian land (NRAR, 2018).

Where watercourses within the Site meet the definition of a ‘river’ under the WM Act, VRZs shall be considered as per the recommended riparian corridor widths. Where a watercourse does not exhibit the features of a defined channel with bed and banks, the NRAR may determine that the watercourse is not waterfront land for the purposes of the WM Act. As such, VRZs shall be established in accordance with NRAR riparian corridor guidelines, adopting the rationale provided below (Table 8-45).

Where a watercourse was defined as a river, NRAR’s guidelines outline an Averaging, which allows non-riparian works / activities to be carried out within the outer riparian corridor provided that the average width of the riparian zone can be achieved over the length of the watercourse within the development site. Under this rule, the outer 50% of the riparian corridor may be used for development lots, infrastructure, etc, provided that an equivalent area connected to the riparian corridor is offset on the site. This approach may provide a suitable outcome for some streams on site, after a merit-assessment based on riparian functionality of the watercourse and considering the highly modified and degraded condition of riparian vegetation on the site

If the proposed solar panels or construction works encroach into the outer half of the riparian corridor. NRAR’s guidelines for offsetting encroachments at a 1:1 ratio to maintain the average riparian width should be considered. The encroachment and offsetting areas may be further refined to incorporate other constraints such as flood inundation areas.

Table 8-45: Required width of riparian exclusion zones as determined by stream order

Stream Order	Watercourse type[1]	NRAR Guideline VRZ Width (each side of channel)	Adopted VRZ width (each side of channel)[2]	Justification
1st	Any permanent flowing first order watercourse	10 metres	0 metres	1st order streams in the Site do not have defined channels, beds or banks.

Stream Order	Watercourse type[1]	NRAR Guideline VRZ Width (each side of channel)	Adopted VRZ width (each side of channel)[2]	Justification
2nd	Any second order watercourse where there is a defined channel where water flows intermittently or permanently.	20 metres	0 metres	2nd order streams in the Site do not have defined channels, beds or banks
3rd	Any third order watercourse where there is a defined channel where water flows intermittently or permanently.	30 metres	20 metres[2]	Riparian zones in the Site are highly disturbed and degraded. In addition, the beds and banks of these channels are poorly defined. Therefore, in consultation with NRAR, a reduced VRZ may be adopted either side of the thalweg.

[1] As classified under the Strahler system of ordering watercourses and based on current 1:25,000 topographic maps combined with DEM analysis.
[2] Merit assessment based on riparian functionality of the river, lake or estuary, the Site and long-term land use

Wetlands

A small number of floodplain wetlands identified in the Wetland GIS of the Murray-Darling Basin Series 2.0 (Murray Darling Bain Authority, 2018) are located within 10 km of the Site (Figure 8-28). These wetland features include 'canegrass swamp tall grassland wetlands' and 'Blakely's Red Gum – Yellow Box grassy tall woodlands' in depressions (BoM, 2018). The floodplain wetlands near the Site are predominantly upstream of the Site, or are located on adjacent flow paths. Furthermore, these vegetation communities are considered as being partially groundwater dependent and hence rely upon both surface and groundwater (BoM, 2018, see following section).

Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDEs) are ecosystems that have their species composition and natural ecological processes wholly or partially determined by groundwater (Geoscience Australia, 2017). Types of ecosystems that can rely upon groundwater include:

- Terrestrial vegetation that show seasonal or episodic reliance on groundwater
- River base flow systems which are aquatic and riparian ecosystems in or adjacent to streams/rivers dependent on the input of ground water for base flows
- Aquifer and cave ecosystems
- Wetlands
- Estuarine and near-shore marine discharge ecosystems
- Fauna which directly depend on groundwater as a source of drinking water of that live within water which provide a source.

A search of the BoM GDE Atlas (BoM, 2017), identified terrestrial vegetation as the only potential GDE within the Site (Figure 8-37). This was corroborated by ground surveys. Terrestrial vegetation types identified by BoM (2017) as potential GDEs within the Site are presented in Table 8-46.

Table 8-46: Potential Terrestrial GDE vegetation types

Terrestrial GDE* name	Potential
Blakely's Red Gum – Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	High potential GDE
Riparian Blakely's Red Gum – box – shrub – sedge – grass talk open forest of the central NSW South West	High potential GDE
Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	High potential GDE
Speargrass - Redleg Grass derived grassland on hills in the Jindera to Holbrook region, southern NSW	High potential GDE
Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling)	High potential GDE
White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion	Low potential GDE

* Sourced from Murray Murrumbidgee regional studies by BoM, 2017

The BOM assessment is based on regional studies involving remote sensing, vegetation community mapping and groundwater level data. Terrestrial vegetation is described, and potential impacts assessed in accordance with the BAM in Section 8.2 and Appendix C.

The *Water Sharing Plan for the Murray Unregulated and Alluvial Water Sources 2011* identified no high priority GDEs within the Site. It also concluded that due to regional geology and the moderate depth of the water table, that surface and groundwater within the region were 'not highly connected'.

Threatened aquatic species, populations, and communities

A search of threatened aquatic species databases indicate that the following aquatic species, communities, or populations have the potential to occur within the Site:

- *Nannoperca australis* (Southern Pygmy Perch) - NSW FM Act endangered - Modelled as occurring within the site and within 10 km radius of the Site
- *Galaxias rostratus* (Flathead Galaxias*)* - NSW FM Act and EPBC Act critically endangered – Species or species habitat likely to occur within area and has been modelled as occurring within the Site and within 10 km radius of the Site under the FM Act
- *Macquaria australasica* (Macquarie Perch) - EPBC endangered – Species or Habitat may occur within 10 km radius of Site
- *Euastacus armatus* (Murray Crayfish) - NSW FM Act vulnerable – Modelled as occurring within 10 km radius of Site
- *Litoria raniformis* (Southern Bell Frog) – EPBC vulnerable - Species or species habitat known to occur within 10 km radius of Site
- *The aquatic ecological community in the natural drainage system of the lower Murray River drainage system* – NSW FM Act EEC – This EEC includes the Murray River below Hume Weir.

The likelihood of these species and the EEC occurring within the Site are considered in Table 8-47.

Table 8-47: Likelihood of occurrence table.

Scientific Name	Common Name	Status			Source	Habitat Potential
		EPBC Act	FM Act	BC Act		
Galaxias rostratus	Flathead Galaxias	CE	CE	-	FSC, 2008a	**No.** Suitable habitat not present. No NSW BioNet Atlas records within 10 km of Site.
Macquaria australasica	Macquarie Perch	E	-	E	DoE 2018a	**No.** Suitable habitat not present. No NSW BioNet Atlas records within 10 km of Site.
Maccullochella peelii	Murray Cod	V	-	-	DoE 2018b	**No.** Suitable habitat not present. No NSW BioNet Atlas records within 10 km of Site.
Nannoperca australis	Southern Pygmy Perch	-	E	-	FSC, 2008b	**Unlikely**. Prefers slow-flowing waters, and still, vegetated habitats in small streams, lakes, billabongs and wetlands. "The Murray River population has contracted to a number of billabongs and small creeks in the Albury area". Unlikely to be present, given the fragmented nature of artificial waterholes in the area. No NSW BioNet Atlas records within 10 km of Site.
Litoria raniformis	Growling Grass Frog	V	-	E Species credit species	DoE 2018c	**Unlikely.** Habitat includes emergent vegetation, including *Typha sp.*, *Phragmites sp.* and *Eleocharis sp.*, in or at the edges of still or slow-flowing water bodies Suitable habitat not present. No NSW BioNet Atlas records within 10 km of Site.
Amphibromus fluitans	River Swamp Wallaby-grass	V	-	V Species credit species	DoE 2018d	**Unlikely**. Found mostly in permanent swamps (NSW OEH 2013h) and also lagoons, billabongs, dams and roadside ditches. Suitable habitat not present. No NSW BioNet Atlas records within 10 km of Site. Low potential to occur in road verges.
Lowland Murray River Endangered Ecological Community	Lowland Murray EEC	-	E	-	NSW DPI, 2007	**Unlikely**. The Site occurs within the defined area of this EEC, but there is no permanent water apart from that residing in constructed habitat, which precludes it from inclusion in the EEC.

The ephemeral nature of waterways occurring within the Site are generally unsuitable for Murray Cod and Macquarie Perch which require permanent deep pools (DoE 2018a; DoE 2018b).

Flathead Galaxias occur in slow-moving or still water bodies like wetlands and lowland streams, and in a range of habitats including rock and sandy bottoms and aquatic vegetation. Southern Pygmy Perch prefer slow-flowing waters, and still, vegetated habitats in small streams, lakes, billabongs and wetlands. The ephemeral nature of water within the Site, coupled with the highly fragmented nature of pools in the form of farm dams, would preclude the presence of these species within the Site.

Growling Grass Frog occurs along permanent still or slow flowing water bodies with aquatic and fringing vegetation cover (DoE, 2018c). There is unsuitable habitat in the Site because riparian areas are generally cleared, and the streams are highly ephemeral.

8.9.3 Potential Impacts

The Proposed Development has been assessed as unlikely to have significant impacts on water resources. There is low potential for indirect impacts to occur during the construction, operation and decommissioning stages through the process of erosion and sedimentation. The Proposed Development has been designed to minimise potential impacts to water resources. A minimum number of appropriately located vehicular access and cable crossings are proposed for Kilnacroft Creek, all other infrastructure shall be located away from aquatic habitats and potential areas of Key Fish Habitat in accordance with the proposed VRZ's identified in Table 8-45.

Potential impacts to water quality, hydrology and aquatic ecosystems for both surface and groundwater resources during construction (including decommissioning) and operational phases are considered in the following sections.

8.9.3.1 Water Quality

Construction

The proposed construction and decommissioning works involve a range of activities that disturb soils and could potentially lead to sediment laden runoff, affecting local waterways during rainfall events. These activities include:

- Excavations for the construction of internal roads and support buildings, construction laydown and parking areas
- Ground preparations associated with the installation of PV panels and inverters
- Ground preparations for overhead cable installation
- Trenching for below ground cable installation
- Soil compaction and reduced permeability in areas of hardstand and access tracks.

At the time of writing, the revised ANZECC water quality guidelines for the Murray Darling had not yet been released and advice was received to use the ANZECC 2000 guidelines (*pers. comm.* Commonwealth Department of Agriculture and Water Resources). All surface water streams associated with the Site are considered Upland Rivers (ANZECC, 2000). Water quality trigger levels for the protection of Upland stream in south-eastern Australia are presented in Table 8-48. Given the lack of baseline data in the area, these guidelines could form monitoring targets through the construction phase of the project.

Table 8-48: ANZECC trigger values for the protection of upland aquatic ecosystems

Indicator	Trigger value	Comment
Total Phosphorus	20 µg/L	The construction phase has potential to impact on Total Phosphorous concentrations through the erosion of phosphorus bound to soil and sediments from cleared areas into surface water streams, potentially leading to nuisance algal growth and Blue-Green Algal blooms. Measures will be put in place to minimise phosphorous inputs to streams during construction and operation of the proposed solar farm.
Total Nitrogen	250 µg/L	The project has potential to impact on Total Nitrogen concentrations during soil disturbance associated with the construction phase, potentially leading to nuisance algal growth and Blue-Green Algal blooms. Measures will be put in place to minimise nitrogen inputs to streams during construction and operation of the proposed solar farm.
Turbidity	2-25 NTU	The project has potential to impact on Turbidity through increased sediment inputs, particularly during construction, leading to higher suspended sediment loads and decreased light penetration. Measures will be put in place to minimise increased turbidity during construction and operation of the proposed solar farm.
Salinity	30-350 µS/cm	The project is considered unlikely to influence salinity concentrations.
Dissolved Oxygen	90-110%	Provided that phosphorus, nitrogen and turbidity are affectively managed, the project is considered unlikely to influence dissolved oxygen saturation.
pH	6.5-8.0	The project is considered unlikely to influence pH.

The use of fuels, lubricants, herbicides and other chemicals during construction pose a risk of surface and groundwater contamination in the event of a spill. However, given the lack of surface – groundwater connectivity and the low slopes over most of the Site, assuming proper spill minimisation and response procedures are followed, there would be minimal risk of contamination to surface and groundwater.

Operation

Operational impacts to water quality are considered negligible, though this will be dependent on the nature and extent of hard access tracks and hardstand areas. The post-construction land use as a solar farm would likely reduce the potential for impacts to water quality, compared to current agricultural land use practices undertaken in the immediate vicinity of the Site. A reduction in stocking rates would also reduce erosion, sedimentation and riparian disturbance at the Site and hence impacts on surface water. In addition, a decrease in fertiliser use and stocking rates would reduce the potential for nutrients to enter surface waters.

During operation, grass cover will be maintained across the Site both between and under the panel rows to provide groundcover. The groundcover will stabilise soils preventing soil erosion and will assist in localised water penetration. Should mowing be used as a method to control grass growth under the solar panels, the grass will be directly mulched back onto the soil surface therefore building soil organic matter and enhancing carbon capture while improving water infiltration.

Although the installation of PV panels presents a large impervious surface standing above the ground at approximately 2 m, the flat shape of the panels, and the separation distance between rows (approximately 4 m - 16 m) will quickly return rainfall as runoff to the natural ground to allow surface penetration and/or runoff to occur in a typical manner (Appendix I). Disturbed areas would be revegetated in order to stabilise the ground surface. Previous research on the effects of solar arrays on catchment runoff has shown there to be a negligible influence of solar panels on runoff, assuming ground cover under the panels is maintained in a similar state to before panel installation (Cook and McCuen, 2013). These authors noted that if the ground under the panels was gravelled or bare, then peak discharge and runoff increased significantly. The GSF shall maintain grassland vegetation under the proposed panels in a similar condition to current, with any disturbed areas revegetated and monitored regularly in order to stabilise the ground surface. Therefore, discharge and runoff would be unlikely to increase post-development. This would prevent soil erosion and, thus, sedimentation impacts to surface water.

The installation of tracking rather than a fixed panel system allows water to drip onto different areas of the ground as the panels track east to west daily, instead of continually being focussed on the same dripline and will increase exposure to sunlight beneath the panels. Some soil scarring could occur under the panels resulting from sudden and intense rainfall events which may, if left untreated, result in soil erosion and potential impacts to surface water and this should be monitored and remediated if necessary. Increased localised runoff from more impervious areas (access tracks, inverters, operations compound (buildings and hardstand) and the Substation) may generate some additional sediment that would require management.

The operational use of fuels and other chemicals on site pose a minor risk to surface and groundwater contamination in the event of a spill. Chemicals commonly used onsite would include fuels, lubricants and herbicides. Again, the risk of contamination to surface and groundwater would be minimal assuming timely spill response procedures are followed (see Section 8.5).

This assessment has concluded there to be limited potential for surface and groundwater quality impacts associated with the construction, operation and decommissioning of GSF. Even so, ELA recommends water quality monitoring be considered in the construction and operational environmental management procedures.

8.9.3.2 Water Use

Construction

It is estimated that the Proposed Development will require approximately 44 ML (pers. comm. Zenviron/Trina EPC) of potable and/or non-potable water for dust suppression and other construction purposes (Table 8-49). This water would be sourced as described below:

- Potable water acquired from offsite sources under commercial arrangements
- Non-potable water from existing farm dams, rainwater tanks, or Kilnacroft and Dead Horse creeks, under existing Water Sharing Plan licence conditions, for construction and/or operational activities including dust suppression on public roads.

Table 8-49: Approximate maximum water consumption during construction

Activity	Volume (L)	No. Times per Week	No. of Weeks	Total (L)
Dust suppression	40,000	5	90	18,000,000
Panel cleaning	40,000	1	90	3,600,000
Road dust suppression	40,000	5	90	18,000,000
Potable water	40,000	1	90	3,600,000
Fire fighting	90,000	1	5	450,000
Total				**43,650,000**

Water access and use is authorised under the WM Act. The volumes of surface water likely to be harvested and used on-site for construction of the Proposed Development would not exceed 10 % of the annual surface water total permitted under surface water harvesting rights, and therefore would not require a surface water access licence under the plan.

Subsurface construction disturbances would be limited to trenching, shallow excavation, and piling activities during the construction phase of the development. Interference of the groundwater resource during construction is considered to be negligible. This is because construction activities at a depth of approximately 1.6 m is unlikely to intersect groundwater at the Site (Table 8-44). Therefore, the Proposed Development is not considered likely to influence groundwater systems or the water balance of the Site, nor would an aquifer interference approval as per the *NSW Aquifer Interference Policy* be required.

Operation

Surface water use during the operational phase of the Proposed Development would be negligible and sourced from retained existing surface water dams or via suitable and appropriately licenced water sources. Water required for staff amenities shall be sourced from on-site rainwater tanks or delivered to site as potable water. Groundwater will not be used during the operational phase.

Panel cleaning requirements depend on prevailing weather conditions at the Site. Some solar plants are never cleaned, while others require multiple cleanings per year. Given the vegetated landscape and climate associated with the Site (approximately 71 days of rain ≥ 1 mm average per annum; BoM, 2018b), resulting in generally low levels of dust, it is anticipated that the Proposed Development may require infrequent cleaning. If required, it is anticipated that water requirements for panel cleaning would be secured through commercial arrangements with a local water supply company and trucked to Site. The volumes of water used for individual panel cleaning will be insufficient to pose an erosion threat, given the proposed erosion and sedimentation mitigation discussed below.

No operational activities would affect groundwater at the Site. No groundwater is proposed to be sourced during operation of the Proposed Development.

8.9.3.3 Hydrology and Flooding

Within the Australian context, the development of PV solar farms has generally been shown to have a very small and easily managed impact on rainfall runoff and downstream hydrology. This is because the vast majority of infrastructure associated with PV solar farms is located above the ground on posts which are driven into the ground with minimal disturbance to the surface or existing groundcover vegetation (Cook & McCuen, 2013).

To determine the impact of the Proposed Development on flooding, indicative temporary construction pads and substation areas were added to the rain-on-grid model as raised terrain to assess potential changes in flood hydrology. These have been placed in arbitrarily chosen locations for modelling purposes and may not be constructed in those locations (subject to detailed design). The solar array itself was not included in the modelling, as the ground elevations, vegetation, and infiltration properties of the soil in the array area will likely remain unchanged in the proposed condition. Because the array is located in locally ponded areas only without significant flow conveyance, the piers would not affect the flow significantly and have not been modelled.

The model does not include culverts, bridges, or other hydraulic structures and no structures are currently known to significantly affect the hydrology and hydraulics of the Site. In addition, farm dams were not incorporated in the terrain model used for the hydraulic model development. This represents a conservative modelling approach, however, given their small size and number, their presence in the landscape is likely to have minimal influence on flow rates and water levels during flooding.

Given that the installed solar panels will be raised above the ground (and therefore not an obstruction to the flow of water across the Site) and the driven piles will be water resistant and will not impede the movement of any overland flow, our assessment is that no significant change is envisaged in the hydrological regime due to the proposed development activities within the Site.

Figure 8-38 shows the indicative temporary building pads within the Site (represented by a red polygon) along with the location of the comparison cross section for water surface elevations and flood hydrographs. In the immediate vicinity of the building pads, stormwater runoff will be routed around the pad, and some localised increases in water surface elevation are predicted. These impacts will be managed onsite through the implementation of the stormwater management plan. The localised effects do not propagate to the boundary of the Site and no hydrological or hydraulic effects on neighbouring lands are anticipated.

Figure 8-39 shows the maximum velocities under 1% AEP (1 in 100-year ARI) peak flood conditions (with the Site represented by a red polygon). A localised Figure 8-40 and Figure 8-41 shows a comparison of maximum water surface elevations between existing and proposed conditions and the flood hydrographs for the selected events under existing and proposed conditions, respectively.

The differences in discharge rate and water surface elevation resulting from the presence of the pads are indiscernible in the figures but can be observed in the tabulated results in Table 8-50 and Table 8-51, which show a comparison between the existing and proposed conditions at the comparison location ("XS Location" shown in Figure 8-38) for 10% AEP (10-year ARI), 2% AEP (50-year ARI) and 1% AEP (100-year ARI) events. The differences between the existing conditions and the proposed conditions indicate that there will be negligible impacts to the off-site flow rates and water levels under design storm conditions.

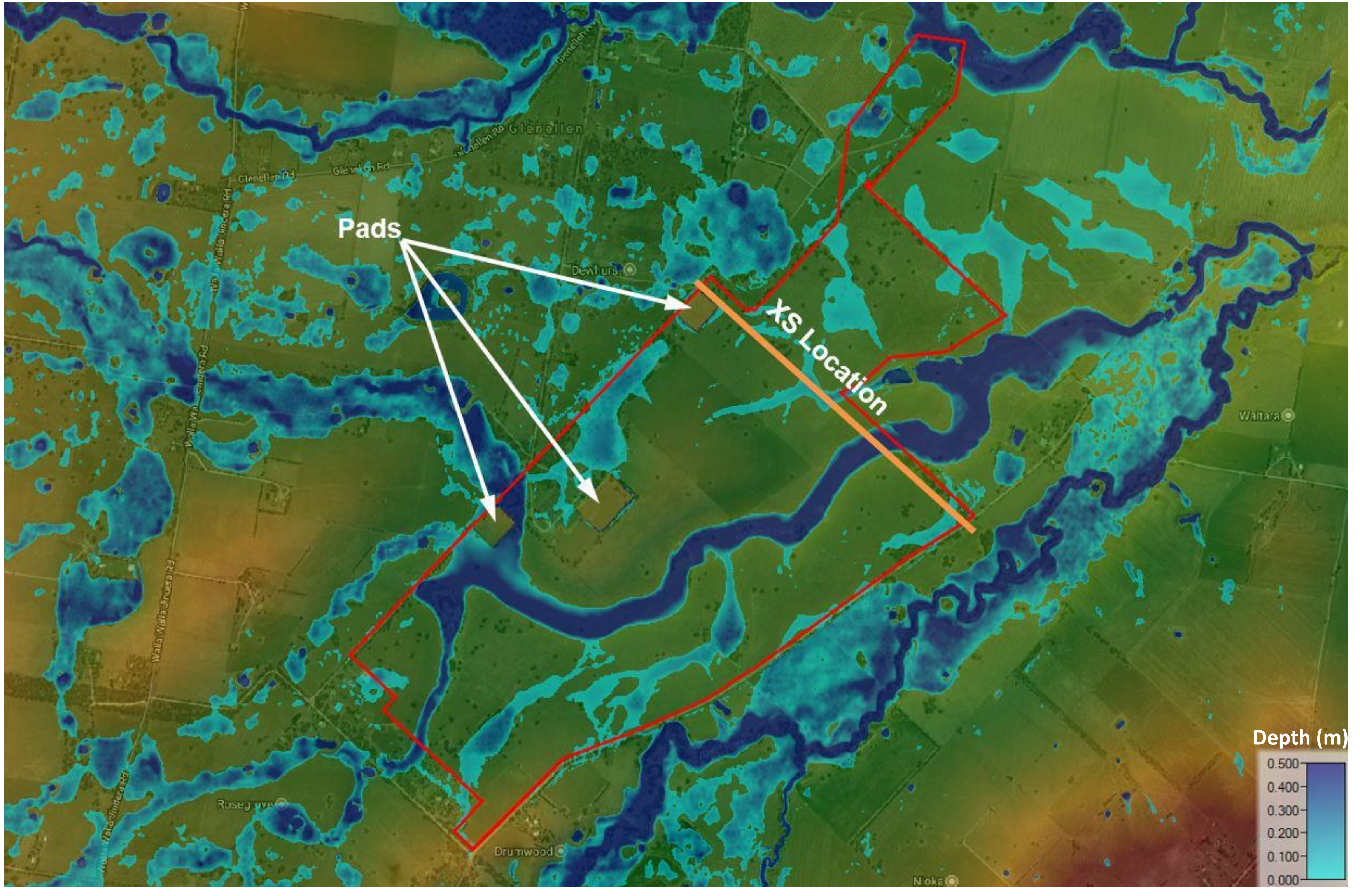

Figure 8-38: Indicative locations of building pads and the comparison section for 1% AEP (100-year ARI) event

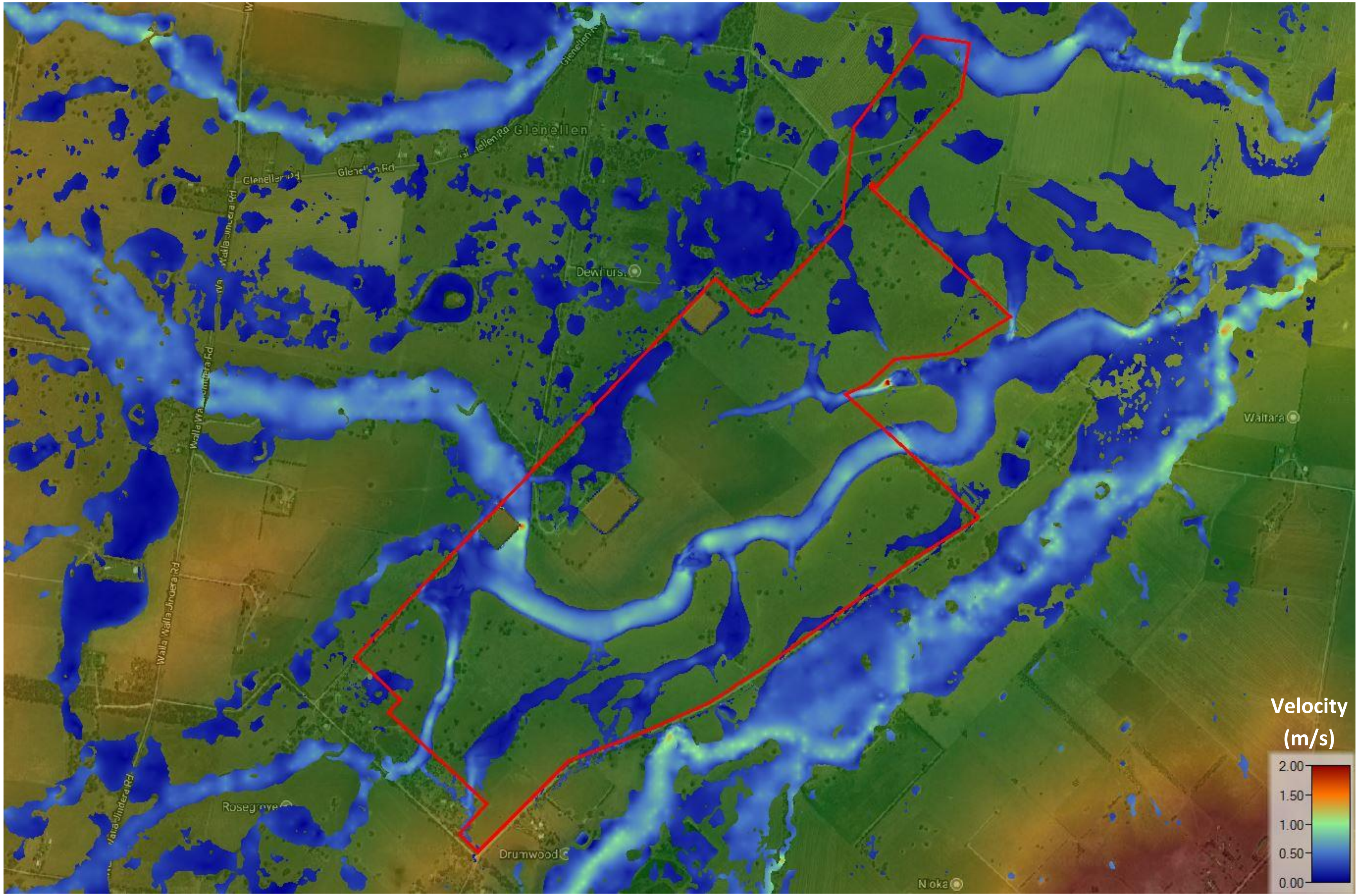

Figure 8-39: Maximum velocities for a 1% AEP (100-year ARI) event

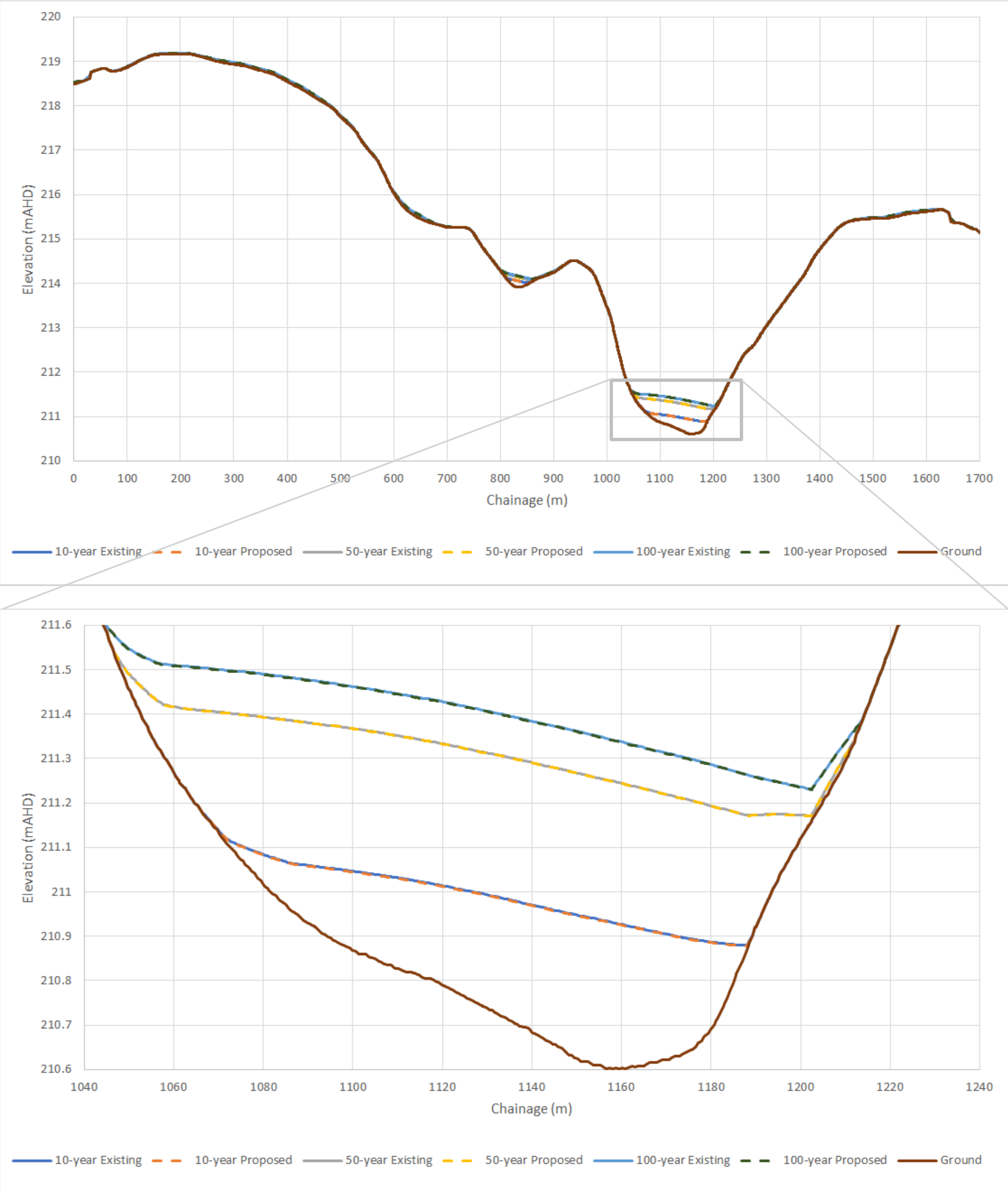

Figure 8-40: Comparison of maximum water surface elevation profiles across index section presented in Figure 8-38 (existing vs. proposed conditions)

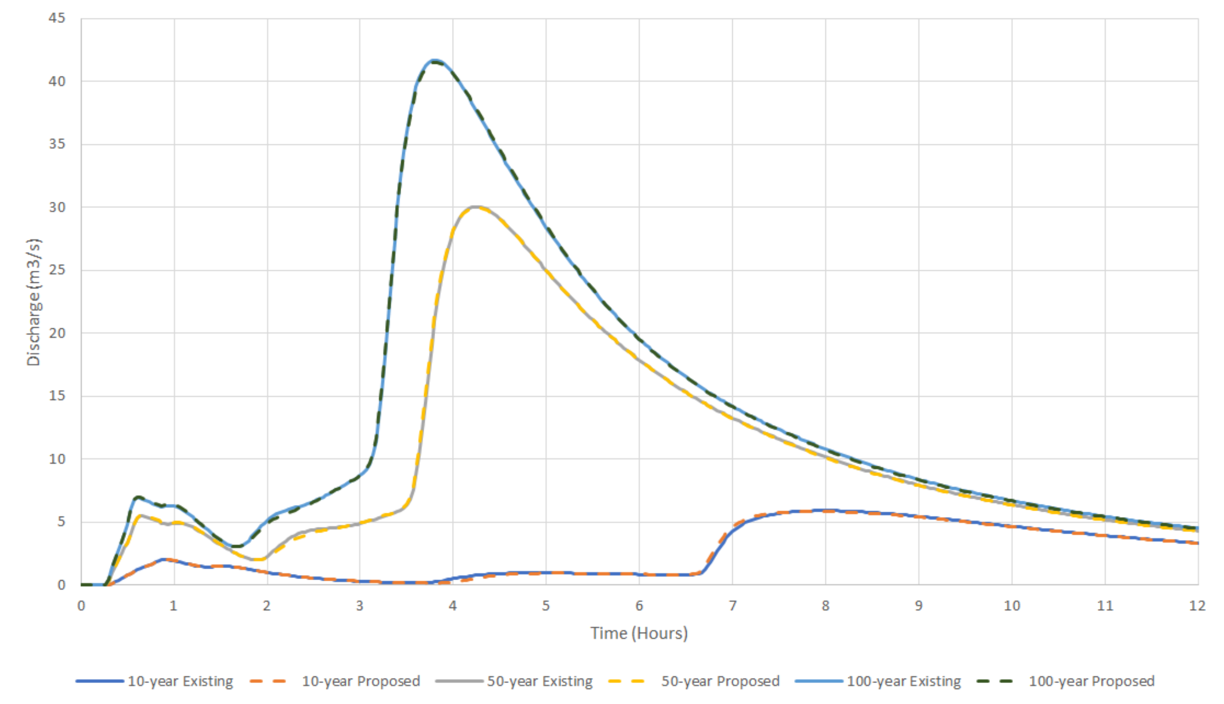

Figure 8-41: Comparison of discharge hydrographs across index section presented in Figure 8-38 (existing vs. proposed conditions)

Table 8-50: Comparison of peak flow across index section (See Figure 8-38 for section location)

Peak discharge (m^3/s)								
10-year ARI			50-year ARI			100-year ARI		
Existing	Proposed	Diff	Existing	Proposed	Diff	Existing	Proposed	Diff
5.917	5.852	1%	30.070	30.016	0.2%	41.716	41.541	0.4%

Table 8-51: Comparison of maximum depth across index section (See Figure 8-38 for section location)

Maximum water level (m)								
10-year ARI			50-year ARI			100-year ARI		
Existing	Proposed	Diff	Existing	Proposed	Diff	Existing	Proposed	Diff
0.332	0.330	0.5%	0.650	0.649	0.1%	0.744	0.743	0.2%

Impact of climate change

A 0.1% AEP (1,000-year ARI) event has been modelled as a proxy for extremely rare events such as the Probable Maximum Flood. Maximum velocities across the Site during the 0.1% AEP event are less than 0.5 m/s, indicating that erosion is unlikely to be an issue even in rare events. Pad designs need to ensure that the pad elevation includes sufficient freeboard above the peak water surface elevation associated with the 100-year event with climate change. The relevant amount of increase to add for climate change varies by jurisdiction, and the 0.5% AEP (200-year ARI) event is considered to be conservatively adequate for testing against the 1% AEP (100-year ARI) event with climate change. Should more detailed climate change impacts be required, methods outlined in Australian Rainfall and Runoff 2016 can be applied to create specific design event climate change scenarios.

8.9.3.4 Impacts on Adjacent Water Users

As indicated in the sections above, the Proposed Development would not impact on the quality or quantity of water available at the Site. As such, no impact on water quality or quantity for adjacent water users is anticipated.

8.9.3.5 Aquatic Ecosystems

Direct impacts

Likelihood Assessments (Table 8-47) indicate that threatened fish, frogs, and/or turtles are unlikely to occur in the waterways within the Site, primarily because there is not suitable habitat to support such populations. Accordingly, the Proposed Development is considered unlikely to pose a direct threat to threatened aquatic species.

Construction and decommissioning activities have the potential to cause direct physical disturbance to small areas of riparian, aquatic and groundwater dependent ecosystems. Operational activities will have negligible direct impacts on riparian, aquatic and ground water dependent ecosystems.

The design of the Proposed Development will include buffer distances based on those described in Table 8-45 (Figure 8-42). Once constructed these shall generally negate the need for access to these environments, except to undertake environmental improvements works such as weed, pest and vegetation management activities. Should road crossings be required across Kilnacroft Creek, these would be constructed in accordance with state regulations and best practice as outlined in Fairfull and Witheridge (2003). In addition, there are no recognised wetlands within the Site (Section 8.9.2.6), and those in the vicinity are either upstream of the site or on adjacent flow paths. Therefore, the Proposed Development would pose no direct threat to these areas.

The reduction of stock and reduced agricultural pressure would improve the ecology of riparian and aquatic habitats relative to current conditions.

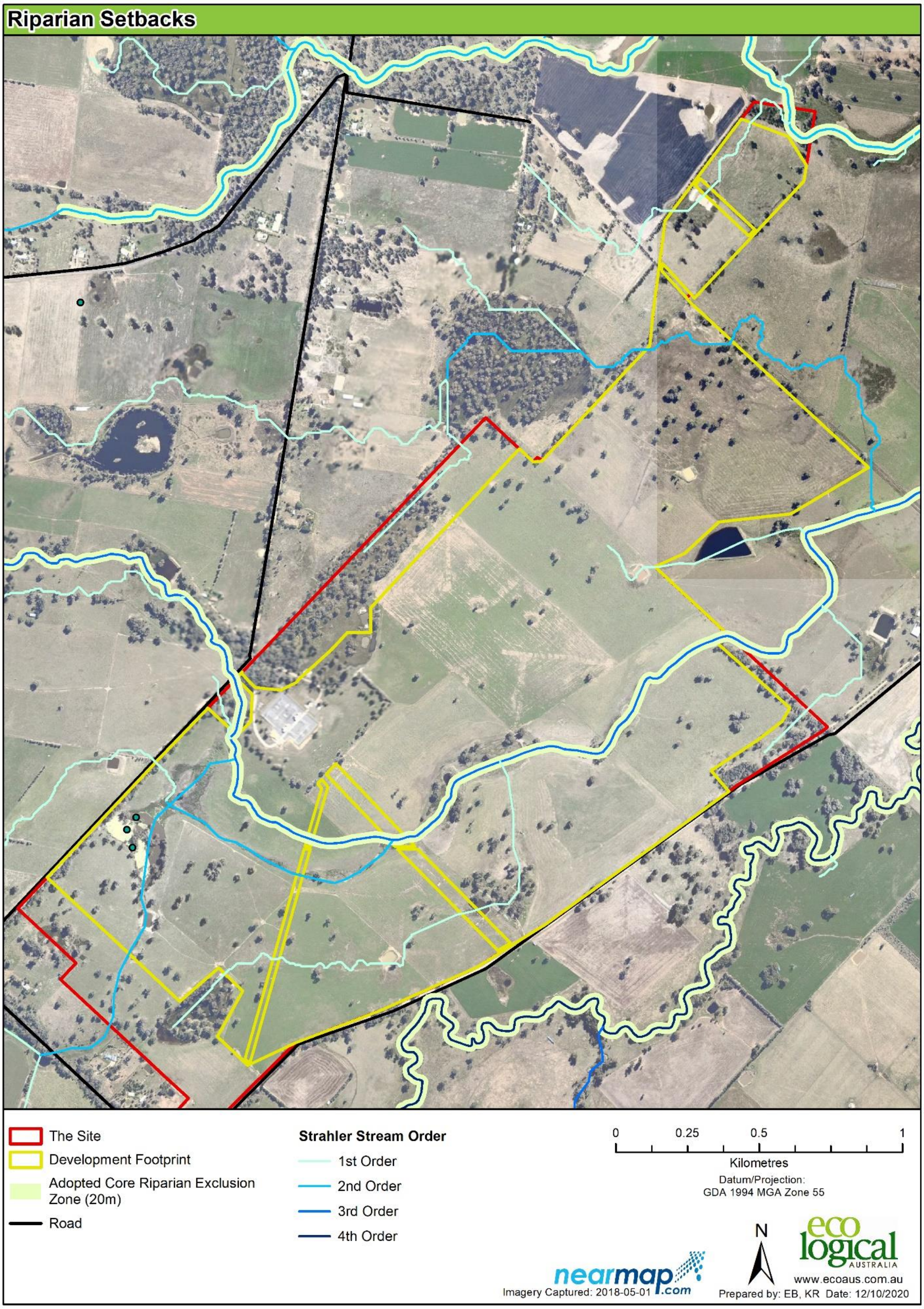

Figure 8-42: Adopted riparian setbacks

Indirect impacts

Through the same processes described above, the construction and decommissioning of the Proposed Development has the potential to indirectly impact riparian, aquatic and ground water dependent ecosystems. Indirect impacts are considered to be minor and it is concluded that indirect impacts do not pose a threat to the aquatic environment. In fact, the reduction in grazing pressure is likely to result in an improvement to the aquatic environment of the Site. Mitigation measures to reduce risk of runoff induced sedimentation to existing riparian, aquatic and ground water dependent ecosystems, as well as to reduce impacts from potential chemical spills are proposed in Section 8.9.3.5.

The Proposed Development would not alter the hydrology of surface water resources such that there would be significant changes to the quantity, timing or duration of flows available to riparian, aquatic or ground water dependent ecosystems.

As there would be no significant change in the overall hydrology of the Site during the operational period of the Proposed Development, operational activities would have negligible indirect impacts on riparian, aquatic and ground water dependent ecosystems.

8.9.4 Mitigation Measures

Potential adverse impacts to water resources will be managed through the mitigation measures and the development of site-specific management plans, as detailed in Table 8-52.

Table 8-52: Mitigation measures for water resources.

Impact	Environmental safeguard	Timing*		
		C	O	D
Water Resources	As a result of a design philosophy that, in the first instance, seeks to avoid impacts, the following environmental protections apply: • Exclusion of 3rd order and higher streams from the Development Footprint (except infrastructure crossings across Kilnacroft and Dead Horse Creeks) • Application of a 20 m (from stream thalweg) buffer zone for 3rd order and higher riparian zones • Minimisation of creek crossings for within site access and electrical cabling • Localised scour protection around building pads • Sourcing of non-potable, construction and operational water from rainwater tanks and existing farm dams • Sourcing from offsite all potable water requirements.	✓		
	To avoid release to the environment, all hazardous materials (fuels, lubricants, herbicides, etc.) will be disposed of offsite in accordance with EPA guidelines.	✓	✓	✓
	Onsite refuelling shall occur in an area that is located greater than 100 m from the nearest drainage line and within an impervious bunded area.	✓	✓	✓
	Machinery will be inspected daily to ensure no oil, fuel or lubricants are leaking from the machinery.	✓	✓	✓
	All contractors and staff will participate in toolbox talks to prevent, minimise and manage accidental spill, and be trained regarding appropriate spill response strategies.	✓	✓	✓
	All hazardous materials will be classified and appropriately stored away from any flood prone areas and drainage lines	✓	✓	✓

Impact	Environmental safeguard	Timing*		
		C	O	D
	Activities with the potential for adverse water quality impacts would be managed through the development of site specific sediment control plans and spill controls.	✓		✓
	Establish and maintain groundcover across the Site. Groundcover species selection and management will balance rapid and maximum ground coverage, grazing and bushfire management objectives to avoid build-up of combustible material.	✓	✓	
	Access tracks will be maintained in good condition, ensuring associated drains and sedimentation traps are monitored to ensure effectiveness is maintained.	✓	✓	
	Culverts (if in design) on Kilnacroft Creek will be designed as per the *Policy and Guidelines for Fish Habitat Conservation and Management* (Fairfull, 2013) and *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge 2003).	✓		
	Installation of cables across Kilnacroft Creek will follow relevant design considerations as per the NSW Office of Water's *Controlled Activities: Guidelines for laying pipes and cables in watercourses.*	✓		
	Potable water will be sourced off-site, via registered water suppliers. Non-potable construction water requirements will be sourced either off-site or from farm dams and creeks under existing Water Sharing Plan licences within the lease area. Rainwater tanks installed to support buildings provide an additional source of non-potable construction water and a climate independent firefighting source.	✓	✓	✓
	The Proponent will source no more than 10% of the total surface water from existing surface water dams located within the Site.	✓	✓	✓
	Solar arrays will be designed and installed so as to not impede overland flow.	✓		
	Construction and operational structures will not be located within flood prone land.	✓	✓	

* C = Construction, O = Operation and D = Decommissioning

8.10 Hazards and Risks

An environmental hazard is an item or situation that has the potential to threaten the environment or human health. This section provides an assessment of potential hazards associated with the Proposed Development and addresses the SEARs which include:

- *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)*
- *an assessment of all potential hazards and risks including but not limited to bushfires, spontaneous ignition, electromagnetic fields or the proposed grid connection infrastructure*

It first considers relevant guidance within NSW, in particular SEPP 33, to determine if the Proposed Development is potentially hazardous, then applies a risk screening and PHA in accordance with NSW DPE's SEPP 33 Guidelines. It then considers potential hazards identified regarding electrical and bushfire, as well as the potential for electromagnetic interference.

8.10.1 Hazardous Materials

A preliminary risk screening in accordance with SEPP 33 and Applying SEPP 33 is presented below.

Stores of chemicals expected on Site, including estimated quantities, are provided in Table 8-53. All substances are below the SEPP 33 threshold level and are therefore not considered further in the SEPP 33 screening process. Additionally, as a Battery Energy Storage System (BESS) is no longer proposed, hazards relating to a BESS facility are no longer relevant.

Table 8-53: Potential chemicals on-site and approximate volumes

Substance	Hazardous Class	Quantity on Site	Threshold Quantity	SEPP 33 Threshold Level	Comments
Petrol	Dangerous Goods Class 3	< 1 tonne	> 2 tonnes	Below	On site storage for minor Site use (e.g. small handheld machinery).
Pesticides	Dangerous Goods Class 6.1	< 1 tonne	2.5 tonnes	Below	Used for weed control if required
Diesel	AS 1940 Class C1 Combustible Liquid	< 1 tonne	Not applicable	Not applicable	On site storage for minor Site use (e.g. small standby generator)
Miscellaneous Minor Chemicals Store	Dangerous Goods Class 2.2, 3, 5.1 and 8	< 1 tonne < 1 m^3	Indicated total storage below all thresholds	Significantly below	On site storage for minor Site maintenance activities.

8.10.2 Bushfire and Electrical Fire

As the Proposal could be exposed to bushfire risk from grasslands or nearby areas of vegetation, and carries the risk of a potential fire starting from within its boundary, a Bushfire Risk Analysis has been conducted in accordance with *Planning for Bush Fire Protection* (PBP), *A guide for councils, planners, fire authorities and developers 2019* (NSW RFS, 2019). The analysis considers relevant guidance within NSW and considers potential fire hazards associated with the Site and surrounds in the existing environment and throughout the lifecycle of the Proposal. Finally, in line with the appropriate standards, it provides a coordinated response to fire risks.

The full Bushfire Risk Analysis is attached in Appendix E, and this section provides a summary of potential hazards associated with bushfire and electrical fire.

Fire presents a threat to human life, property, infrastructure and ecology. Risk can be considered in terms of environmental hazards that increase the likelihood or severity of fire (vegetation, topography and weather patterns), as well as specific activities and infrastructure that increase combustion or ignition risks.

The Proposed Development is classified as SSD, is not a subdivision for residential or rural residential purposes, nor is it a development for a special fire protection purpose, hence issue of a a Bush Fire Safety Authority (BFSA) under section 100B of the *Rural Fires Act 1997* is not formally required. Nonetheless, the Rural Fires Act places a duty of care on land owners/managers to prevent fire spreading on and from their land, which is a principle that will be adhered to through all phases of the Proposed Development.

8.10.2.1 Existing Environment

The statutory Bush Fire Danger Period is between 1 October and 31 March annually, reflecting seasonal fire hazards; however, this will vary from year to year depending on the prevailing climatic conditions in the region.

The harvest period is between November and mid-December and is considered a high-risk period due to the use of machinery in crops, providing both an ignition source and fuel. The harvest period also creates additional activities such as vehicles transporting grain, grain dryers and grain augers. Higher temperatures are experienced in January and February, coupled with low humidity and dry crop stubble over extensive areas thus extending the period of a high fuel load.

In the wider area, due to historic clearing for agriculture, broad-scale vegetation cover is generally low except within road reserves, in isolated patches in paddocks, low-lying areas and gullies, and in gardens, parks and surrounding residences across the landscape. In cleared areas, groundcover generally consists of grazed improved pastures and cropping.

The Development Footprint will cover up to 334.2 ha of rural land, the majority of which has been cleared and is used for grazing. Areas cleared for grazing have been sown with improved pasture, except for patches of retained native woodland and paddock trees scattered throughout. The Site is located in a relatively flat landscape, where elevation ranges between 200 - 220 m AHD.

Portions of the Site and its surrounds are mapped as BPL (Vegetation Category 2) on the Greater Hume Shire Bushfire Prone Land Map (Greater Hume Shire Council, 2011).

Existing land uses of the Site include agricultural activities and the existing TransGrid substation. Existing fire hazards on site include small areas of native vegetation and although managed, grazed pastures are also susceptible to grass fires in hot, dry and windy conditions. Other on-site ignition sources associated with the existing land uses include:

- Machinery operating in long grass
- Hot work activities, including welders and grinders
- The storage of waste and combustible materials onsite
- Storage of flammable liquids
- Electrical faults
- Lightning strikes
- Agricultural activities
- Carelessly discarded cigarette butts.

The existing overhead electricity transmission lines also pose a potential hazard, however, TransGrid and Essential Energy are required to maintain line infrastructure to minimise fire risk.

The commercial helicopter business, Forest Air, situated approximately 1 km from the Site has eight helicopters equipped for fire fighting.

All Fire and Rescue NSW (FRNSW) stations are equipped with the resources, including breathing apparatus, and trained personnel required to deal with fire and hazmat incidents. The fire-fighters likely to respond to a fire in this area would be FRNSW fire fighters (located in Albury Civic Fire Station, 15 km south from the Site) and/or volunteers from the NSW RFS. The nearest RFS Brigades are at Glenellen and Jindera, approximately 1.8 km north and 2.5 km south of the Site respectively.

Direct access to the Site is via Ortlipp Road and Lindner Road and an optional emergency egress route for the Site is proposed from Drumwood Road. There will also be internal access tracks created for GSF. These roads can provide emergency evacuation routes and emergency vehicle entry.

Existing assets at risk from fire include the TransGrid substation located within the Site. There are 110 dwellings located within 2 km of the Site that may be potentially at risk from a fire originating from within the Site.

8.10.2.2 Potential Impacts

In accordance with relevant guidelines, consideration is given to human health and safety as well as potential interruption of existing services during the construction, operational and decommissioning phases of the Proposal. Potential cumulative impacts are addressed in Section 8.13. Fire could damage structures and impact the safety of employees and contractors at the Site. Fire leaving the Site poses a human safety and property threat and imperils native flora, fauna and ecosystems.

Higher flammability risk areas are the treed areas of the Site. Woodland fragments are sparse across the Site and will be retained in areas not developed for the Proposed Development as detailed in Section 8.2. Due to the construction and operational activities occurring outside the more densely treed areas, it is considered unlikely the Proposed Development will pose a significant bushfire risk. Although cleared areas of the Site are not currently mapped as BPL, grassland fires burn at a higher intensity and spread more rapidly with a shorter residence time than that of fires in other vegetation classifications (RFS, 2018).

The Proposal will alter the land management practices within the Development Footprint, potentially resulting in an increase in pasture fuel load as a consequence of reduced grazing pressures from livestock. As a result, grassfires within the Site are considered a potential risk; however, this risk can be effectively managed through mitigation measures to reduce the fuel load within the Site.

Further, the flammability of a solar farm is very low as they are predominantly constructed of glass, silicon, steel and aluminium.

Construction and decommissioning

Potential ignition sources during the construction and decommissioning phases of the Proposed Development would include:

- Machinery movement in long grass
- Hot work activities, including welders and grinders
- The storage of waste and combustible materials onsite
- Storage of flammable liquids
- Electrical faults
- Lightning strikes
- Cigarette butts disposed of carelessly on-site and from cars travelling along roads.

Considering the sparse vegetation cover over the Development Footprint and other factors discussed above, it is considered unlikely that the Proposed Development would pose a significant bush fire risk. The bush fire hazard associated with the activities listed above is considered highly manageable through staff and contractor consultation and awareness programs, electrical equipment selection, appropriate access arrangements, fuel load reduction programs, safety protocols during periods of high fire risk and the implementation of an emergency response plan as part of a Bushfire Emergency Management and Operations Plan - detailed below in Section 8.10.4.

Potential fire risk during decommissioning activities would be similar to those for construction.

Operation

In addition to the potential ignition sources identified above, the operational phase would include fire risks associated with damaged or faulty electrical equipment.

The solar panels are non-reflective and present no risk of ignitions from concentrated solar energy. Ignitions from other PV equipment is theoretically possible from electrical faults such as arc faults, short circuits, ground faults and reverse currents (Allianz Risk Consulting, 2012). It is conceivable that arcs or melted components resulting from a fault could, if conditions were suitable, ignite grass fuels under or surrounding installations and potentially start a fire. The level of fire risk from faults cannot be assessed at this stage because there is no case history available, however, the risk of faults is considered to be low.

The flammability of solar farms is very low as they are predominantly constructed of glass, silicon, steel and aluminium. The flammable components of solar PV panels include the thin layers of polymer encapsulates surrounding PV cells, polymer back sheets, plastic junction boxes and wiring insulation, however the components which make up a small portion of PV panels cannot self-support a significant fire.

With appropriate mitigation strategies in place, including electrical equipment design, selection and appropriate maintenance programs as discussed below, bushfire and electrical fire risks during the operation of the solar farm are considered highly manageable.

Potential risks to fire-fighter safety associated with a fire burning the solar panels and associated equipment include:

- Electrocution – as solar panels would be energised under any natural or artificial light conditions; therefore, isolation of DC current can only occur at an inverter (Backstrom & Dinni, 2011);
- Safe use of water spray or foam application is only possible from the perimeter of the solar panelled portion of the farm and could not reach the 250 to 500 m required to reach the furthest internal distance (without an aerial ladder platform appliance); and
- Inhalation of potentially toxic fumes and smoke from any plastic components such as cables (although the main structure of the panels will be glass and aluminium) or other decomposed products of the panels (Allianz Risk Consulting, 2012).

8.10.3 Electromagnetic Interference

This section considers the potential for nuisance and health impacts from Electromagnetic Fields (EMFs) associated with the Proposed Development within the vicinity of the Site.

In accordance with relevant guidelines, consideration is given to human health and safety as well as potential interruption of existing services during the construction, operational and decommissioning phases of the Proposed Development.

8.10.3.1 Description of EMFs

EMFs consist of electric and magnetic fields, and are produced by electrical equipment of all sizes, existing around electrical wires, electrical devices, as well as occurring naturally. Electric fields are produced by voltage while magnetic fields are produced by current. The strength of the EMF is directly related to the size of the voltage and the current that creates it (EMFs Info, 2019). EMF strength reduces quickly with distance and, depending on the strength and type of equipment generating it, becomes indistinguishable from background levels at distances between 5 m and 50 m from the source of the EMF (Australian Radiation Projection and Nuclear Safety Agency (ARPANSA), 2019; 2014). Finally, electric fields can be insulated by their surroundings such as buildings or the earth, whereas magnetic fields are not (EMFs Info, 2019).

In Australia, transmission lines and other electrical devices and infrastructure operate at 50 Hertz (Hz) and fall within the Extremely Low Frequency (ELF) range of 0 – 300 Hz. Short-term exposure to very high levels of EMFs can be detrimental to human health, however exposure to EMFs generated within the ELF range, at the low levels experienced by the general public, do not have substantive impacts to health (EMFs Info, 2019; ARPANSA, 2015). This is the case for the EMFs that would be produced by the Proposed Development (and the transmission lines that already exist on site).

8.10.3.2 Existing Environment

Existing potential sources of electromagnetic interference within the vicinity of the Site include two 330 kV and two 132 kV TransGrid transmission lines and one 22 kV distribution line. There is also an existing TransGrid 330/132/22 kV substation located on the Site.

8.10.3.3 Potential Impacts

Health Impacts

There is uncertainty about the health impacts of longer-term exposure to ELF EMFs. Advice from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA, 2015) indicates that scientific evidence of exposure to 50 Hz electromagnetic fields near transmission lines has not been established a human health hazard, and concludes that where any risk does exist, it would be small (ARPANSA, 2015).

In the absence of Australian standards for regulating exposure to extremely low frequency EMFs, the National Health and Medical Research Council's (NHMRC) *Interim guidelines on limits of exposure to 50/60 Hertz electric and magnetic fields* has been used to assess the impact of the existing and Proposed Development infrastructure to contractors and the general public's health (Table 8-54).

Table 8-54: Summary of NHMRC's Interim Guidelines on limits of exposure to 50/60 Hz electric and magnetic fields

Receptor	Exposure characteristics	Electric field strength (volts per metre – kV/m)	Magnetic flux density (Microtesla - µT)
Occupational	Whole working day	10	500
	Short term (maximum exposure is 2 hours/work day)	30	5,000
General public	Up to 24 hours/day	5	100
	Few hours/day	10	1,000

Impacts to Electrical Equipment

In rare circumstances EMFs can interfere with electrical equipment. However typically, the EMF fields capable of this are produced at higher frequencies than those commonly encountered in the environment or produced from electricity infrastructure (EMF Info, 2019).

Construction and decommissioning

The potential of EMF impacts during the construction and decommissioning phases is low. Exposure by construction staff would be limited to intermittent periods, during works at and around the existing high voltage transmission lines and substation on site. Furthermore, construction of the solar array would not occur within the transmission line easements.

Operation

Potential EMF impacts would occur only during the operational phase, when the solar farm infrastructure is capable of generating EMFs. The EMFs generated would vary due to the type and size of electrical equipment on site, and whether potential sources of EMF are overhead or buried.

EMF generating components at the Proposed Development include:

- Substations and switchyards
- PCUs including a 33 kV transformer
- The PV array and its wiring system
- The underground and/or overhead cables connecting the array area, substations, switchyards and PCUs with the Jindera Substation.

Due to the function of the substation and the required components, substations have the highest variation in magnetic fields, ranging from 0.1 µT to 6 µT at the security fence (EMFs Info, 2019). However, due to the locations of the substations and the security fencing at each substation, EMF exposure to the general public will be below the guideline limits in Table 8-54.

The Proposed Development will connect to the grid via an upgrade to the existing 330/132/22 kV substation. Any electromagnetic fields around the substation will be almost entirely from the existing transmission lines and the proposed overhead lines and underground cables entering the substation. Furthermore, the main substation has been co-located between the existing overhead 330 kV transmission lines which would be producing a greater electromagnetic field. Typical electric and magnetic field strengths for overhead transmission lines, including the connector are shown in Figure 8-43 and Figure 8-44.

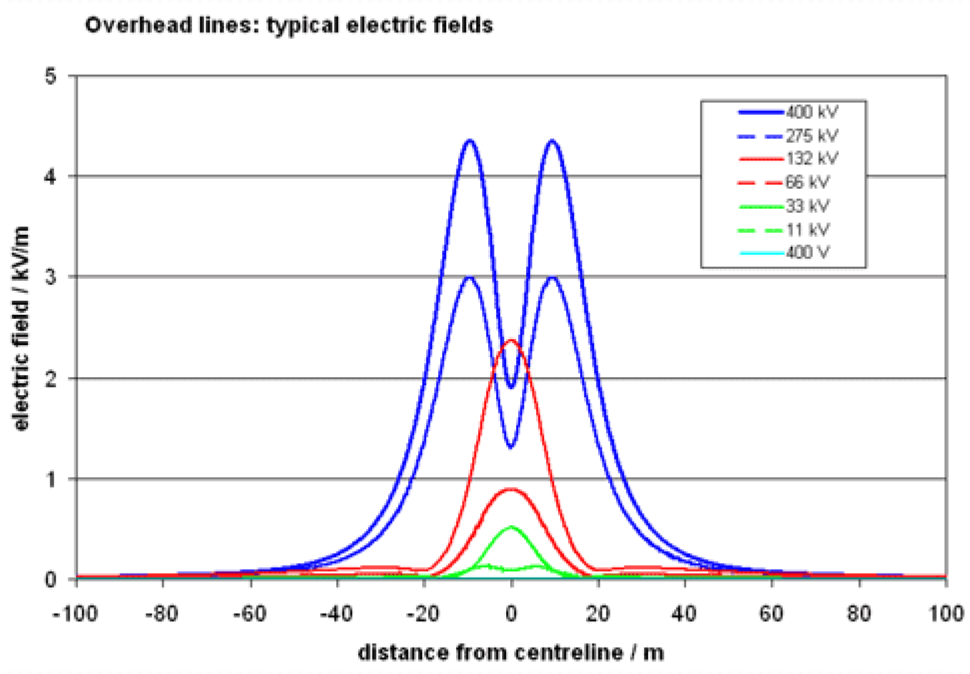

Figure 8-43: Typical electric fields for overhead transmission line (EMFs Info, 2019)

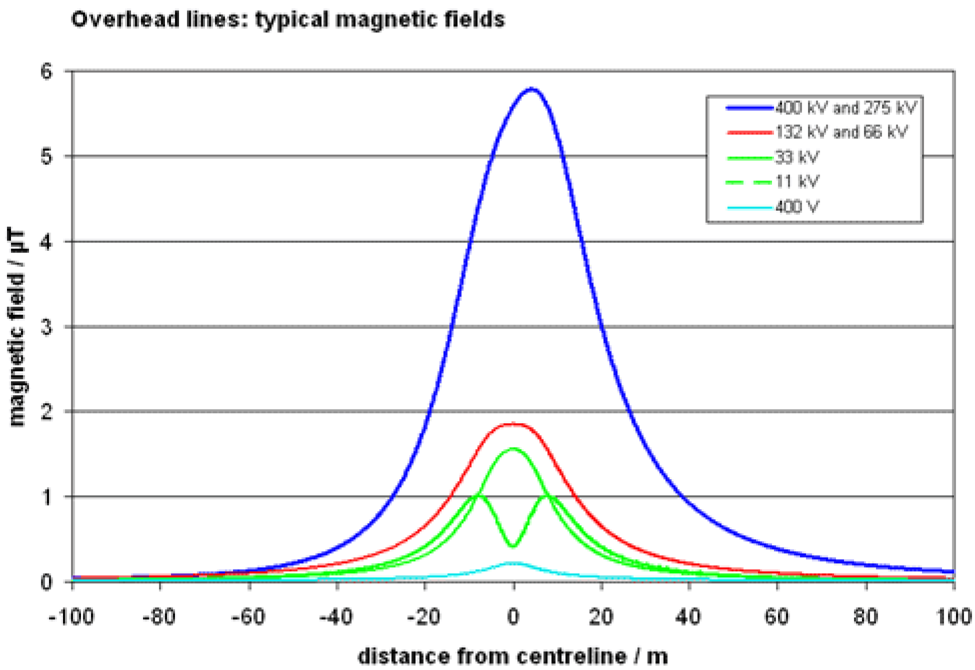

Figure 8-44: Typical magnetic fields for overhead transmission line (EMFs Info, 2019)

Magnetic fields produced by the PV solar array would be significantly less than those produced for household applications and are indistinguishable from background levels at the Site boundary (Chang & Jennings, 1994). Therefore, the health risk of EMFs from solar arrays would be insignificant.

The 33 kV cabling connecting the solar array to the adjacent existing substation may either be underground or overhead, producing both electric and magnetic fields. The magnetic field associated with the line would be greatest if installed overhead, with approximately 1.7 µT directly below the line diminishing to 0.4 µT at a distance of 10 m. Under the same scenario, the electrical field would be approximately 2.6 kV/m (2600 V/m) directly below the line, diminishing to 0.7 kV/m (700 V/m) within 10 m (EMFs Info, 2018). The typical magnetic field from the underground cables is 1 µT immediately above a 33 kV cable buried at 0.5 m (Figure 8-45). These levels are below the requirements for contractors and public exposure levels as per NHMRC's Interim guidelines in Table 8-54.

The maximum electric and typical magnetic fields for a 33 kV overhead powerline is shown respectively in Figure 8-45 and Figure 8-46. The maximum electric field produced by a 33 kV overhead powerline is less than 0.85 kV/m (850 V/m) at the source, while the maximum magnetic field produced is approximately 26 µT at the source. These are also below the exposure limits for contractors and the general public as per the NHMRC's Interim Guidelines (Table 8-54) and do not pose a health risk.

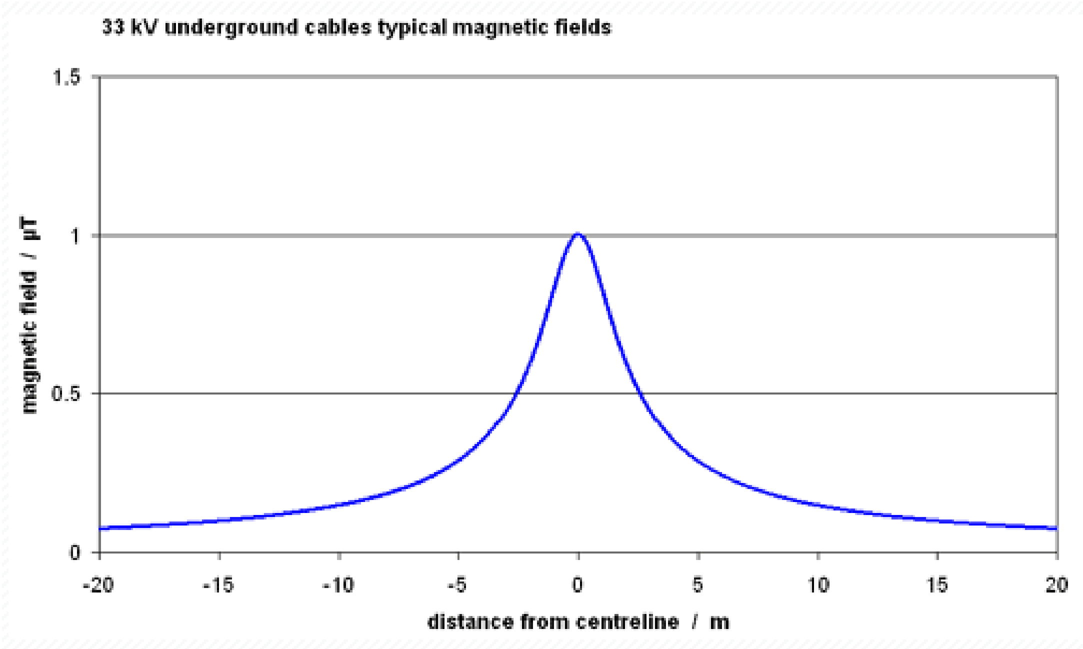

Figure 8-45: Typical magnetic field from a 33 kV underground cables (EMFs Info, 2019)

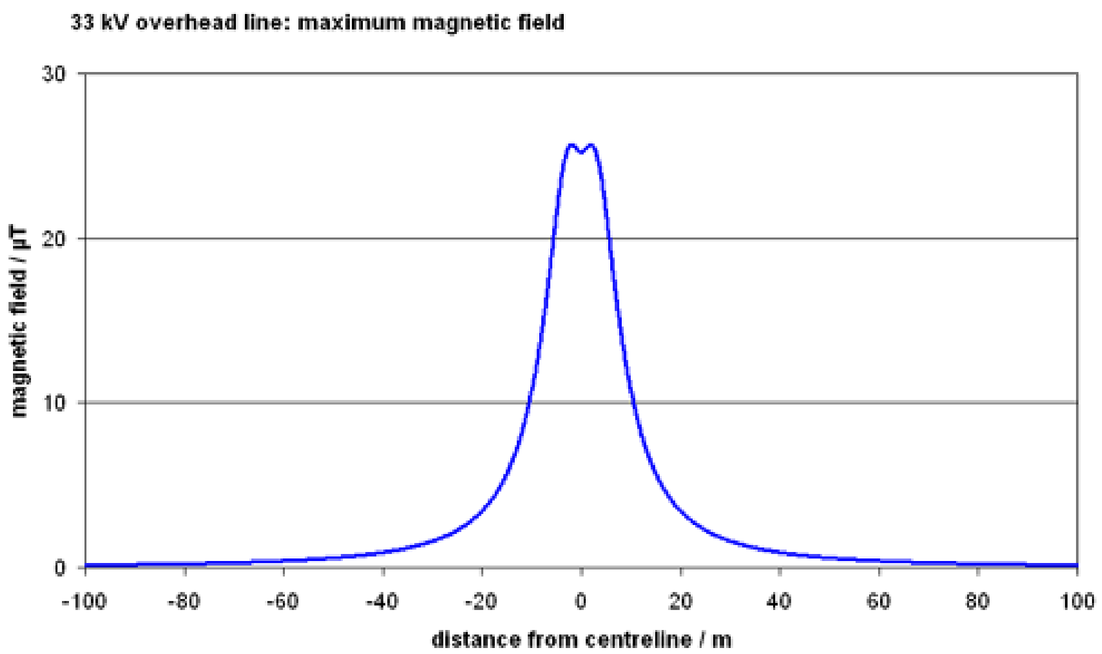

Figure 8-46: Maximum magnetic field from a 33 kV overhead powerline (EMFs Info, 2019)

There are 22 residences, including two involved residences, located within approximately 1 km of the boundary of the Development Footprint, the closest of which (ORT005, not involved) is 244 m away. 95 non-involved residences are located within 2 km of the Development Footprint. Given the distance from the highest EMF emitter (the substation) and the low EMFs emitted from the PV solar arrays, and the existing 22 kV local distribution network and the double-circuit 330 kV transmission lines located near these residences, EMFs from the Proposed Development are likely to be indistinguishable from background levels at the boundary fence.

All AC electrical equipment that would be used as part of the Proposed Development will operate at 50 Hz. Household appliances and devices, as well as telecommunication signals operate at much higher frequencies. For example, microwave ovens and Wi-Fi routers operate at 2.4 GHz, while mobile phones currently operate at 1.8 GHz. As these devices operate at higher frequencies which do not overlap with 50 Hz, and due to the rapid dissipation with distance from the source of EMFs, it is considered that they would not be impacted by EMFs from the Proposed Development.

8.10.3.4 Mitigation Measures

Design principles and staff safety

In limiting exposure to EMFs, following advice from the International Commission on Non-Ionizing Radiation Protection, priority will be given to engineering and access controls that limit exposure (ICNIRP, 2010). This means that:

- The final design of the Proposed Development would be undertaken by qualified and competent persons and would meet relevant Australian standards, ensuring EMFs would be minimised as far as possible
- Access to electrical equipment would be limited to qualified personnel only.

In addition to the design and access control measures outlined above, potential exposure levels on Site are predicted to be below the exposure limits for staff in the NHMRC's Interim Guidelines (Table 8-54), therefore further mitigation is not proposed.

Receptors – public safety

To reduce the potential for chronic or acute exposure to EMFs, no unsupervised public access to the Proposed Development would be permitted. As discussed above there is unlikely to be any negative impact to public health from EMFs outside of the Site.

The landholder or its employees may have access to the Site for grazing activities, however there will be no need to spend extended periods near electrical infrastructure. As such, the potential for impacts from EMFs is low.

The landholder or its employees would not have access to the substation or inverters.

Receptors - electrical devices

As noted, electrical equipment commissioned as part of the Proposed Development would be designed to reduce possible interference in line with Australian Standards. It would also operate at different frequencies to household electrical devices and telecommunication signals. In addition, due to potential receptors' location outside of the Site, there would be no impact on any electrical devices. Impact to household devices created by EMFs would require no additional mitigation measures.

8.10.4 Mitigation Measures

Potential adverse impacts relating to hazards will be managed through the development of site-specific management plans, as detailed in Table 8-55.

Table 8-55: Mitigation measures for hazards

Impact	Environmental safeguard	Timing*		
		C	O	D
Bushfire and Electrical Fires	*Create and maintain an Asset Protection Zone (APZ) around the Development Footprint* APZ around the perimeter, between the security fence and the panel array, which allows for a defendable firefighting space that permits unobstructed vehicle access. A 20 m APZ is to be established around the Development Footprint from woodland areas and 10 m width in grassland areas. The APZ is to be maintained from the commencement of construction in perpetuity in accordance with the NSW RFS (2019) APZ requirements for an Inner Protection Area. The Development Footprint APZ is to incorporate a 4 m Category 1 perimeter fire trail (see *Access* below). Develop bushfire management measures and an emergency response plan prior to commencing construction activities, and for the operational and decommissioning phases, to manage site specific risks.	✓	✓	✓
	Implement appropriate site landscaping Where screen plantings are proposed they are to be: • Located on the external side of the APZ (away from the asset) • Consist of low flammability and fire spotting (e.g. smooth bark) species in consultation with the RFS and local nurseries • Be planted as a continuous break • Maintained to remove any dead leaf litter, branches and dead vegetation. Within the solar farm layout, maintain minimal fuel load by grazing, slashing, mowing or. The fuel load across the Proposal will be monitored and will be actively managed through grazing, mechanical slashing and/or mowing or herbicides as required to reduce the risk of grass fires starting within the Site and ensuring that fires originating from outside the Site do not intensify as a consequence of entering the Site. During the bushfire season, pastures within the Site (including under panels) are to be maintained with minimal fuel load (<100 mm grass height). If grazing is utilised, overgrazing will be avoided to maintain the groundcover and reduce the potential for erosion. Alternate cropped and uncropped areas to breakup continuous potential fire runs within the Site. Use a mosaic of crop plantings of varying age classes to reduce the availability of higher uniform fuel loads across the Site at any one given time. Avoid harvesting machinery on very high fire danger days or above to reduce likelihood of ignition.	✓	✓	
	Construction and design Electrical equipment selected for the 30-year life span of the Proposed Development would be designed to minimise the potential for ignition and certified to comply with relevant Australian Standards. The Proponent will ensure that all equipment at the Site is installed correctly and maintained in good order to prevent sources of ignition from faulty equipment. All installed equipment would be earthed appropriately following comprehensive testing of soil conductivity to ensure lightning effects are not harmful to the operation of the Proposed Development. All electrical equipment must comply	✓	✓	

Impact	Environmental safeguard	Timing*		
		C	O	D
	with relevant construction standards and design and is to be in accordance with AS 3000:2007 Wiring Rules. All dangerous or hazardous materials on site will be stored and handled in accordance with safety data sheet (SDS) requirements and Australian Standard AS1940-2004: The storage and handling of flammable and combustible liquids, or its latest version. Chemical storage will be in accordance with Safety Data Sheet (SDS) requirements and would consider potential fire hazards (e.g. the use of fire cupboards for the storage of chemicals). An inventory of the quantities, storage location and copies of SDSs will be held at both access points to the solar farm and will be made available to the emergency services on arrival to the Site.			
	Construction and Operations protocols during bushfire season All operations involving earth moving equipment, vehicles, slashers and hot works (e.g. grinders, welders) must cease during Total Fire Bans, while the Grassland Fire Danger Index (GFDI) is or is forecast to be 35 or greater, or high winds are forecast. During Very High or worse fire danger days, the “fires near me” app is to be checked hourly for the occurrence of any fires likely to threaten the Site; and all plant, vehicles and earth moving machinery are cleaned of any accumulated flammable material (e.g. soil and vegetation). Should construction take place during a declared Bushfire Danger Period, the following measures are recommended to control the risk of grassfire ignitions: • The APZ is constructed as one of the first stages of development • A suitable fire appliance is present on site with at least two personnel trained in bushfire fighting.	✓	✓	✓
	Maintain emergency access/egress for fire fighters and site personnel The APZ is to incorporate a 4 m Category 1 perimeter fire trail, established and maintained in accordance with NSW RFS requirements (NSW RFS, 2019) standards for fire trails (NSW RFS, 2019a) including provisions for passing bays and turn around points. Proposed main access point is from a new entry from Ortipp Road. In an emergency, secondary access to the Site may be obtained from any of the access points, including along Drumwood Road and Blight Road.	✓	✓	✓
	Water and utilities A dedicated water supply of four 10,000 litre tanks fitted with Storz couplings as filling points for fire tankers will be provided at locations agreed with the RFS for the sole use of fire protection in line with the RFS standards: one at the operations compound, one at the main entrance and two along Drumwood Road.	✓	✓	✓
	Fire preparedness and response A Bushfire Emergency Management and Operations Plan (incorporating a discrete ERP) will be developed prior to commencing construction activities, and for the operational and decommissioning phases, including: • Ignition reduction strategies • Fire suppression equipment details • Flammable materials storage requirements • Fire preparedness procedures • Fire reporting and response to formal emergency alerts	✓	✓	✓

Impact	Environmental safeguard	Timing*		
		C	O	D
	• A standalone ERP: detailing firefighting restrictions, potential hazards, specialised Personal Protective Equipment (PPE) requirements, shut-down/isolation procedures, evacuation zone distances, aerial suppression considerations and availability of the ERP			
Electromagnetic Interference	In limiting exposure to EMFs, following advice from the International Commission on Non-Ionizing Radiation Protection, priority will be given to engineering and access controls (ICNIRP, 2010). This means that: • The final design of the Proposed Development would be undertaken by qualified and competent persons; • Design would meet relevant Australian standards, ensuring EMFs would be minimised as far as possible • Access to electrical equipment would be limited to qualified personnel only.	✓	✓	✓
	To reduce the potential for chronic or acute exposure to EMFs, no unsupervised public access to the Proposed Development would be permitted.	✓	✓	✓
	The landholder or its employees would not have access to the substation or inverters.	✓	✓	✓
	Electrical equipment commissioned as part of the Proposed Development would be designed to reduce possible interference in line with Australian Standards.	✓	✓	
	To ensure adequate exposure separation for the general public, the integrity of substation and boundary fencing will be maintained for the lifetime of the Proposed Development.	✓	✓	✓

* C = Construction, O = Operation and D = Decommissioning

8.11 Waste and Resource Use

8.11.1 Introduction

The consumption of resources, and production and disposal of waste has the potential to have a negative impact upon the environment, and needs to be managed to ensure that:

- Resources are used efficiently
- Waste production is minimised
- Reuse of materials is maximised
- Contamination of land and water is avoided.

The developer's obligations in regard to waste management are guided by the following legislation:

- WARR Act – promotes waste avoidance and recovery
- POEO Act – requires a licence to carry out certain scheduled waste activities and makes it an offence to pollute or potentially pollute land, air or water with waste
- Protection of the Environment Operations (Waste) Regulation 2005 (POEO (Waste) Regulation) – prescribes requirements for the tracking and management of certain wastes.

The POEO Act and the POEO (Waste) Regulation regulate waste management and pollution in NSW. Under section 134 of the POEO Act, it is an offence to unlawfully transport and deposit waste, and littering is an offence under section 145 of the same Act.

The WARR Act aims to encourage the most efficient use of resources and to reduce environmental harm. Waste management hierarchy principles are provided in the WARR Act and are considered in the following order:

- Avoidance of unnecessary resource consumption
- Resource recovery (including reuse, reprocessing, recycling and energy recovery)
- Disposal.

Adopting the above principles would encourage the most efficient use of resources and reduce costs and environmental harm in accordance with the principles of ESD.

8.11.2 Existing Environment

The existing Site is characterised by agricultural production and grazing activities. Responsibility for the management of waste generated by these activities lies with the landholder.

8.11.3 Potential Impacts

8.11.3.1 Resource use

Construction

Key resources required for the Proposed Development include gravel, sand, metal, glass, silicon and water. Imported water may be required for dust suppression, as well as cleaning equipment intermittently during dry periods. Imported potable water may also be required for staff amenity.

The supply of these materials is not currently limited or restricted, and the likely quantities required by the Proposed Development are unlikely to place significant pressure on necessary resources.

Operation

The production of electricity using PV panels utilises an energy resource (sunlight) that is renewable, as such, there would be no impact on this resource as a consequence of the Proposed Development.

During operation, the resources used would largely be associated with maintenance activities and the use of machinery and vehicles. While this would require the use of non-renewable resources such as hydrocarbon fuels to power machinery and vehicles, in the very limited volumes required, the Proposed Development is unlikely to place significant pressure on the availability of these resources. Furthermore, their use during this period is considered reasonable in light of benefits of offsetting fossil fuel electricity generation.

Imported potable water may be required for cleaning panels intermittently during dry periods (Section 8.9). Imported potable water may also be required for staff amenity.

The consumption of resources during the operation of the Proposed Development would not place significant pressure on necessary resources.

Decommissioning

The main resources required to support the decommissioning phase of the Proposed Development would be the use of machinery and vehicles associated with the activities of removing all onsite infrastructure. While this would require the use of non-renewable resources such as, hydrocarbon fuels to power machinery and vehicles, in the volumes required, the Proposed Development is unlikely to place significant pressure on the availability of these resources. Accordingly, their use during this limited period is considered reasonable in light of benefits of the initial 30 year term of the Proposed Development.

8.11.3.2 Waste Generation

In accordance with definitions of the POEO Act and associated waste classification guidelines, most waste generated during the construction and decommissioning phases would be classified as building and demolition waste within the class general solid waste (non-putrescibles).

Potential impacts associated with waste management on Site include:

- Contamination of land and water from inappropriately managed waste and waste storage areas
- Human and animal health impacts
- Resource wastage through inefficient use or the recycling of over-ordered stock.

Construction

Solid wastes will be the main pollutant generated by construction activities. Solid wastes will include packaging, excavated material, metal and cable off-cuts, excess building materials, general refuse and other non-putrescible wastes. It is also noted, that it is possible that there will be a limited number of PV panels that fall into the waste stream during construction due to damage occurring during delivery or installation. Ancillary facilities in the site compound would also produce sanitary wastes classified as general solid waste (putrescibles) in accordance with the POEO Act.

The Proponent has liaised with Greater Hume Shire Council Waste Services regarding the types of waste streams likely to be generated during construction, and the options for disposal and re-use of the identified waste streams. Council liaison will continue throughout the detailed design phase. The estimated quantities of generated waste associated with construction is provided in Table 8-56.

Table 8-56: Waste types, estimated quantities and where recyclable

Waste Type	Estimated Total Material (tonnes)	Recyclable within Greater Hume LGA?[1]	Recyclable within Albury LGA?[2]
Timber pallet	735	-[3]	-
Cardboard box	325	Yes	Yes
Plastic bags	19	-	-
Polystyrene sheets	41	-	Yes
Plastic corner pieces	13	-	-
Aluminium straps	64	Yes	-
Plastic wrap ends	2	-	-
Aluminium banding	5	Yes	-
Plastic banding	3	-	-
Steel supports	115	Yes	Yes
Steel cable drums	28	Yes	Yes
Other timber (drums & bracing)	103	-	-
Aluminium casing	10	Yes	-
Total (estimated)	1,484		

1. Facility: Jindera Landfill. Listed items are those generally accepted at that facility.
2. Facility: Albury Waste Management Centre. Listed items are those generally accepted at that facility
3. Alternative waste recycling and disposal options will be planned for all remaining unacceptable and uncertain waste items via further detailed liaison.

Operation

Waste streams during the operation of the Proposed Development would be limited to minor quantities of putrescible waste, redundant equipment, and general waste from maintenance workers. These would be disposed of via Greater Hume Shire Council Waste Services. Some materials such as fuels and lubricants, redundant equipment and metals may require replacement over the operational life of the Proposed Development.

No direct waste streams would be associated with using PV Panels to generate electricity from the sun's energy. While it is very unlikely, it is possible that limited numbers of the PV panels could become damaged during operation and would fall into the waste stream. For this to occur they would need to be functionally faulty or physically damaged. PV panels are robust and are manufactured to withstand a wide range of environmental conditions including extremes in temperature, rainfall, hail and humidity (Clean Energy Review, 2019). While the panels themselves contain potentially hazardous materials, for intact PV panels, leaching of these elements is unlikely to occur because these potentially toxic materials are encased in a number of protective layers within the PV panel. Typically, a clear hardened resin, protected by strengthened glass on the front side, with a hardened polymer material (such as Tedlar PVF) on the back side of the panel. The completed panel is further protected by an aluminium frame. This robust design, combined with a standard 25 year warranty (DNV-GL, 2017) ensures that the likelihood of cell material being exposed and becoming hazardous to the environment is very low.

As the damaged PV panels would not be suitable for reuse they would be recycled where possible as described under decommissioning below.

No direct waste streams would be associated with using PV Panels to generate electricity from the sun's energy. While it is very unlikely, it is possible that limited numbers of the PV panels could become damaged during operation and would fall into the waste stream. For this to occur they would need to be functionally faulty or physically damaged. PV panels are robust and are manufactured to withstand a wide range of environmental conditions including extremes in temperature, rainfall, hail and humidity (Clean Energy Review, 2019). While the panels themselves contain potentially hazardous materials, for intact PV panels, leaching of these elements is unlikely to occur because these potentially toxic materials are encased in a number of protective layers within the PV panel. Typically, a clear hardened resin, protected by strengthened glass on the front side, with a hardened polymer material (such as Tedlar PVF) on the back side of the panel. The completed panel is further protected by an aluminium frame. This robust design, combined with a standard 25 year warranty (DNV-GL, 2017) ensures that the likelihood of cell material being exposed and becoming hazardous to the environment is very low.

As the damaged PV panels would not be suitable for reuse they would be recycled where possible as described under decommissioning below.

Decommissioning

The Proposed Development has a design life of at least 30 years. At the end of its useful life, the Proposed Development will be decommissioned, and the Site will be returned to agricultural use.

Decommissioning activities will involve the removal of all above ground infrastructure, including the PV modules, the racking system, the piles, and grid connection infrastructure. Note, underground cables (inert and stable) at a depth greater than 0.5 m would be left in-situ to avoid unnecessary ground disturbance.

Solid wastes will be generated by decommissioning activities (non-putrescibles, putrescibles), although to a lesser degree than during the construction phase. Solid wastes will include packaging, excess building materials, general refuse and other non-putrescible wastes.

Decommissioning of the Site would involve the recycling or reuse of materials including:

- Solar panels and mounting system
- Metals from posts, cabling, fencing.

Infrastructure and equipment that may be suitable for reuse include grid connection equipment, substation equipment and inverters. Support buildings will be removed from the Site for reuse if possible.

Where reuse of a material is not possible, recycling is considered to be the next desirable option. Solar panels are made of valuable materials that can be recycled at recovery rates greater than 90%, with this figure expected to improve as recycling techniques develop over time (IEA, 2017). The recovery, reuse and/or recycling of panels at the end of their life is necessary to avoid landfill waste generation and to fulfil obligations set out in the WARR Act. Typical Crystalline silicon PV panels are comprised of the following components by weight:

- 76% Glass
- 10% polymer
- 8% aluminium (mostly the frame)
- 5% silicone
- 1% copper
- 0.1% silver and other metals (mostly tin and led) (IEA & IRENA, 2016).

Industry trends also show that the percentage of glass content is predicted to increase to around 80% of the total weight of a panel by 2030 reducing the respective components of Silicone (to 3%), Aluminium to 7% with a slight reduction also expected in other metals (IEA & IRENA, 2016).

In 2012 it became mandatory to recover, reuse and/or recycle PV panels in Europe through the modification of the European Waste Electrical and Electronic Equipment Directive (WEEE 2012/19/EU). This has resulted in an emerging and expanding commercial recycling industry which employs a variety of techniques to recycle panels (IEA, 2017).

The Australian solar market is not as mature as the European market, however in line with other markets such as the US and Asia, the industry is already developing its capacity to take advantage of the future opportunity that the recycling will offer as panels reach the end of their useful life (Reneweconomy, 2016). The first Australian panel recycling company ('Reclaim PV Recycling', based in Adelaide) is now proposing to expand its recycling drop-off locations to include Brisbane, Sydney, Melbourne and Perth (Reclaim PV Recycling, 2020).

The mounting system and other metals used to support the solar panels are considered to be readily recyclable.

8.11.3.3 Waste Classification

The classification and description of the potential waste types likely to be generated by each phase of the Proposed Development are summarised in Table 8-57, below.

Table 8-57: Potential waste description

Waste Type	Project phase*	Waste Classification#	Details
Hydrocarbons	C,D	Liquid Waste	Used lubricants, etc.

Waste Type	Project phase*	Waste Classification#	Details
Construction/ structural Waste	C,D	General Solid Waste (non-putrescible)	Waste from construction would include excess concrete, metal, timber, fittings and packaging.
Domestic/ office waste	C,O,D	General Solid Waste (non-putrescible and putrescible)	Waste would consist of everyday items such as paper, aluminium cans, plastics, packaging and other material generated by onsite contractors.
Green Waste	C	General Solid Waste (non-putrescible)	Cleared vegetation.
Liquid waste	C, D	Liquid waste	Oil, paint, lubricants, glue etc.
Sewage	C,O,D	Liquid Waste General Solid Waste (putrescible)	Effluent from ablutions and office buildings.
Chemical/ hydrocarbon containers	C,O,D	General Solid Waste (non-putrescible)	Fuel and lubricant storage. Herbicides and pesticide storage.
Dangerous goods	O,D	Hazardous Waste	Lithium-ion cell and batteries

* C – construction; O – operation D – decommissioning

As defined in clause 49 of Schedule 1 of the POEO Act

Managed effectively, in line with the mitigation measures described in the section below, the generation of waste as a consequence of the construction, operation and decommissioning of the Proposed Development would not result in significant adverse impacts and adequate arrangements can be made throughout the various stages of the Project to ensure resource reuse and waste disposal complies with the relevant legislative requirements, including the EPA *Waste Classification Guidelines*..

8.11.4 Mitigation Measures

Mitigation strategies are provided in Table 8-58.

Table 8-58: Mitigation measures for waste

Environmental safeguard	Timing*		
	C	O	D
To encourage the efficient use of resources, reduce costs and environmental impacts, in line with the POEO Act, POEO (Waste) Reg, and the WARR Act, resources and waste will be managed throughout the life of the Proposed Development according to the following hierarchy: 1. Reduce waste production; 2. Recover resources (including reuse, reprocessing, recycling and energy recovery) 3. Dispose of waste appropriately.	✓	✓	✓
Wastes will be classified in accordance with the NSW Environment Protection Authority (EPA) *Waste Classification Guidelines – Part 1: classifying waste* (EPA 2014) and *addendum* (EPA 2016). These wastes will be disposed of lawfully at a licensed waste facility.	✓	✓	✓
In order to minimise the potential for waste, purchasing protocols to reduce the likelihood for equipment failure will be adhered to in the selection of all components of the Proposal. With specific regard to panels:	✓	✓	

Environmental safeguard	Timing*		
	C	O	D
• As a minimum, panels will meet the Australian standard AS/NZS 5033 for photovoltaic modules and the international standard IEC 62804 (Clean Energy Council, 2018) • Panels will be backed by a 25 year warranty (DNVGL, 2017).			
Opportunities for recycling will be investigated	✓		✓

* C = Construction, O = Operation and D = Decommissioning

A Waste Management Plan will be prepared in order to meet the hierarchy set out in Table 8-58 above and will form part of a suite of management plans. The objectives, protocols and responsibilities within it will be communicated to all staff and contractors through a site induction process, subcontractor agreements and ongoing training. Specific measures to be incorporated into the Waste Management Plan would include, but not limited to the following:

- Protocols to identify opportunities to follow the waste hierarchy - to ensure that waste is minimised, recovered, and disposed of appropriately, and also to ensure a culture of responsible waste management is upheld by staff
- Quantification, classification, and tracking of all waste streams - to encourage waste reduction and minimise inter-contamination of waste streams
- Controls on the disposal methods of all waste streams
- Adequate bins (with lids that prevent wind-blown litter and exclude pest and native animal scavenging) will be provided on site, including for each identified waste stream, and clearly labelled with the appointed waste stream
- All waste will be disposed at facilities permitted to accept the waste. All controlled waste will be removed from the Site by a licenced waste contractor and the associated controlled waste tracking forms / information captured for reporting and auditing purposes
- Provision of toilet facilities for onsite workers and how sullage would be disposed of (i.e. pump out to local sewage treatment plant)
- Provision of recycling facilities onsite to reduce waste streams
- Provision of a dedicated waste management area onsite
- Provisions as per the ADG Code for the packaging, transportation of spent lithium-ion batteries to collection and/or recycling facilities
- An export permit under section 40 of the Hazardous Waste Act will be obtained prior to spent batteries being exported
- Protocols on the transportation of waste, for example covered loads.

8.12 Socio-economic Factors

8.12.1 Introduction

In this section the potential socioeconomic impacts of the Proposed Development are considered within the Greater Hume Shire and Albury City Council LGAs, as well as within wider Southern NSW in accordance with the project SEARs which require:

- *an assessment of the likely impacts on the local community, provision of or increase the demand for public amenities and public services within the area and a consideration of the construction workforce accommodation.*

Firstly, this assessment describes the socioeconomic composition of the area and reviews the Council and the communities' longer-term strategies for the region and attitudes to solar farms. Secondly, potential socioeconomic impacts throughout the various stages of the Proposed Development are considered, along with strategies to enhance positive socioeconomic effects and mitigate negative impacts.

8.12.2 Existing Environment

The Proposed Development occurs within Greater Hume Shire Council LGA, near the Albury City Council LGA boundary, 4 km north-east of Jindera and 20km north of Albury in southern NSW, and as such any existing or potential impacts will be localised within these two Council areas. The population of the greater Riverina Murray region is expected to grow modestly over the next 20 years from 273,150 in 2016 to a predicted 284,300 in 2036 (DPE, 2016).

In the 2016 Census, there were 10,351 people in Greater Hume Shire LGA representing a 5.44% population increase since the 2011 Census (ABS, 2017). Of these, 50.1% were male and 49.9% were female (ABS, 2017a). Aboriginal and Torres Strait Islander people made up 3.3% of the population (ABS, 2017a). The median age of people in the Greater Hume Shire LGA is 44 years, six years older than the national median (ABS, 2017a).

In the 2016 Census, there were 51,076 people in the Albury City LGA representing a 6.84% increase since 2011 Census (ABS, 2017b). Of these 48.3 % were male and 51.7 % were female (ABS, 2017c). Aboriginal and Torres Strait Islander people made up 2.8 % of the population (ABS, 2017c). The median age of people in the Albury LGA is 39 years, one year older than the national median (ABS, 2017c).

8.12.2.1 Local Economy

The Murray regional economy has historically been based on agriculture, and it remains one of the most productive agricultural areas in Australia. In 2018-19, the gross value of agricultural production in the Murray region was $1.5 billion, with the agriculture, forestry and fishing sector employing 4,100 people, equating to 13% of the region's employment (ABARES, 20208). The agricultural industry is complemented or supported by urban industries and services ranging from manufacturing to professional services.

Greater Hume Shire's main industries include agriculture, education and training, and health care and social assistance (ABS, 2017a). Of the employed people in Greater Hume Shire LGA, 5.3% worked in Beef Cattle Farming (Specialised). Other major industries of employment included Sheep Farming (Specialised) 3.5%, Hospitals (except Psychiatric Hospitals) 3.4%, Grain-Sheep or Grain-Beef Cattle

Farming 3.4% and Other Grain Growing 2.8%. The unemployment rate is 4.6%, less than the national unemployment rate of 6.3% (ABS, 2017a).

Albury is a regional centre for Southern NSW and provides educational facilities, transport facilities, sporting and recreational facilities, hospitals and services for the tourism industry. Of the employed people in Albury (LGA), 4.5% worked in Hospitals (except Psychiatric Hospitals). Other major industries of employment included Supermarket and Grocery Stores 2.6%, Cafes and Restaurants 2.3%, Takeaway Food Services 2.3% and Primary Education 2.3% (ABS, 2017c). The unemployment rate is 6.8%, which is greater than the national unemployment rate of 6.3% (ABS, 2017c).

8.12.2.2 Strategic Plans

Riverina Murray Regional Plan 2036

The Riverina Murray Regional Plan provides a 20-year blueprint for the region, encompassing the NSW Government's visions for the Riverina Murray, and the goals, directions and actions that have been developed with the community. The Proposed Development supports the four goals outlined in the Regional Plan:

- **Goal 1 – A growing and diverse economy:** The Proposed Development is a utility-scale project that will provide an opportunity to diversify energy supply, and employment opportunities within the region
- **Goal 2 – A healthy environment with pristine waterways:** The Proposed Development has been located and designed to minimise environmental impacts, including those to water catchments, including fish habitat and riparian corridors. Land disturbance associated with the development is minimal
- **Goal 3 – Efficient transport and infrastructure networks:** The Proposed Development has been located to maximise the use of existing transmission lines ensuring that electricity infrastructure is being used efficiently
- **Goal 4 – Strong, connected and healthy communities:** The Proposed Development will provide a diversified income base for host landholders, and employment opportunities and flow-on economic benefits to the broader region.

Both the Greater Hume Shire and Albury Councils have in place Strategic Plans to provide information on aspiration goals for each community, including each Council's mission and purpose.

Greater Hume Shire – Live a Greater Life Our Community Strategic Plan 2017 – 2030

This Community Strategic Plan (CSP) was adopted by Greater Hume Shire Council in 2017 and establishes the community's goals and long-term aspirations. The Greater Hume Shire Council's vision is to have a community that is "Partnering to advance our rural communities" (Greater Hume Shire Council, 2017). The Proposed Development finds support in two of the community's main priorities and aspirations which are identified in the Community Strategic Plan and detailed below:

- **Outcome 2.1 – Welcoming, resilient and involved communities**: The Proposed Development may create local career opportunities by employing trainees/cadets/apprentices in the construction and operational phases, contributing to a community that is resilient and involved in local industry

- **Outcome 3.3 - Increased number of visitors enjoy our shire:** The Proposed Development will directly provide contractor construction jobs which in turn will benefit the services, hospitality and retails sectors through an increased number of bookings.

Community and National Attitudes to Solar Farms

Solar power is considered to be the preferred form of electricity generation in Australia. For example, in a 2016 survey, 86% of respondents named solar power among their top three most preferred energy sources, up from 81% in the same survey in 2012 (The Climate Institute, 2016).

As detailed in Section 7, during the course of engaging with neighbours, both CWPR and Trina Solar sought to engage with 42 distinct households within a 5 kilometre radius of the Project site. Discussions were held with 38 of these neighbours over the course of 2 years.

A majority (T=27 neighbours) indicated they had no material issues with the project. Many raised valid questions which Trina Solar sought to provide responses to via email, phone and follow up meetings.

A smaller group of neighbours voiced a higher number of individual concerns with some also expressing their opposition to the Project (T=9 neighbours). Through concerted engagement, Trina Solar was able to alleviate some of these concerns for these specific neighbours. In other cases, concerns remain unresolved. In all cases, Trina Solar will continue to engage and consult with all neighbours as the Project moves through the Approvals process.

Of these discussions held with residents, 27 indicated they had no material issues with the project, however raised valid questions which Trina Solar sought to provide responses to via email, phone and follow up meetings, and nine voiced a higher number of individual concerns with some also expressing their opposition to the Project. Key concerns raised include:

- Visual impact/amenity
- Glint and glare
- The potential for property devaluation
- Agricultural land loss/ Impacts on agricultural use of the land
- Noise during construction and operation
- Traffic.

8.12.2.3 Renewable Energy Targets

Federal and State policies are important factors influencing the demand and investment in the renewable energy sector across NSW, as noted below.

Paris Climate Accord

The Paris Accord is a comprehensive international climate agreement to which Australia is a party. The Accord provides a framework for participating nations to set themselves NDCs, beginning in 2020, with review at five-year intervals. The agreement sets out a global consensus to limit temperature increases to below two degrees Celsius when compared to pre-industrial levels; an additional goal is to maintain this increase at less than one and a half degrees Celsius. NDCs do not have any set lower limit but are required to progress over time (beginning with the intended NDC pledged during the Paris conference), and to be 'ambitious'. Australia's current targets are a reduction in emissions by five% from 2000 levels by 2020, and by 26-28% below 2005 levels by 2030. (Department Agriculture, Water and Environment, 2015).

Federal Renewable Energy Target

The RET is an Australian Government scheme designed to reduce emissions of greenhouse gases in the electricity sector and to encourage the additional generation of electricity from sustainable and renewable sources.

The RET works by allowing both large-scale power stations and the owners of small-scale systems to create certificates for every megawatt hour of power they generate. Certificates are then purchased by electricity retailers who sell the electricity to householders and businesses. These electricity retailers also have legal obligations under the RET to surrender certificates to the Clean Energy Regulator, in percentages set by regulation each year. This creates a market which provides financial incentives to both large-scale renewable energy power stations and to the owners of small-scale renewable energy systems.

In June 2015, the Australian Parliament passed the Renewable Energy (Electricity) Amendment Bill 2015. As part of the amendment bill, the large-scale RET was reduced from 41,000 GWh to 33,000 GWh in 2020, with interim and post-2020 targets adjusted accordingly (Clean Energy Regulator, 2016).

NSW Renewable Energy Action Plan 2013

The NSW REAP provides a framework to enable the State to meet the RET target. While the NSW Government does not mandate a specific renewable energy target for the State (unlike Victoria and Queensland which have 50% renewable energy targets by 2030), it does have an aspirational target of zero net emissions by 2050.

The NSW Renewable Energy Action Plan Implementation Report was published in December 2018, which outlined that all 24 actions had been implemented, cementing the position of renewable energy generation as a means of meeting energy needs in NSW.

8.12.2.4 Electricity Demand in NSW

The AEMO's 2019 *Statement of Opportunities Report* concluded that although population increase within Australia is the main driver of electricity consumption, average operational electricity consumption is decreasing and is forecast to continue to decrease (Figure 8-47). This is thought to be due to increases in energy efficiency and shifting away from energy-intensive industries. However, load factors are also decreasing. This indicates that the difference between average electricity consumption and maximum electricity demand is growing – meaning Australia is experiencing more record high maximum demand days per year. This requires high electricity usage over short-term durations, putting generating plants at capacity and at risk of critical plant outages.

In the long-term, maximum operational demand is forecast to increase by 0.7% in NSW (AEMO, 2019). Therefore, to ensure critical plant outages during periods of peak demand do not increasingly occur, the development of new renewable energy generation across the NEM is required.

As of 18 July 2019, over 7.2 GW of new capacity is committed to enter the market, with the majority being wind and solar generation. Before 2021-22, an additional 4.7 GW of wind and solar energy is expected to reach full commercial use and over 41 GW of proposed wind and solar projects are known to AEMO.

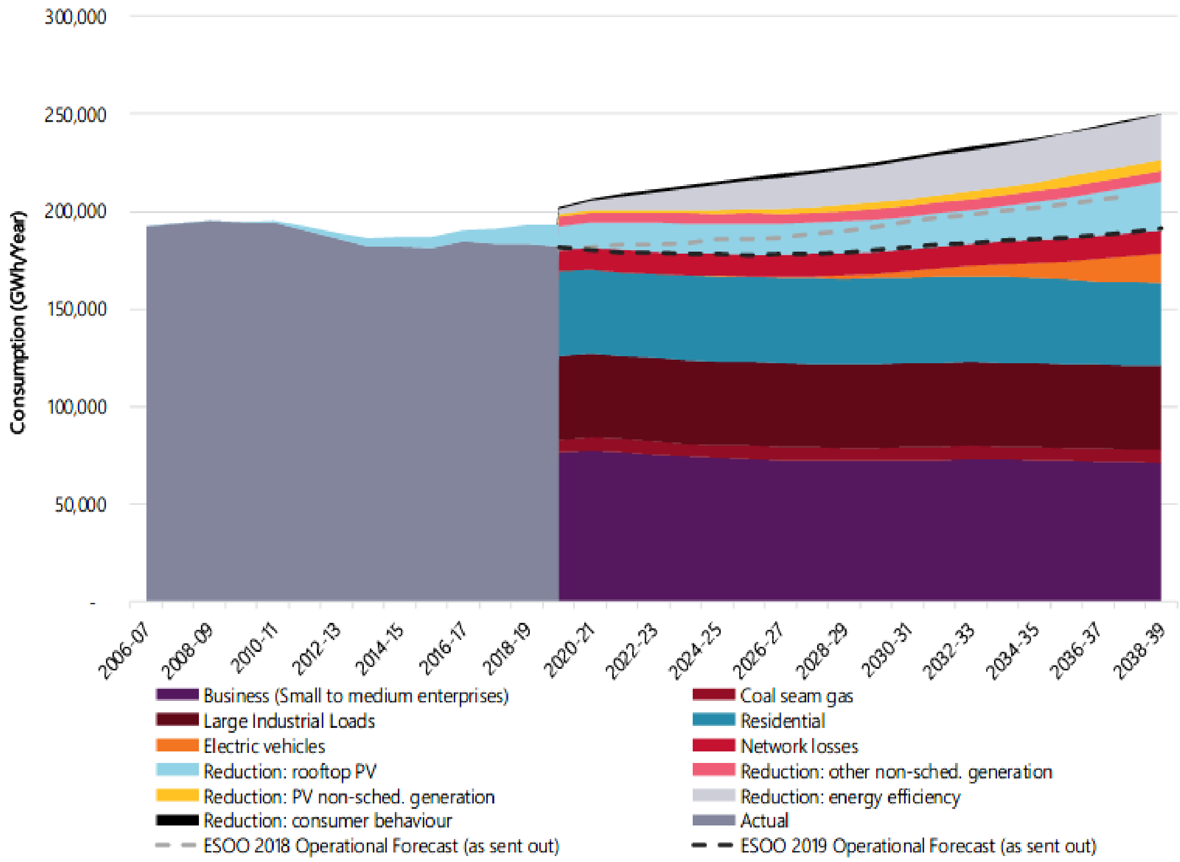

Figure 8-47: Total National Energy Demand consumption (GWh), actual and forecast, 2006-07 to 2038-39 (AEMO, 2019)

8.12.3 Potential Impacts

General

The socioeconomic and environmental benefits of developing renewable energy sources, and transitioning to a low carbon future are large, providing potential benefits to communities and helping to maintain quality of life in the longer term. Indeed, increased adoption of renewable energy sources will assist Australia to transition away from traditional carbon intensive energy production which is linked to atmospheric pollution and carbon emissions associated with climate change. Reducing carbon emissions has the potential to reverse or slow the effects of climate change, benefitting current and future generations (IPCC, 2018).

Electricity produced from the Site provides a clean power source for local and regional consumers in a cost-effective manner. GSF would produce clean renewable energy to the local electricity transmission network, providing enough energy to power around 50,000 average NSW homes each year. This would reduce up to 328,000 tonnes of CO_2 per annum through the displacement of conventional electricity supply (based on current NSW emission figures of 0.82 kg of CO_2-equivalent per kWh).

There will be a temporary reduction in agricultural production and therefore incomes from agricultural activities during construction and operation of the GSF, such as modified grazing activities of associated landowners. This loss of income will be appropriately offset by the rental income generated from the land lease arrangements for all associated landowners hosting the Proposed Development and therefore localised negative economic impacts will be minimised. Diversification of farm income will provide the host landholders the opportunity to further invest in agricultural production activities of the remaining portions of the farms not leased for renewable energy purposes.

A carefully designed solar farm in a rural area, which includes mitigation measures to neighbouring properties, is not expected to have a major impact on property values in its vicinity. Property values are determined by a wide-range of factors, many of which cannot be controlled by the owner of a landholding. Further, impacts on property values may be subjective. There have not been any published Australian studies into the impact of utility-scale solar on property values; however, of the few international studies available, none indicated negative impacts to property values in proximity to a utility scale solar farm (FutureAnalytics, 2016; McGarr, 2018). Urbis (2016) reviewed the impact of wind farms on property values and found that wind farms are not likely to adversely affect land values in Australia. Wind farms have significantly greater visual and operational noise impacts than solar farms, so the impact of solar farms on land values is considered likely to be substantially lower than that of wind farms.

Most lots in the area surrounding the Proposed Development are zoned RU1 and RU4. Property will therefore mostly be valued by its productivity for agricultural purposes. As demonstrated through this EIS, this will not be negatively affected by the solar farm, therefore an anticipated change in property value cannot be established. Additionally, the suite of mitigation measures the proponent has agreed to, including setbacks and screening measures, will further reduce impacts to residences and, as a result, minimise potential negative impact on values.

Construction

GSF would have an overall positive impact on the local and wider economy during the construction period. Construction will take up to 18 months and up to 200 staff will be required. The construction stage of the Proposed Development will generate the largest economic gain for the greatest number of people and businesses in, with these gains expected again during the decommissioning phase. This is due to the project requiring a large temporary work force over the construction period and later for six months of decommissioning. Employment opportunities generated from earthworks, concreting, steel works and electrical cabling during construction, with demolition and removal during decommissioning. Where possible the Proponent will source from local companies. Indirect employment opportunities would be created by the demand for food industries, fuel, equipment suppliers, vehicle maintenance, accommodation and other services that contractors coming to the area would require.

Community wellbeing is likely to be positively influenced by the Proposed Development during the construction phase in a number of ways, including:

- A short-term increase in population during construction due to the incoming workforce, stimulating the local economy due to demand for local accommodation, hospitality and retail services
- An increase in the number of jobs available in the area during the construction of the Proposed Development;

Local employment opportunities will be generated, while additional workers from outside the region would stimulate the local economy through demand for accommodation, hospitality and retail services. A temporary influx of staff may lead to an increase in pressure on local services, including accommodation. However, it is anticipated that a large majority of additional workers will commute from Albury, which provides more short-term accommodation options than those available in the Greater Hume LGA. There may be opportunities for longer term rental arrangements within the Greater Hume LGA, which had an 85.7 % occupancy rate for private dwellings on the night of the last census (ABS, 2017a), where it is determined that there will be a positive benefit. There is the possibility that construction of the Proposed Development will overlap with that of other major projects in the region, leading to accommodation shortages. This cumulative impact is discussed further in Section 8.13.

Construction noise and additional traffic on the Jindera Walla Walla Road, Lindner Road and Ortlipp Road will be noticeable to local residents during the construction period, however longer term, the improvements made to those roads will be of benefit to local residents (Section 8.8).

During the construction period, there would be a moderate change to the visual character of the Site. However, construction activities would be temporary in nature, and would be lessened in magnitude through the retention or areas of existing boundary vegetation, incorporation of residential set-backs and the early establishment of vegetation screening around the perimeter of the Site (Section 8.6). Furthermore, the changes in construction activities and their relative location as they move across the Site would limit both the duration and intensity of visual impacts. Generally, views of the Proposed Development from Lindner Road, Ortlipp Road and Drumwood Road would only extend over part of the Site (see Section 8.6).

Operation

GSF would have an overall positive effect on the local and wider economy through the employment of up to 10 full-time equivalent employees. Increased employment from GSF would provide an opportunity for the diversification of rural incomes and, therefore, would increase economic security for the local economy. GSF would result in a diversification of farm income for the host landholders. GSF would not create major land disturbances or land use conflict (Section 8.5). Furthermore, the size of the Development Footprint (up to 334.2 ha) would not diminish the availability of land for agricultural production purposes within the Greater Hume Shire LGA as the land will remain in place and available to grazing livestock underneath the panels (Section 8.5).

Noise and traffic impacts during this time are not predicted to be significant.

It is not anticipated that GSF would have any adverse impacts on tourism given its limited visibility and the general positive attitude of Australians towards renewable energy and solar developments. Elsewhere, solar farms, as well as other renewable energy projects are being used as a tourism drawcard (South East Region of Renewable Energy Excellence, 2016). Anticipated operational impacts to landscape character are considered to be low, and impacts to visual amenity can be managed through detail design and mitigation (Section 8.6)

Community wellbeing may be positively influenced by the Proposed Development by a small increase in full-time employment during operation for a select skilled workforce.

No negative socioeconomic impacts are expected as a result of the introduction of the Proposed Development during the operational period.

Decommissioning

The Proposed Development would not create major land disturbances or land use conflict (Section 8.5). Furthermore, the Proposed Development is fully removable and would not result in any long-term impacts to the inherent soil fertility, allowing existing farming activities to continue following decommissioning.

It is anticipated that decommissioning will be undertaken over a shorter duration than the construction period (up to 6 months). However, the same economic benefits and opportunities identified for the construction period would arise during this time. Further economic benefits may include local recycling of infrastructure.

8.12.4 Mitigation Measures

Mitigation measures for socioeconomic impacts are outlined in Table 8-59. Mitigation measures relating to noise, traffic and visual amenity have been addressed in Sections 8.7, 8.8 and 8.6.

Table 8-59: Mitigation measures for socioeconomic impacts

Environmental safeguard	Timing*		
	C	O	D
Continued consultation with the community and relevant stakeholders during the construction phase.	✓		✓
Construction staff, where possible, are recruited from local areas.	✓		✓
An informal 'buy local' practice applies, where goods and services are purchased from local businesses provided that they are competitive in terms of quality and price.	✓		✓
The Proponent will liaise with local industry and local councils to minimise any potential conflicts arising from demand for accommodation and related services.	✓	✓	✓

***** C = Construction, O = Operation and D = Decommissioning

8.13 Cumulative Impacts

8.13.1 Introduction

The close proximity of multiple construction and/or operational projects provides opportunity for potential cumulative impacts. Key mitigation strategies for cumulative impacts are:

- Spatial separation of impacts
- Temporal separation of impacts
- Development of specific mitigation strategies.

The following section provides an assessment of potential cumulative impacts associated with GSF.

8.13.2 Existing environment

A search of the NSW Major Projects Register and LGA websites (NSW and Victoria) was undertaken on 16 October 2020 to identify other large or major projects which may contribute to cumulative impacts on the local community. The location and status of projects identified during the search are provided in Table 8-60 and projects within 50 km of the GSF are shown in Figure 8-48.

Table 8-60: Nearby major and/or renewable energy projects

Project	Approximate Distance and Direction from GSF	Development Phase
Jindera Solar Farm (130 MW)	310 m NE	NSW DIPE decision pending
Walla Walla Solar Farm (300 MW)	21 km N	NSW DIPE decision pending
Hume Battery Energy Storage System (capacity of 20 MW / 40 MWh)	22 km SE	NSW DIPE decision pending
Howlong Sand and Quarry Expansion	25 km W	Response to Submissions
Wodonga Solar Farm, Victoria (54 MW)	26 km SW	Approved
Culcairn Solar Farm (400 MW)	27 km NNE	NSW DIPE decision pending
Corowa Solar Farm (27 MW)	45 km W	Approved
Wangaratta Solar Farm, Victoria (20 MW)	66 km SW	Approved
Mulwala Solar Farm (80 MW)	81 km W	Approved
Laceby Solar Farm, Victoria (60 MW)	85 km SW	Approved
Winton North Solar Farm, Victoria	88 km SW	Under consideration in Victoria
Gregadoo Solar Farm (45 MW)	89 km NE	Approved
Glenrowan Solar Farm, Victoria (140 MW)	89 km SW	Approved
Glenrowan West Solar Farm, Victoria (130 MW)	91 km SW	Under construction
Winton Solar Farm, Victoria (85 MW)	98 km SW	Under construction

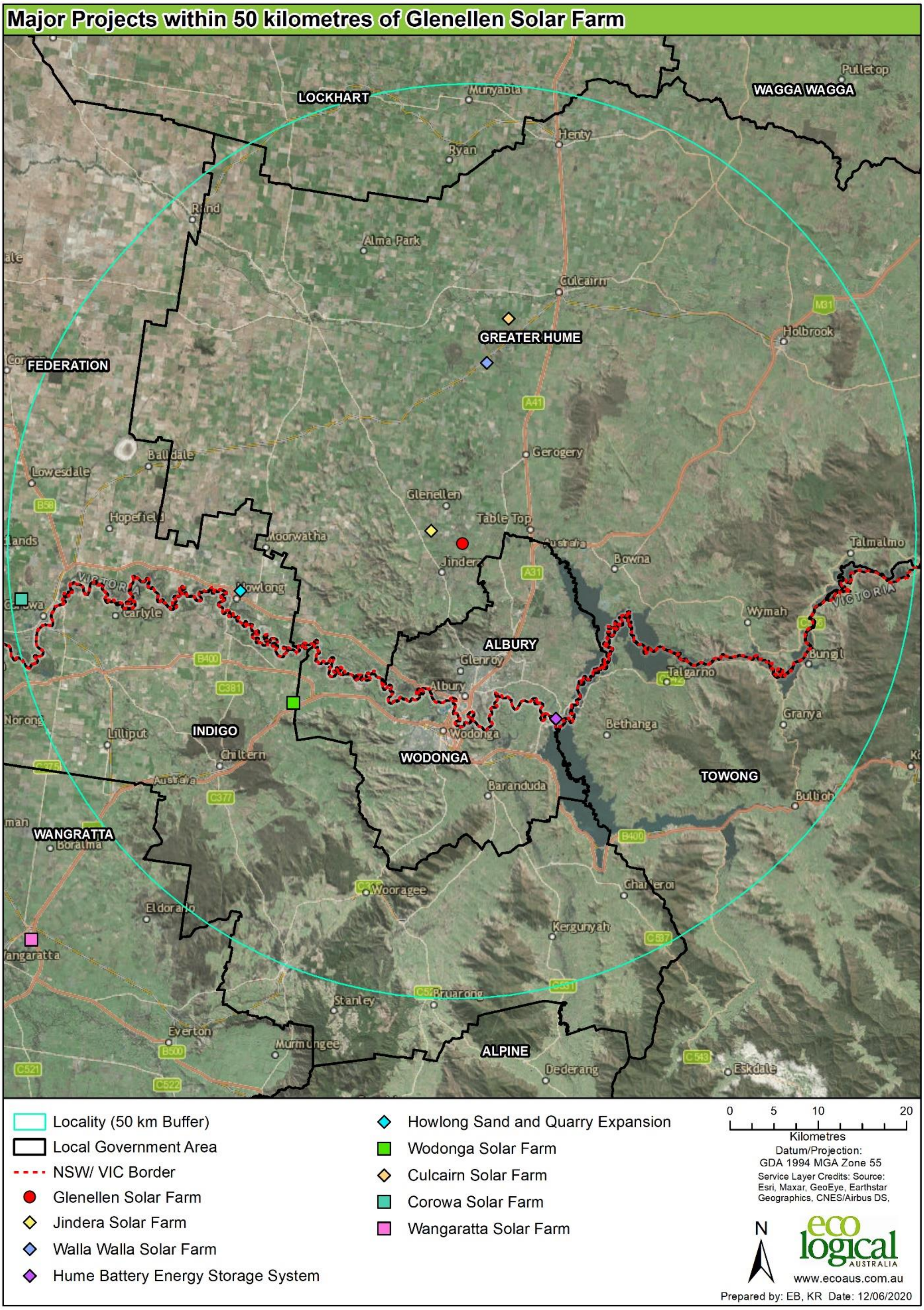

Figure 8-48: Location of major and large projects within 50 km of the Proposed Development.

Of these projects, the proposed JSF is considered the most likely project to contribute potentially significant cumulative impacts. JSF would be a commercial scale PV solar farm located 310 metres to the north-east of the GSF Site boundary and 490 m from the Development Footprint (Figure 8-49; Figure 8-53). JSF would also connect to the Jindera Substation.

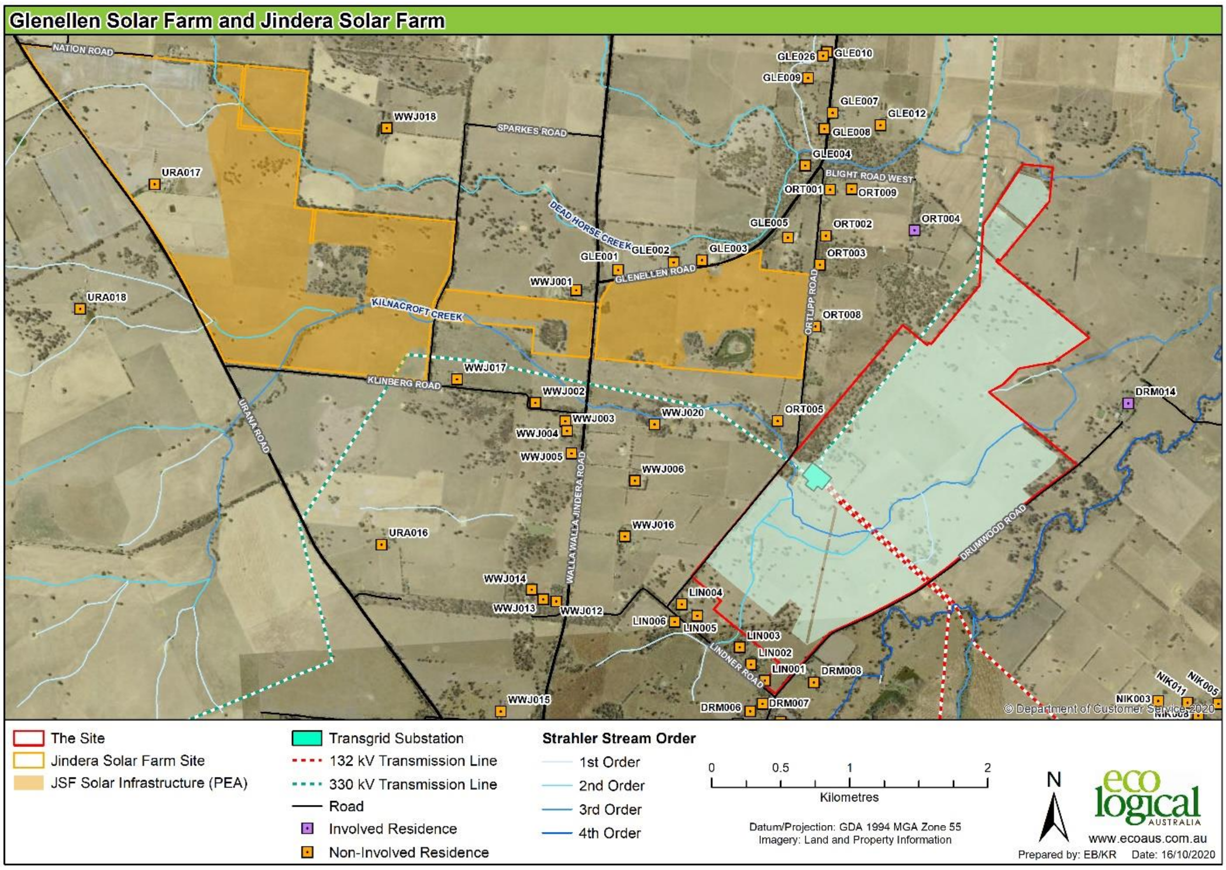

Figure 8-49: Jindera Solar Farm (PEA) and Glenellen Solar Farm

8.13.3 Potential impacts

The construction and/or operation of these proposed developments may possibly coincide with construction and/or operation of the GSF. Potential cumulative impacts have been considered for each issue assessed as part of the Environmental Assessment and are discussed below:

8.13.3.1 Land

The JSF site contains 245.7 ha of land mapped as IAL in the Draft Riverina-Murray Important Agricultural Land Mapping Program, 2018. Combined with the 164.5 ha of IAL the GSF Development Footprint, this 410.2 ha represents 0.67% of all land classified as IAL within the Riverina Murray Region. It is important to note that the IAL is not lost, such as in the case of rural residential subdivision, and following the project decommissioning the land will again be available for agriculture. The temporary installation of solar panels generally limits the range of agricultural land uses available (with current technology and knowledge this is limited to grazing), but in the case of the GSF, this will not lead to change in existing land use. Therefore, although agricultural productivity may be reduced during operation, it will not fundamentally change the balance of land use in the area.

8.13.3.2 Traffic

Several of the identified proposed developments are likely to also use the Hume Highway for access and deliveries including JSF, Wodonga SOL1 Solar Farm, Victoria (54 MW), and Wangaratta Solar Farm, Victoria (20 MW). As identified in Section 8.8, daily traffic flows recorded on Hume Highway are well within the capacity of the road leaving ample spare capacity to accommodate additional traffic. Additionally, the larger spatial separation between projects (with the exception of GSF and JSF) further reduces potential cumulative impacts associated with the Hume Highway.

During construction of the GSF it is anticipated that up to a maximum peak of 153 vehicle movements will be made per day to access the GSF Site, the majority via Walla Walla-Jindera Road, Lindner Road, and Ortlipp Road. The number of vehicle movements per day for the proposed neighbouring JSF are provided in Table 8-61. Indicative new site access to the JSF for haulage during construction will be constructed off Urana Road and Walla Walla-Jindera Road (being the approved heavy vehicle access route), with proposed emergency and maintenance only access from Klinbergs Lane and Ortlipp Road (Figure 8-50; NGH Environmental, 2020).

If construction periods for both proposed solar farms overlap, increased traffic volumes on the local road network would have a cumulative impact on surrounding residents. Additionally, there is potential for cumulative impacts relating to increased traffic volumes, traffic noise and dust generation along Ortlipp Road for residents along Ortlipp Road and its intersection with Lindner Road. These impacts would be temporary in nature, occurring over a 12 to 18-month construction period.

Traffic generation during operation will involve a small maintenance team using light vehicles and small trucks on a periodical basis, and in the event of unplanned maintenance. Such traffic volumes are considered unlikely to provide potential for future cumulative impacts.

Table 8-61: Jindera Solar Farm's Final Traffic Numbers (NGH Environmental, 2020: Appendix A.2.)

	Solar Farm		Transmission / Ortlipp Road		TOTAL Traffic (Solar Farm + Transmission line)	
Vehicles Movement per Day (vmpd)	Construction and decommissioning*	Operation	Construction and decommissioning*	Operation	Construction and decommissioning*	Operation
Heavy Vehicles	40 (vmpd)	8 (vmpd)	20 (vmpd)	2 (vmpd)	60 (vmpd)	10 (vmpd)
Light vehicles	200 (vmpd)	8 (vmpd)	12 (vmpd)	4 (vmpd)**	212 (vmpd)	12 (vmpd)**
OMOD total	10				10	

*in practice, decommissioning traffic is expected to be less

**No more than 4 vmpd to use Ortlipp Road maintenance access gates

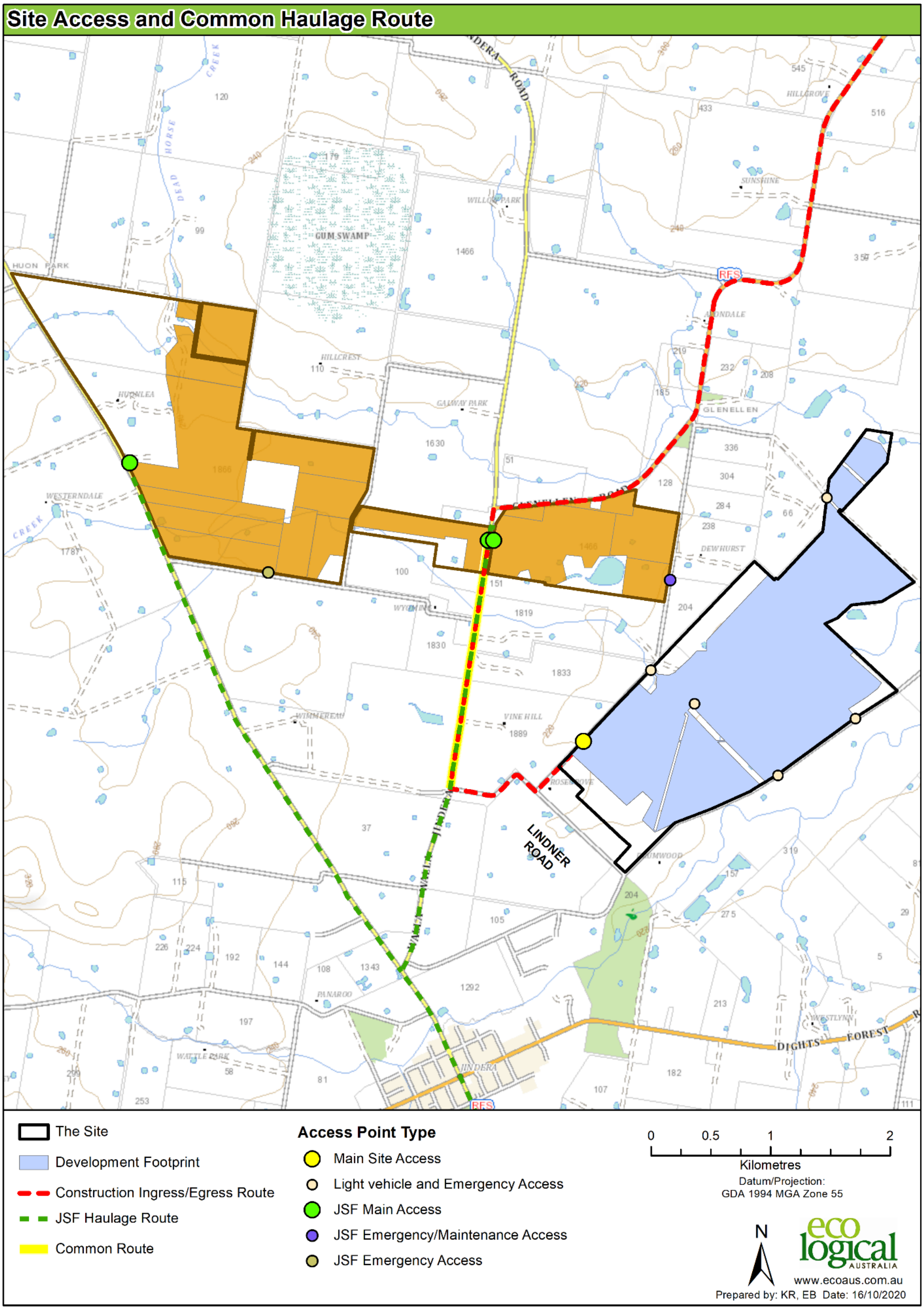

Figure 8-50: Approximate Site Accesses and Common Haulage Route (JSF route data from NGH Environmental, 2020)

8.13.3.3 Socio-economic

There is potential for the GSF construction period to overlap with JSF and other major projects in the region, leading to impacts to workforce accommodation availability. Whilst accommodation options within the Greater Hume LGA are limited, Albury-Wodonga as a regional centre in close proximity is expected to be able to meet potential cumulative demand for accommodation and related services.

It is anticipated the workforce for other major projects in the region are unlikely to travel more than 100 km to their workplace and would utilise accommodation in closer towns such as Howlong and Corowa and associated border towns, many of which have several motels (remnant from when gambling was restricted in Victoria).

The reduction in agricultural productivity (and impacts on associated ancillary services supporting agriculture) would therefore be offset by other economic activity associated with the GSF construction and operation).

8.13.3.4 Noise

Noise impact assessment for JSF were not available at the time of preparation of the GSF noise assessment, however, the PEA for JSF identifies potentially impacted 'sensitive receivers' within a 1 km buffer from the JSF site boundary (Figure 8-51; re-illustrated in Figure 8-52). Of the receivers within a 1 km buffer of JSF (Figure 8-52), ORT005 and ORT004 have been modelled as potentially noise affected from GSF during most construction activities (potentially exceeding the 50 dB(A) noise target) using CONCAWE Met Category 6 (worst-case scenario).

NGH Environmental, (2018), reported that noise impacts from JSF would largely "only occur during construction (generated by construction vehicles and machinery)" and that "noise impacts during operation of the solar farm are expected to be very low". Jindera Solar Farm Pty Ltd have committed to "adopt best practice mitigation measures during construction, such as standard work hours and regular vehicle and machinery maintenance to reduce the risk of adverse noise impacts" (NGH, 2018). Furthermore, construction phases of the JSF and GSF may overlap, however they are not expected to occur at the same location at the same time, therefore reducing any potential risk of cumulative noise impacts.

8.13.3.5 Visual impacts

Based on topography and separation distances it is anticipated that there is limited potential for significant views of GSF and any other solar farm developments other than JSF. During construction and operation, there may be a cumulative visual impact from GSF, JSF and associated existing and upgraded electricity infrastructure for private and public receivers.

Visual impact assessment for JSF is not available at the time of preparation of this assessment, however, the PEA for JSF identifies potentially impacted 'sensitive receivers' within a 1 km buffer from the JSF site boundary (Figure 8-51; re-illustrated in Figure 8-52). Of these, only one residence (WWJ016) is identified as potentially impacted by GSF. Given the low levels of visual impact associated with GSF, it can be anticipated that there is limited capacity for potential direct cumulative visual impacts.

Public viewpoints located within close proximity to both GSF and JSF include Ortlipp Road, Lindner Road, Blight Road West, Walla Walla Jindera Road, and Glenellen Road. Potential visual impacts to these public viewpoints associated with the proposed GSF are shown to be either low or insignificant (Table 8-31), and further reference to ZVI analyse indicates that only occasional momentary glimpses are likely from all roads within the assessment area (Figure 8-18). On this basis, potential direct cumulative visual impacts (including potential glint and glare) to public areas associated with GSF and JSF are considered to be low and manageable.

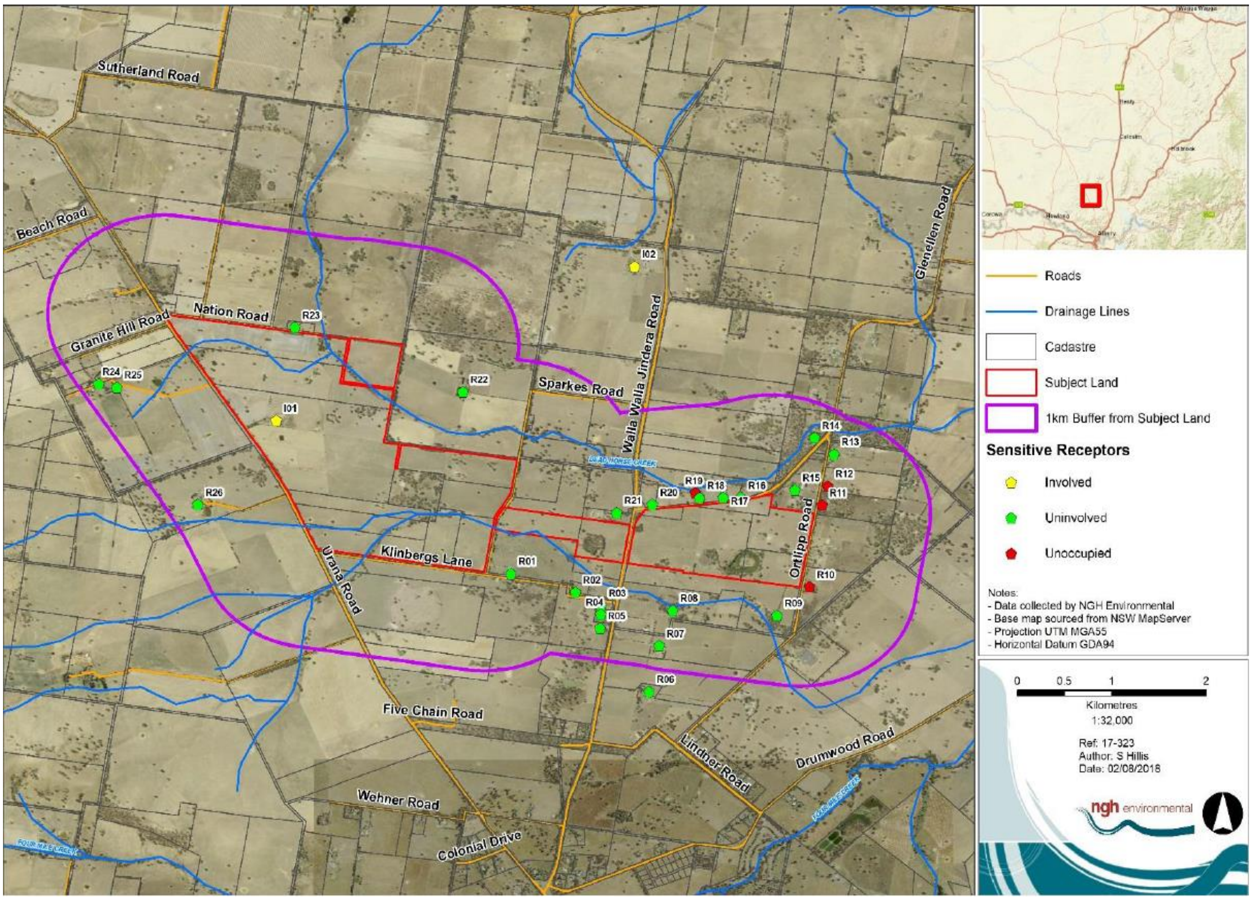

Figure 8-51: Jindera Solar Farm PEA "Sensitive Receivers within 1 km of the proposal" (NGH Environmental, 2018)

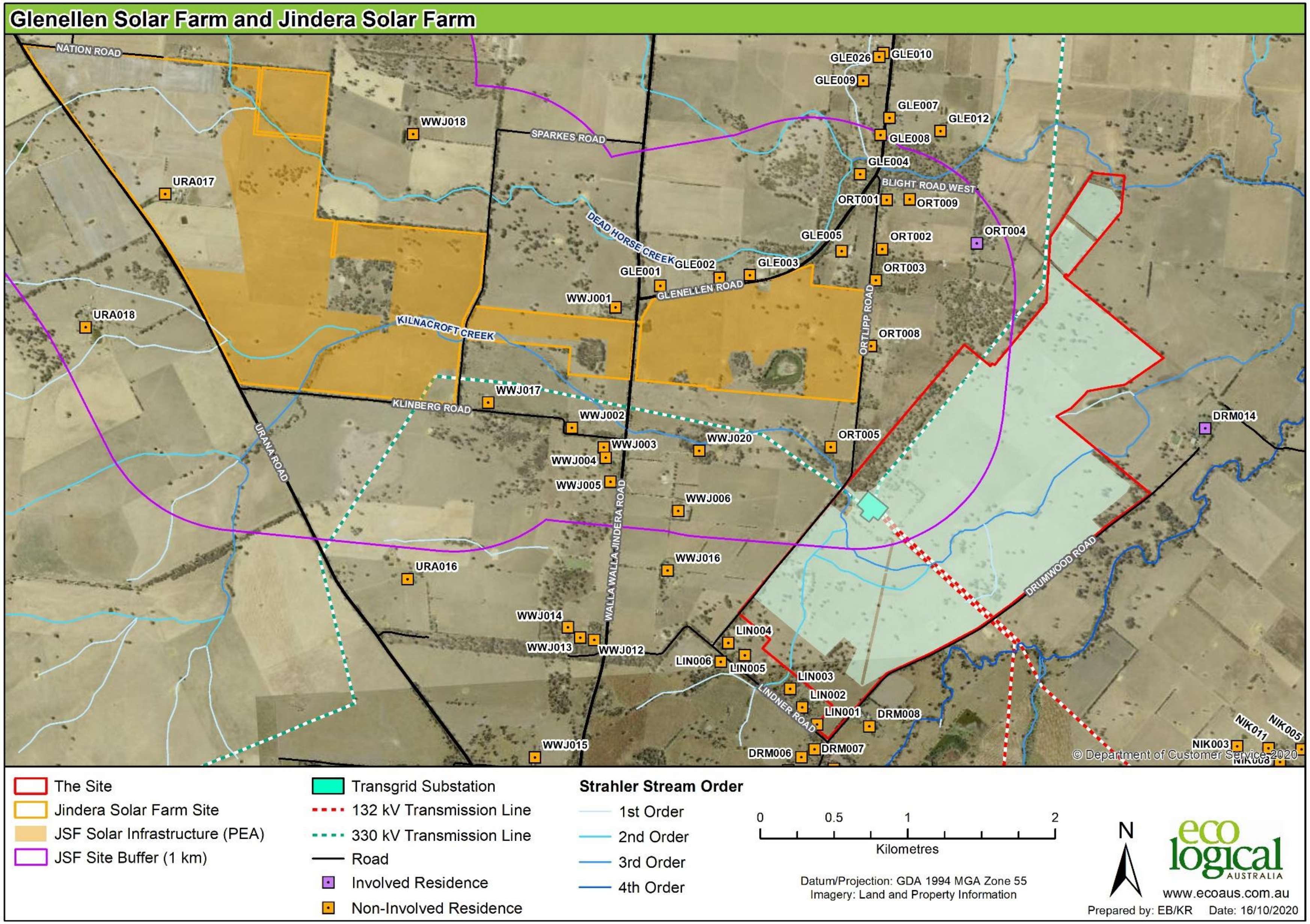

Figure 8-52: Jindera Solar Farm PEA 'Sensitive Receivers' relative to Glenellen Solar Farm residential receivers

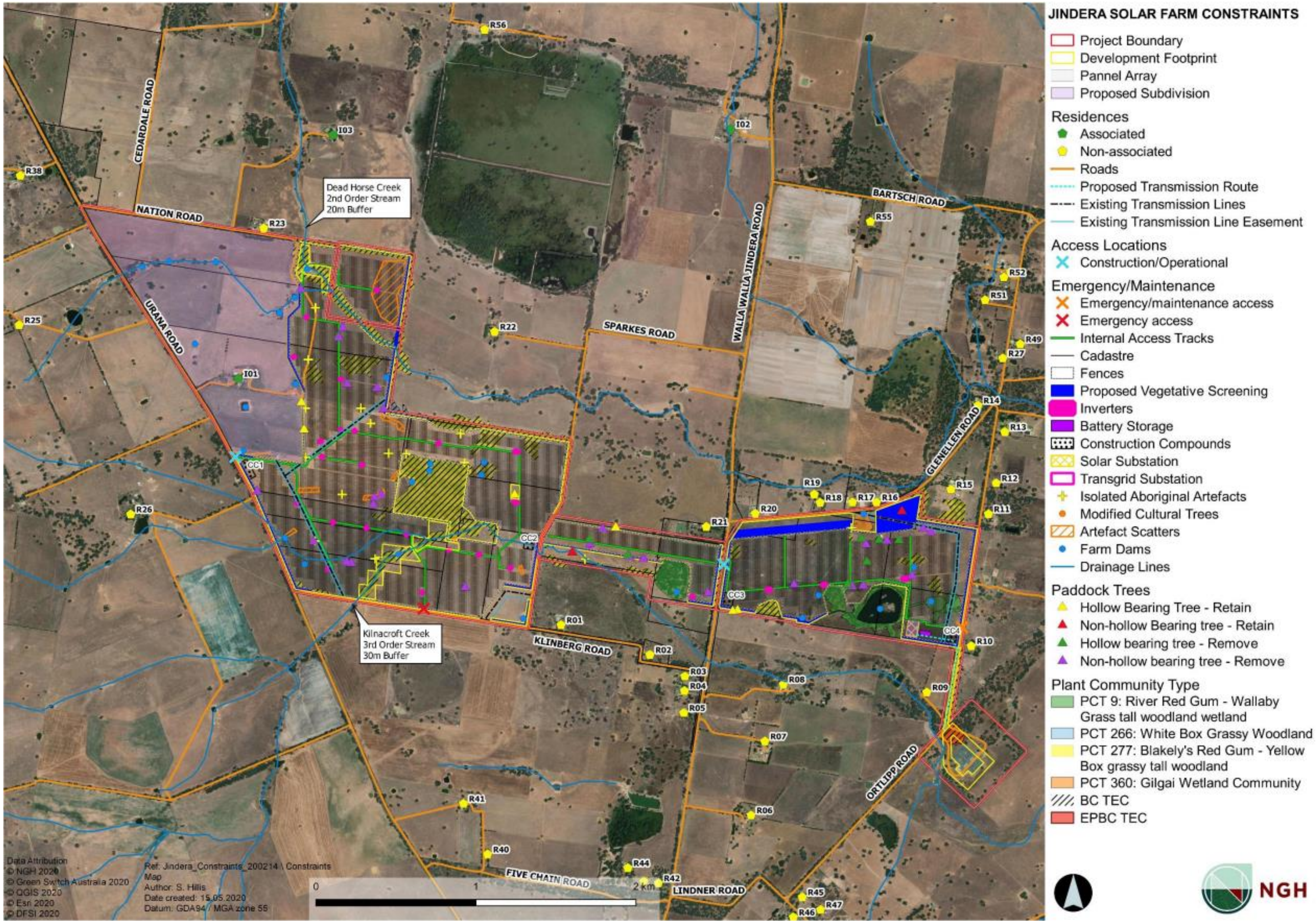

Figure 8-53: Jindera Solar Farm Project Layout (NGH Environmental, 2020)

8.13.4 Mitigation measures

For all other identified projects, besides JSF, the combined effect of temporal and spatial separation between GSF and other developments occurring, or proposed to occur, in conjunction with project specific mitigation measures are considered appropriate to satisfactorily mitigate potential cumulative impacts.

The following mitigation measures outlined in Table 8-62 may be used to further mitigate potential cumulative impacts with JSF if approval of both solar farm projects is granted, in addition to the subject-specific mitigation measures established that prevent and minimise potential impacts from the GSF.

Table 8-62: Mitigation measures for cumulative impacts

Impact	Environmental safeguard	Timing*		
		C	O	D
Agricultural Land	The cumulative impacts identified for the proposal are considered to be managed by existing mitigation measures that minimise the areas temporarily lost to infrastructure, Maintenance of livestock grazing to maintain agricultural production and prevent fragmentation of productive land, assist with biosecurity and bushfire management. No additional safeguards are proposed.	✓	✓	✓
Traffic	Preparation of a construction traffic management plan for GSF based on contemporaneous JSF traffic information.	✓		✓
	If the construction periods for GSF and JSF overlap, consultation with Jindera Solar Farm Pty Ltd may be required to finalise access points and routes for both solar farms to reduce the cumulative impact of increased traffic volumes.	✓		✓
	Should changes be made to the GSF estimated construction period, analysis of the activity levels of other large projects in the region should be undertaken to ensure potential cumulative impacts relating to traffic volumes and accommodation availability are managed accordingly.	✓		✓
Socio-economic	Consideration of preparation of a sub-contractor accommodation strategy to co-ordinate and optimise the utilisation of locally available accommodation resources and services.	✓		✓
Noise	If the construction periods for GSF and JSF overlap, consultation with Jindera Solar Farm Pty Ltd may be required to ensure adequate temporal and/or spatial separation of noise impacts. Staged construction to avoid cumulative impacts will be considered within a CEMP and monitoring of cumulative noise impacts will be undertaken for potentially impacted sensitive receivers located between the JSF and GSF.	✓		
Visual Amenity	Visual screening and buffer zones shall be established to mitigate potential visual impacts associated with GSF, thus minimising potential cumulative effects.	✓	✓	✓

***** C = Construction, O = Operation and D = Decommissioning

9. Environmental Management

9.1 Environmental Management Plans

Environmental management for the Proposed Development would be undertaken in accordance with appropriate management plans, which would be prepared to provide an overall framework for the management of environmental impacts that could potentially arise as a consequence of the Proposed Development. Mitigation measures identified throughout this EIS and summarised in Section 9.2 would be incorporated into the management plans, which would provide:

- An environmental manual for staff and contractors throughout the construction, operation and decommissioning of the Proposed Development
- Identification of the potential impacts of the Proposed Development and the measures identified to mitigate these impacts as described in Section 9.2 of this EIS
- Details of how environmental safeguards are to be implemented
- Details of the timing of the implementation of the mitigation measures
- Clearly defined allocations of environmental responsibilities for all staff members and contractors
- Monitoring and reporting requirements to demonstrate compliance with licensing and approval requirements
- Procedures for review and updating of the management plans.

Adherence to the management plans would enable environmental safeguards and mitigation measures to be effectively implemented and sustainable work practices adopted throughout the duration of the Proposed Development.

This would demonstrate the Proponent's intent to comply with conditions of consent, relevant environmental legislation, prevent environmental pollution and minimise the impact of the Proposed Development on the environment.

9.2 Statement of Commitments

A final design of the Proposed Development (Final Layout Plan) would be submitted to DPIE prior to the commencement of construction. Based on the final layout, mitigation measures outlined in this document are to be incorporated into the management plans. Each plan will be prepared prior to each stage of development commencing and submitted to the DPIE for approval. These mitigation measures will minimise any potential adverse environmental impacts arising from the Proposed Development. The mitigation measures and management plans are summarised in Table 9-1.

Table 9-1: Statement of Commitments

Impact	Objective	Mitigation Measure	Responsibility	Stage				Code
				PC	C	O	D	
Management Plans								
Detailed Design	Minimise impact	The project will be designed and constructed with the key objective to reduce environmental impacts. This will include avoiding and minimising impacts where practicable.	Proponent and Construction Contractor	✓				EM01
General	Minimise impact	An Environmental Management System (EMS) will be developed which outlines practices and procedures to be followed during construction and operation of the development.	Proponent	✓	✓	✓		EM02
	Minimise impact	An Environmental Management Plan (EMP) will be developed by the construction contractor to outline environmental management measures and procedures to be implemented during construction. This will include sub-plans to address: • Water quality • Air quality • Heritage (including unexpected finds) • Biodiversity • Noise and vibration • Environmental Incident response and notification • Traffic • Waste • Contamination • Storage of chemicals, oils and fuels • High risk activities • Training and induction.	Construction Contractor	✓				EM03
	Minimise impact	All employees and contractors will attend a project induction including details of environmental approvals, site management requirements and an overview of sub-plans contained in the EMP.	Proponent and Construction Contractor		✓	✓	✓	EM04
Biodiversity								
Biodiversity impacts during construction	Minimise impact	• Prior to the commencement of construction, a BMP will be developed in consultation with BCD. • Pest and feral animal management strategies will be implemented to control vertebrate pest populations within the Project Site and minimise their spread to and from the Project Site. • Weed management strategies will be implemented aiming at preventing and minimising the spread of priority weeds to and from, and within the Project Site. These include controlling any existing priority weed infestations prior to construction activities and implementing weed hygiene protocols. • Pre-clearing surveys will be undertaken by a qualified ecologist to determine if roosts, nests or dens are present in any trees proposed for clearing. • An ecologist/wildlife handler will be present to supervise during clearing of identified fauna roosting or nesting habitat. • Vegetation that is to be removed nearby to retained vegetation will be removed using a chain-saw rather than heavy machinery to avoid any additional impacts on adjacent vegetation.	Proponent and Construction Contractor	✓	✓			BM01
Biodiversity Offset	Compliance	A BOS will be developed prepared prior to commencement of construction to demonstrate the Proponent's capability to acquire and retire the full quantum of credits as required by the BAMC.	Proponent	✓	✓			BM02
Aboriginal Heritage								
Aboriginal heritage items	Minimise impact	Community collection in partnership with the RAPs will be undertaken prior to works commencing in order to mitigate impacts against AHIMS sites: 55-6-0111, 55-6-0112 and 55-6-0113.	Construction Contractor	✓				AH01
	Avoid	A CHMP will be prepared in consultation with DPIE and Aboriginal stakeholders. Additional archaeological assessment will be carried in any areas which are proposed for impacts that have not been surveyed during the current assessment. Design and ground disturbance will be undertaken to minimise impact to heritage items. If cultural heritage material is located during works that work will cease immediately and a suitably qualified person engaged to ascertain whether the material is of cultural origins and if so, they will advise how to proceed. If human remains are found, works should immediately cease, and the NSW Police should be contacted. If the remains are suspected to be Aboriginal, the BCD may be contacted to assist in determining appropriate management.	Proponent and Construction Contractor	✓	✓			AH02

Impact	Objective	Mitigation Measure	Responsibility	Stage PC	Stage C	Stage O	Stage D	Code
Historic Heritage								
Historic Heritage Items	Avoid	If potential historic heritage is identified all work within a 10 m radius of the site will cease and advice sought from an historic archaeologist. If required, notification under Section 146 of the Heritage Act would be undertaken and works would not recommence in the area until permitted.	Construction Contractor		✓			HH01
Land Resources								
Erosion	Minimise	As part of the EMP the contractor will prepare an erosion and sedimentation control sub plan. The plan will be prepared in accordance with the Blue Book Managing Urban Stormwater: Soils and Construction (Landcom, 2004) and include: • Site constraints and receiving waters; • Stockpile management; • Temporary site stabilisation and progressive revegetation; • Management measures for disturbance of sodic soils; • Separation of clean and dirty water; • Progressive erosion and sediment controls drawings prepared by a Certified Professional in Erosion and Sediment Control; and • An inspection, monitoring and maintenance schedule.	Proponent and Construction Contractor	✓	✓	✓	✓	LR01
	Minimise	Cable trenches will be constructed in accordance with relevant regulations and ground conditions. Trenches will be excavated and filled progressively to ensure they are left open for the shortest period possible. Surface conditions will be returned to pre-disturbance conditions and groundcover rehabilitated as soon as practicable to prevent the formation of preferential flow pathways. Where sodic soils are identified in areas to be disturbed by trenching activities, soil ameliorating additives will be considered (such as the use of Gypsum or alternatives as guided by soil testing results during detailed design).	Construction Contractor		✓		✓	LR02
Land Use Conflicts	Detailed Design	The solar array would be designed to ensure there is sufficient space between panels to allow establishment and maintenance of groundcover and weed control activities. Where practicable, the existing pasture composition will be retained. Where establishment fails in disturbed areas or under the panels agronomic advice may be sought to determine alternative management options for groundcover to protect soil from erosion in addition to the above erosion measures.	Proponent	✓				LR03
	Minimise	Areas used for temporary construction compound and laydown areas during construction will be restored to original condition or revegetated with grasses suitable to achieve the ground cover and erosion minimisation goals.	Construction Contractor		✓			LR04
Contamination	Avoid	To avoid release to the environment, all hazardous materials (fuels, lubricants, herbicides, etc.) will be disposed of site in accordance with NSW EPA guidelines. Onsite refuelling shall occur in a dedicated area that is located greater than 100m from the nearest drainage line, on an impervious, flat and bunded surface (such as an appropriate drip tray). Machinery will be inspected regularly to ensure no oil, fuel or lubricants are leaking from the machinery.	Proponent and Construction Contractor		✓			LR05
Dust	Minimise	Modify working practices by limiting construction activities during periods of high winds (greater than 20 km/hour). Modify activities if dust is observed leaving the Site towards nearby sensitive receptors. May require use of a water truck. Stage clearing and excavation activities to minimise total areas of cleared ground. Minimise the number and volume of stockpiles on-site and the number of work faces on stockpiles.	Construction Contractor		✓	✓	✓	LR06
Visual								
Visual Amenity	Minimise Impact	Visual impact mitigation measures will be offered to owners of non-involved neighbouring residences where there is opportunity to significantly reduce potential visual impacts from the proposal. Visual impact mitigation measures may include landscaping, screen plantings, which can be located on the owner's land to minimise visual impacts of the Project at the residence and its curtilage. Mitigation measures will be determined through consultation with the owner, be reasonable and feasible, and directed towards reducing the visual impacts of the Project on the residences, commensurate with the level of visual impact. However, this mitigation measure will not apply where the Proponent has an agreement with the relevant owner/s of these residences with regard to visual impact.	Proponent	✓	✓			VM01
Impact to Receivers	Minimise Impact	To minimise impact from external lighting, lighting will be low intensity lighting (except where required for safety or emergency purposes), erected to not shine above the horizontal and comply with Australian Standard AS 4282 (INT) 1997 — Control of Obtrusive Effects of Outdoor Lighting, or its latest version.	Proponent	✓	✓			VM02
Noise								
Construction Noise	Minimise impact	Construction work will be restricted to the following hours: • Monday to Friday – 7 am to 6 pm; • Saturday – 8 am to 1 pm; and	Proponent and Construction Contractor	✓	✓		✓	NM01

Impact	Objective	Mitigation Measure	Responsibility	Stage				Code
				PC	C	O	D	
		• No construction work on Sundays or public holidays. Notwithstanding works undertaken outside these hours may occur where the activity is inaudible, for emergency works, delivery of certain materials, in accordance with Environmental Planning and Assessment (COVID-19 Development – Construction Work Days) Order 2020 or where agreement from the Secretary has been provided.						
	Compliance	Construction and decommissioning activities will be managed to minimise noise impact in accordance with the Interim Construction Noise Guidelines 2009 and outlined in the EMP. This may include maximising separation distances, use of acoustic barriers, acoustic enclosures, scheduling work and / or modifying work practices.	Proponent and Construction Contractor		✓		✓	NM02
Construction Vibration	Minimise impact	Where residential dwellings are located within 100 m of construction works and a 10 tonne vibratory/foot roller is expected to be used, it is recommended to use a smaller vibratory/foot roller to suit the required buffer distance.	Construction Contractor		✓			NM03
Operational Noise	Compliance	Implement sound reduction strategies if invertor/NSR separation distances cannot be met. The operator will maintain effective relationships with NSRs and work in a proactive manner to minimise operational noise impacts.	Proponent and Construction Contractor			✓		NM04
Transport								
Traffic and Transport Impacts during Construction	Minimise Impact	Prior to the commencement of construction, a TMP will be prepared for the Project in consultation with Transport for NSW and the Greater Hume Shire Council.	Proponent and Construction Contractor	✓				TM01
	Minimise Impact	Road dilapidation surveys will be undertaken in accordance with guidelines and standards established by Austroads of the designated vehicle route prior to construction and decommissioning works and post construction and decommissioning. Following completion of construction and decommissioning works, any development related damage identified in post dilapidation survey will be rehabilitated / repaired.	Construction Contractor	✓			✓	TM02
	Minimise Impact	Any road upgrades required will be subject to detailed design and constructed to the relevant Australian road design standards.	Construction Contractor	✓	✓			TM03
	Minimise Impact	Should transportation of oversize loads be required, the proponent will investigate the procedures and requirements for special permits for oversized loads in the traffic management plan and in liaison with Transport for NSW. The proponent will liaise with the Special Permits Unit early in the process to assess the appropriateness of the route and identify potential issues.	Construction Contractor	✓	✓			TM04
Water								
Water Use	Design	As a result of a design philosophy that, in the first instance, seeks to avoid impacts, the following environmental protections apply: • Sourcing of non-potable, construction and operational water from rainwater tanks and existing farm dams • Sourcing from offsite all potable water requirements.	Proponent and Construction Contractor	✓				WM01
	Minimise	Potable water will be sourced off-site, via registered water suppliers. Non-potable construction water requirements will be sourced either off-site or from farm dams and creeks under existing Water Sharing Plan licences within the lease area. Rainwater tanks installed to support buildings provide an additional source of non-potable construction water and a climate independent firefighting source. The Proponent will source no more than 10% of the total surface water from existing surface water dams located within the Site.	Proponent and Construction Contractor		✓	✓		WM02
Water Resources (Including Groundwater, Aquatic and Riparian Environments)	Design	As a result of a design philosophy that, in the first instance, seeks to avoid impacts, the following environmental protections apply: • Exclusion of 3rd order and higher streams from the Development Footprint (except infrastructure crossings across Kilnacroft and Dead Horse Creeks) • Application of a 20 m (from stream thalweg) buffer zone for 3rd order and higher riparian zones • Minimisation of creek crossings for within site access and electrical cabling • Localised scour protection around building pads	Proponent and Construction Contractor	✓				WM03
	Minimise	Activities with the potential for adverse water quality impacts would be managed through the development of site specific sediment control plans and spill controls. Culverts (if in design) on Kilnacroft Creek will be designed as per the Policy and Guidelines for Fish Habitat Conservation and Management (Fairfull, 2013) and Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge 2003). Installation of cables across Kilnacroft Creek will follow relevant design considerations as per the NSW Office of Water's Controlled Activities: Guidelines for laying pipes and cables in watercourses. Solar arrays will be designed and installed so as to not impede overland flow. Construction and operational structures will not be located within flood prone land.	Proponent and Construction Contractor		✓	✓		WM04
Hazards and Risks								
Bushfire and Electrical Fire	Minimise Risk	Develop bushfire management measures and an emergency response plan in consultation with the RFS prior to commencing construction activities, and for the operational and decommissioning phases, to manage site specific risks. This will include high risk tasks, seasonal constraints, fuel load management, mitigation strategies and emergency response procedures.	Proponent	✓				HR01

Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	O	D	Code
	Minimise Risk	An area of grassland (which may contain gravel access roads) serving as a defendable space (a minimum width of 10 m) would be provided for the operations and maintenance buildings, substation and solar array.	Proponent and Construction Contractor		✓	✓		HR02
	Minimise Risk	Asset protection zones would also be designed and maintained around buildings and infrastructure to reduce the risk of fuel loads building up around sensitive assets	Proponent and Construction Contractor		✓	✓		HR03
	Minimise Risk	Electrical equipment selected for the life span of the Proposed Development would be designed, installed and earthed appropriately to limit the potential risk of fire from lightning strike and to minimise potential for ignition and would be certified to comply with relevant Australian Standards.	Proponent and Construction Contractor	✓	✓			HR04
	Minimise Risk	Four 10,000 litre water tanks will be provided at locations agreed with the RFS for the sole use of fire protection in line with the RFS standards.	Proponent and Construction Contractor		✓			HR05
	Minimise Risk	Restrictions imposed during declared Total Fire Bans will be observed and consultation carried out with the RFS where required.	Construction Contractor		✓	✓	✓	HR06
Electromagnetic Fields	Minimise	Engineering and administrative controls will be used to reduce the potential for EMF emissions in accordance with Interim guidelines on limits of exposure to electric and magnetic fields ARPANSA/National Health and Medical Research Council and Overhead Line Design AS/NZS 7000. .	Proponent		✓	✓	✓	HR07
Waste and Resource Use								
Waste and Resource Use	Minimise and Avoid	Wastes will be classified in accordance with the NSW EPA Waste Classification Guidelines – Part 1: classifying waste (EPA 2014) and addendum (EPA 2016). All waste will be handled and stored on site in accordance with its classification and disposed of at appropriately licensed waste facilities. In order to minimise the potential for waste, purchasing protocols to reduce the likelihood for equipment failure will be adhered to in the selection of all components of the Proposal. With specific regard to panels: • As a minimum, panels will meet the Australian standard AS/NZS 5033 for photovoltaic modules and the international standard IEC 62804 (Clean Energy Council, 2018) • Panels will be backed by a 25 year warranty (DNVGL, 2017).	Proponent and Construction Contractor		✓	✓	✓	WRR01
Socio-economic Factors								
Socio-Economic Factors	Minimise	Recruitment of construction staff, contractors and suppliers from the local areas and purchase of local products will be encouraged during all phases of the development. The Proponent will liaise with local industry and local councils if there is a conflict arising from demand for accommodation and related services.	Proponent	✓	✓	✓		SE01

9.3 Residual environmental risks and impacts

The *Australian New Zealand Risk Management Standard (AS/NZS ISO 31000:2009*) defines risk management as the "*coordinated activities to direct and control an organisation with regard to risk*" (Standards Australia, 2009). Risk arises in all aspects of the project life cycle and offers both opportunity and threat, and must therefore be managed appropriately. Risk management involves establishing an appropriate risk management culture and applying logical and systematic risk management processes to all stages in the life cycle of any activity, function or operation.

This EIS adopts an environmental impact assessment methodology aligned to the *AS/NZS ISO 31000:2009* standard:

- Potential risks (environmental impacts) have been identified through the Environmental Assessment (Section 8)
- Strategies and actions are identified to mitigate the impact of the risk (Section 9.2)
- An assessment is made of the likelihood of the risk occurring and the consequence if the risk were to occur:
    - the likelihood of the risk occurring is described as *very unlikely, unlikely*, *possible*, *likely*, or *almost certain* to occur
    - the consequences or potential impact if the risk event occurred are described as *minor*, *major, severe, critical* or *catastrophic*.

The risk matrix below (Table 9-2) determines a risk rating of low, medium, high or extreme.

Table 9-2: Residual environmental risk assessment

Risk Assessment Matrix		**Consequence**				
		Minor	**Major**	**Severe**	**Critical**	**Catastrophic**
Likelihood		**A**	**B**	**C**	**D**	**E**
Very Unlikely	1	Low	Low	Medium	Medium	Medium
Unlikely	2	Low	Low	Medium	Medium	High
Possible	3	Low	Medium	High	High	High
Likely	4	Medium	Medium	High	High	Extreme
Almost Certain	5	Medium	High	High	Extreme	Extreme

In each case the likelihood and consequence is independently assessed in order to assign a mitigate risk score (Table 9-3).

Table 9-3: Residual risks for all impacts identified in the environmental assessment

Factor	Receptor	Potential Impact	Mitigated Likelihood	Mitigated Consequence	Mitigated Risk
Biodiversity	Flora species, plant communities and/or habitat	Disturbance/loss	5	A	Medium
	Fauna species	Injury and mortality	3	A	Low
	Terrestrial and aquatic ecosystems	Introduction/spread of weeds	3	A	Low
		Introduction/spread of pests	2	A	Low
		Sedimentation and erosion	3	A	Low
		Soil and water pollution	2	A	Low
		Indirect impacts of proposal e.g. light, noise, dust	3	A	Low
Heritage	Aboriginal heritage	Impacts on known artefacts/values	3	A	Low
		Impacts on unknown artefacts/values	2	B	Low
	Historic heritage	Impacts on known artefacts/values	1	A	Low
		Impacts on unknown artefacts/values	1	A	Low
Land resources	Proposed Development Site	Disturbance and erosion of soils and productive topsoil	3	A	Low
		Soil compaction leading to concentrated runoff and erosion	3	A	Low
		Soil contamination due to spills	2	A	Low
		Introduction/spread of weeds	3	A	Low
	Nearby properties	Reduced agricultural viability	1	A	Low
		Dust deposition	2	A	Low
Visual amenity	Landscape	Altered landscape character	2	A	Low

Factor	Receptor	Potential Impact	Mitigated Likelihood	Mitigated Consequence	Mitigated Risk
	Nearby residences	Reduction in visual amenity	3	B	Low
	Adjoining landscape	Reduction in visual amenity	2	A	Low
Noise	Nearby residences	Nuisance noise levels during construction	3	A	Low
		Nuisance noise levels during operation	1	A	Low
	Adjoining environment	Disturbance	3	A	Low
Traffic and transport	Existing road network	Increase in traffic volumes	5	A	Medium
		Increased traffic risks and/or reduced safety	1	D	Medium
Water resources	Surface water	Degradation of water quality	2	A	Low
		Reduction in water quantity	1	A	Low
		Flooding	1	A	Low
	Groundwater	Degradation of water quality	1	A	Low
		Reduction in water quantity	1	A	Low
	Aquatic Ecosystems	Direct Impacts	2	A	Low
		Indirect Impacts	2	A	Low
Hazard and risks	Development Footprint	Bushfire Fire and Electrical Fire	1	D	Medium
	Adjoining environment	Electromagnetic interference	1	A	Low
Waste management	Development Site and adjoining areas	Contamination of land and water	2	A	Low
		Resource wastage	2	A	Low
		Human and environmental health	1	B	Low
Socio-economic	Nearby properties	Reduced amenity and/or property values	2	A	Low

Factor	Receptor	Potential Impact	Mitigated Likelihood	Mitigated Consequence	Mitigated Risk
	Local community	Reduced economic activity	1	B	Low

Most residual risks are assessed as low (Table 9-3). Medium residual risks and justifications are discussed below:

- Biodiversity – Clearing of native vegetation and potential impacts to habitat will be offset in accordance with the strategies outlined within the BDAR
- Traffic – The Proposed Development will result in increased heavy and light vehicle movements on local roads, however, proposed mitigation strategies are considered appropriate to manage potential road safety issues. As such, the Proposed Development is considered highly unlikely to increase the likelihood of vehicular accidents, however, the potential for fatalities remains
- Fire – Despite preventative mitigation actions resulting a very low likelihood of fire ignition, and well-developed response strategies to manage and respond to potential fires, the consequences of fire at local and regional scales remain critical.

Based on these findings, environmental impacts associated with the construction, operation and decommissioning of the Proposed Development are compliant with the requirements for SSD under the SEPP(SRD) and Division 4.7 of the EP&A Act. Therefore, environmental impacts associated with the construction, operation and decommissioning of the Proposed Development, with the implementation of the mitigation strategies and management plans identified within this EIS, are deemed acceptable.

10. Conclusion

The proposed utility-scale PV solar farm is located at Glenellen, within the Greater Hume Shire LGA, 4 km north-east of Jindera and 20 km north of Albury in southern NSW. The Proposed Development would have an electricity generation capacity of approximately 200 MW_{AC} at the point of connection, producing enough energy to power around 94,899 average NSW households each year.

The Proposed Development is recognised as SSD and is subject to assessment under Division 4.7 of the EP&A Act. This EIS has examined and taken into account all matters affecting or likely to impact the environment by reason of the Proposed Development, including consideration of Commonwealth EPBC Act listed MNES.

Information about the Proposed Development has been extensively shared with local communities through a variety of consultation approaches. Issues raised during the community consultation process have been addressed through the evolution of the design and are identified throughout this EIS.

Potential environmental impacts associated with the Proposed Development have been first avoided, and then reduced during the concept development process. In the absence of mitigation, the Proposed Development would result in some impacts on biodiversity via vegetation clearing, soil and water via erosion, noise, visual amenity, dust and traffic via increased vehicle movements

Mitigation measures as detailed in this EIS would ameliorate or minimise these expected impacts to acceptable levels. The Proposed Development would also provide a number of employment opportunities and benefits to the local economy, while reducing carbon emissions by displacing approximately 328,000 tonnes of CO_2 annually (based on current NSW emission figures of 0.82 kg of CO_2-equivilent per kWh) and providing progress towards national and international environmental commitments.

On the basis of the information provided in this EIS, it is concluded that the proposal presents relatively minor and manageable environmental impacts, which can be effectively mitigated using best practice strategies and methodologies. Potential benefits associated with the Proposed Development are a substantial reduction in greenhouse gas emissions, reduced reliance on non-renewable energy sources and positive outcomes for the local community. On this basis the Proposed Development is strongly justified.

11. References

Australian and New Zealand Environment and Conservation Council (ANZECC). (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality: Volume 1 – The Guidelines.*

Australian Bureau of Agriculture and Resources Economics and Science (ABRES). (2020). *About my region – Murray region New South Wales.* Retrieved from: http://www.agriculture.gov.au/abares/research-topics/aboutmyregion/nsw-murray#employment

Australian Bureau of Statistics (ABS). (2017). *Greater Hume Shire (A) (LGA13340) 2016 Census of Population and Housing Time Series Profile* (Cat. No. 2003.0). Retrieved from http://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/communityprofile/LGA13340?opendocument. Accessed 17 September 2018.

Australian Bureau of Statistics (ABS). (2017a). *2016 Census QuickStats - Greater Hume Shire (A)*. Retrieved from http://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/LGA13340?opendocument. Accessed 17 September 2018.

Australian Bureau of Statistics (ABS). (2017b). *Albury (C) (LGA10050) 2016 Census of Population and Housing Time Series Profile* (Cat. No. 2003.0). Retrieved from http://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/communityprofile/LGA10050?opendocument. Accessed 17 September 2018.

Australian Bureau of Statistics (ABS). (2017c). *2016 Census QuickStats - Albury (C).* Retrieved from http://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/LGA10050?opendocument. Accessed 17 September 2018.

Australian Bureau of Statistics (ABS). (2018). *Land Management and Farming in Australia 2016-17. 46270DO001_201617.* Available at http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/130D329F99FC69BCCA2582B7001B1F31/$File/46270do001_201617.xls. Accessed 27 August 2018.

Australian Energy Market Commission. (2019). Residential Electricity Price Trends 2019. Final report, 9 December 2019. Retrieved from https://www.aemc.gov.au/sites/default/files/2019-12/2019%20Residential%20Electricity%20Price%20Trends%20final%20report%20FINAL.pdf

Australian Energy Market Operator (AMEO). (2019). *Draft 2020 Integrated System Plan (Draft ISP)*. Retrieved from https://www.aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2020-integrated-system-plan-isp

Australian ICOMOS Charter for Places of Cultural Significance (ICOMOS (Australia)). (2013). *The Burra Charter.*

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). (2015). *Fact Sheet – Electricity and Health.* Retrieved from https://www.arpansa.gov.au/sites/g/files/net3086/f/legacy/pubs/factsheets/ElectricityAndHealth.pdf. Accessed 17 October 2018.

Barker, P. (1983). *NSW Soil and Landscape Information System: Soil Profile Report*. Retrieved from https://www.environment.nsw.gov.au/espade2webapp/report/profile/1895. Accessed 16 November 2018.

Barron-Gafford, G. A. *et al*. (2016). The Photovoltaic Heat Island Effect: Larger solar power plants increase local temperatures. *Sci. Rep*. **6**, 35070

Border Mail. (June 14, 2014). Jindera's main street to get revamp. Retrieved from: https://www.bordermail.com.au/story/2358995/jinderas-main-street-to-get-revamp/

Bureau of Meteorology (BOM). (2012). *Atlas of Groundwater Dependent Ecosystems*. Retrieved from http://www.bom.gov.au/water/groundwater/gde/map.shtml. Accessed 29 November 2018.

Bureau of Meteorology (BOM). (2017). *Australian National Groundwater Explorer database*. Retrieved from http://www.bom.gov.au/water/groundwater/explorer/map.shtml. Accessed 28 November 2018.

Bureau of Meteorology (BoM). (2018). *Monthly climate statistics for Albury Airport AWS (072160)*. Retrieved from http://www.bom.gov.au/climate/averages/tables/cw_072160_All.shtml. Accessed 25 October 2018.

Chang, G. J. and Jennings, C. (1994). *Magnetic field survey at PG&E photovoltaic sites*. Prepared for Pacific Gas and Electric Company Research and Development Department, California.

Cook, L. M. & McCuen, R. H. (2013). Hydrologic response of solar farms. *Journal of Hydrologic Engineering, 18(5), 536 – 541.*

CSIRO and Bureau of Meteorology. (2018). *Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report*. CSIRO and Bureau of Meteorology, Australia

Department of Planning and Environment (DPE). (2016). *2016 New South Wales State and Local Government Area Population Projections*. Excel file retrieved from http://www.planning.nsw.gov.au/Research-and-Demography/Demography/Population-projections

Department of Planning and Environment (DPE). (2017). *Riverina Murray Regional Plan 2036.* Retrieved from https://www.planning.nsw.gov.au/~/media/Files/DPE/Plans-and-policies/riverina-murray-regional-plan-2017.ashx

Department of Environment and Energy (DoEE). (2017). *Climate change Government and international initiatives*. Retrieved from https://www.environment.gov.au/climate-change/government.

Department of Environment and Energy (DoEE). (n.d.). *Climate change impacts in Australia*. Retrieved from https://www.environment.gov.au/climate-change/climate-science-data/climate-science/impacts.

Department of Environment and Energy (DoEE). (2019a). *The Renewable Energy Target (RET) scheme*. Retrieved from http://www.environment.gov.au/climate-change/government/renewable-energy-target-scheme.

Department of the Environment and Energy (2017a). *Species Profile and Threats Database*. Retrieved from: http://www.environment.gov.au/sprat. Accessed 19 September 2018.

Department of the Environment and Energy (DoEE). (2017b). *Australian Energy Update 2015.* Retrieved from http://www.environment.gov.au/system/files/resources/f02a388d-74eb-4200-96fb-fe2a9d0caf5b/files/energy-update-report-2017.pdf Accessed 12 December 2017.

Department of the Environment and Energy. (2018). *Australian Energy Update, August 2018*. Canberra.

Department of Industry, Science, Energy and Resources (DISER). (2020) - https://www.energy.gov.au/government-priorities/energy-supply; hthttps://www.industry.gov.au/funding-and-incentives/renewable-energy-target-scheme

Department of Environment and Energy. (2019). National Greenhouse Accounts Factors – August 2019. Retrieved 9/09/2020 from https://www.industry.gov.au/sites/default/files/2020-07/national-greenhouse-accounts-factors-august-2019.pdf

Douglas Partners. (2019). *Report on Preliminary Geotechnical Investigation Proposed Solar Farm 66 Blight Road West, Glenellen*. Prepared for Changzhou Trina Intelligence Energy Engineering Ltd, July 2019.

Eberbach, P. & Black, S. (n.d.) *Managing the soil.* In *Principles of Field Crop Production (4th Edition amended).* Ed J. Pratley. Oxford University Press

EMFs info. (2017). *EMFs.info Electric and Magnetic Fields and Health*. Retrieved from http://www.emfs.info/. Accessed 17 October 2018.

Fairfull, S. & Witheridge, G. (2003). *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*. NSW Department of Primary Industries.

Fairfull, S. (2013). *Fisheries NSW Policy and guidelines for fish habitat conservation and management (2013 update)*. Retrieved 26 February 2020 from http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0009/468927/Policy-and-guidelines-for-fish-habitat.pdf

Fitzpatrick, R., Powell, B. & Marvanek, S. (2011). *Atlas of Australian Acid Sulfate Soils v2*. Retrieved from http://doi.org/10.4225/08/512E79A0BC589. Accessed 27 August 2018.

Forest Air. (2018). *Home*. Retrieved from http://www.forestair.com.au/

Fthenakis, V. & Yu, Y. (2013). Analysis of the potential for a heatisland effect in large solar farms. *2013 IEEE 39th Photovoltaic Specialists Conference* 3362–3366

FutureAnalytics (2016). *Planning and Development Guidance Recommendations for Utility Scale Solar Photovoltaic Schemes in Ireland*. Funded by the Sustainable Energy Authority of Ireland's Energy Research, Development & Demonstration Programme 2016. Retrieved from http://www.futureanalytics.ie/wp-content/uploads/2016/11/Solar-Research-Report-2016.pdf

Geological Survey of New South Wales. (2009). *New South Wales 1:1 500 000 Geology Map, First Edition*. NSW Department of Primary Industries, Maitland, NSW.

Geoscience Australia. (2017). *Groundwater Dependent Ecosystems.* Retrieved from http://www.ga.gov.au/scientific-topics/water/groundwater/understanding-groundwater-resources/groundwater-dependant-ecosystems.

Geoscience Australia (2018). *Interactive Maps.* Retrieved from http://www.ga.gov.au/interactive-maps/#/theme/minerals/map/geology

Greater Hume Shire Council. (2011). *Bushfire Prone Land*. Retrieved from http://www.greaterhume.nsw.gov.au/LinkClick.aspx?fileticket=7omYBxDXnyE%3d&tabid=125

Greater Hume Shire Council. (2012). *Local Environmental Plan 2012*.

Greater Hume Shire Council (2013). *Greater Hume Development Control Plan 2013*.

Greater Hume Shire Council. (2017). *Live a Greater Life - Our Community Strategic Plan 2017 – 2030*. Retrieved from http://www.greaterhume.nsw.gov.au/LinkClick.aspx?fileticket=Wai5P8MosY4%3d&tabid=114

Hassanpour Adeh E, Selker JS, Higgins CW. (2018). Remarkable agrivoltaic influence on soil moisture, micrometeorology and water-use efficiency. *PLoS ONE 13*(*11*): e0203256. Retrieved from https://doi.org/10.1371/journal.pone.0203256

Heritage Branch of the Department of Planning. (2009). *Assessing Significance for Historical Archaeological Sites and 'Relics'*. Heritage Branch of the Department of Planning, Sydney.

Intergovernmental Panel on Climate Change (IPCC). (2018). *Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.* [V. Masson-Delmotte, P. Zhai, H. O. Pörtner, D. Roberts, J. Skea, P. R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, T. Waterfield (eds.)]. *World Meteorological Organization*, Geneva, Switzerland.

International Commission ono Non-Ionizing Radiation Protection (ICNIRP). (2010). *Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields*. Retrieved from: http://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf. Accessed 17 October 2018.

Isbell, R. F. (2016). *The Australian Soil Classification.* Retrieved from: http://www.clw.csiro.au/aclep/asc_re_on_line_V2/soilhome.htm

Landcom. (2004). *Managing Urban Stormwater: Soils and Construction (Blue Book).* New South Wales Government.

Learmonth, R., Whitehead, R., Boyd, B. & Fletcher, S. (2007). *Living and Working in Rural Areas: A handbook for managing land use conflict issues on the NSW North Coast.* NSW Department of Primary Industries, Wollongbar NSW.

Mawhinney, W. and Muschal, M. (2015). *Assessment of Murray-Darling Basin Plan water quality targets in New South Wales; 2007 to 2012*. New South Wales Department of Primary Industries, Water, Sydney.

McDowall, R. (1996). *Freshwater Fishes of South-eastern Australia*. Reed Books, Sydney.

McGarr, P. (2018). Property Value Impact Study – Proposed Newark Road Solar Energy Use. Retrieved from http://www.co.kendall.il.us/wp-content/uploads/Attachment-29-Property-Value-Study.pdf

McKenzie, N., Isbell, R.F., Brown, K. & and Jacquier, D. (1999). *Major soils used for agriculture in Australia*. In Soil analysis: An interpretation Manual. Eds K.I. Peverill, L.A. Sparrow, D.J Rueter CSIRO Publishing, Collingwood VIC.

McMahon, D.M. (2020). *Land and Soil Capability Assessment Letter Report 6589*. Prepared as Appendix A.2. for *Amendment Report - Jindera Solar Farm* by NGH Environmental, 2020. Prepared for Jindera Solar Farm Pty Ltd on behalf of Hanwha Energy Corporation and Green Switch Australia. Sourced from NSW DPE Major Project website: http://www.majorprojects.planning.nsw.gov.au/

Mitchell, P. (2002). Descriptions of NSW (Mitchell) Landscapes: Version 2.

Murray-Darling Basin Authority. (2018). *Wetlands GIS of the Murray-Darling Basin Series 2.0*. Retrieved from https://data.gov.au/dataset/wetlands-gis-of-the-murray-darling-basin-series-2-0

National Committee on Soil and Terrain. (2009). *Australian soil and land survey field handbook* (3rd ed). CSIRO Publishing, Collingwood, Vic

Natural Resources Access Regulator (NRAR). (2018). *Guidelines for Controlled Activities on waterfront land—Riparian corridors*. NSW Department of Industry, INT19/15607. Retrieved from https://www.industry.nsw.gov.au/__data/assets/pdf_file/0004/156865/NRAR-Guidelines-for-controlled-activities-on-waterfront-land-Riparian-corridors.pdf

NGH Environmental. (2010). *Environmental Assessment: Capital Solar Farm.* Prepared for Infigen - Suntech

NGH Environmental. (2018). *Preliminary Environmental Assessment Jindera Solar Farm*. Prepared for Jindera Solar Farm Pty Ltd on behalf of Hanwha Energy Corporation and Green Switch Australia. Sourced from NSW DPE Major Project website: http://www.majorprojects.planning.nsw.gov.au/

NGH Environmental. (2019). *Environmental Impact Assessment Jindera Solar Farm*. Prepared for Jindera Solar Farm Pty Ltd on behalf of Hanwha Energy Corporation and Green Switch Australia. Sourced from NSW DPIE Major Project website: https://www.planningportal.nsw.gov.au/major-projects/project/9811

NGH Environmental. (2020). *Response to Request for Additional Information Jindera Solar Farm*. Prepared for Jindera Solar Farm Pty Ltd on behalf of Hanwha Energy Corporation and Green Switch Australia. Sourced from NSW DPIE Major Project website: https://www.planningportal.nsw.gov.au/major-projects/project/9811

NSW Department of Environment & Climate Change (DECC). (2008a). *Managing Urban Stormwater: Soils and Construction Volume 2A Installation of Services.* Retrieved fromhttp://www.environment.nsw.gov.au/resources/stormwater/0801soilsconststorm2a.pdf. Accessed 23 November 2017.

NSW Department of Environment & Climate Change (DECC). (2008b). *Managing Urban Stormwater: Soils and Construction Volume 2C Unsealed Roads.* Retrieved from http://www.environment.nsw.gov.au/resources/stormwater/0802soilsconststorm2c.pdf. Accessed 23 November 2017.

NSW Department of Environment & Climate Change (DECC). (2009). *Interim Construction Noise Guideline*. Department of Environment & Climate Change, Sydney.

NSW Department of Environment Climate Change and Water (DECCW). (2006a). *Murray River catchment (NSW), Water Quality Objectives explained*. Retrieved from https://www.environment.nsw.gov.au/ieo/Murray/report-03.htm

NSW Department of Environment Climate Change and Water (DECCW). (2006b). *Murray River (NSW), River Flow Objectives explained*. Retrieved from https://www.environment.nsw.gov.au/ieo/Murray/report-04.htm

NSW Department of Environment, Climate Change & Water (DECCW). (2010a). *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*. Department of Environment, Climate Change & Water, Sydney.

NSW Department of Environment, Climate Change & Water (DECCW). (2010b). *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales.* Department of Environment, Climate Change & Water, Sydney.

NSW Department of Environment, Climate Change & Water (DECCW). (2010c). *State of the Catchments: Riverine Ecosystems: Border Rivers-Gwydir Region.* Department of Environment, Climate Change & Water, Sydney.

NSW Department of Infrastructure, Planning and Natural Resources (DIPNR). (2005). *Floodplain Development Manual: The Management of Flood Liable Land.* NSW Department of Infrastructure, Planning and Natural Resources, Sydney.

NSW Department of Land and Water Conservation (NSW DLWC). (1994). *Guidelines for planning, construction and maintenance of tracks*. NSW Department of Land and Water Conservation, Maitland, NSW.

NSW Department of Land and Water Conservation (DLWC). (2000). *Soil and landscape Issues in Environmental Impact Assessment. Technical Report No. 34, 2nd edition.* NSW Department of Land and Water Conservation, Sydney.

NSW Department of Planning, Industry and Environment (DPIE). (2019). NSW Electricity Strategy. Retrieved from https://energy.nsw.gov.au/media/1926/download

NSW Department of Planning, Industry and Environment (DPIE). (2020). Major Project websites: http://www.majorprojects.planning.nsw.gov.au/ and https://www.planningportal.nsw.gov.au/major-projects

NSW Department of Planning and Environment (DPE). (2011). *Planning guidelines for hazardous developments, various working papers*. Retrieved from: http://www.planning.nsw.gov.au/Policy-and-Legislation/Hazards/Industrial-Hazards

NSW Department of Planning and Environment (DPE). (2018). *MinView. Second Edition.* Retrieved from: https://minview.geoscience.nsw.gov.au/#/?l=&lat=146.8611117311174&lon=-35.94511684799068&z=13&bm=bm1. Accessed 15 October 2018.

NSW Planning and Environment (2018). *1:250 000 Geological Maps.* Retrieved from https://resourcesandgeoscience.nsw.gov.au/miners-and-explorers/geoscience-information/products-and-data/maps/geological-maps/1-250-000

NSW Department of Planning & Infrastructure. (2013). *Strategic Agricultural Land (SAL) Biophysical (Upper Hunter and New England North West regions).* Bioregional Assessment Source Dataset. Department of Planning and Infrastructure, Sydney

NSW Department of Primary Industries (NSW DPI). (n.d.a). *Key Fish Habitat: Greater Hume*. Retrieved from https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/634307/GreaterHume.pdf. Accessed 27 September 2018.

NSW Department of Primary Industries (NSW DPI). (n.d.b). *What are C3 and C4 Native Grass?* Retrieved from https://www.dpi.nsw.gov.au/agriculture/pastures-and-rangelands/native-pastures/what-are-c3-and-c4-native-grass. Accessed 29 October 2018.

NSW Department of Primary Industries (NSW DPI). (2007). *Endangered ecological communities in NSW - Lower Murray River aquatic ecological community*. Primefact 172 Factsheet. Retrieved from https://www.dpi.nsw.gov.au/ data/assets/pdf file/0004/634495/Lower-Murray-River-aquatic-ecological-community.pdf

NSW Department of Primary Industries (NSW DPI). (2013). *Primefact 1063 – Infrastructure proposals on rural land. Second Edition.* NSW Department of Primary Industries, Sydney.

NSW Department of Primary Industries (DPI). (2018). *Draft Riverina Murray Important Agricultural Land Mapping*. Retrieved from https://www.dpi.nsw.gov.au/agriculture/lup/agriculture-industry-mapping/important/riverina-murray-online

NSW Department of Primary Industries (DPI). (2019). *Riverina Murray Important Agricultural Lands*. Retrieved from https://www.arcgis.com/apps/webappviewer/index.html?id=65e3be0196f44197b0c6c8e91d1c7ae7

NSW Department of Primary Industries (DPI). (2020). *Important Agricultural Land Mapping in NSW*. Retrieved from https://www.dpi.nsw.gov.au/agriculture/lup/agriculture-industry-mapping/important

NSW DPI Water. (2018). *Upper Murray Catchment Snapshot*. NSW Department of Primary Industry. Retrieved from https://www.industry.nsw.gov.au/water/basins-catchments/snapshots/upper-murray

NSW Environmental Protection Authority (EPA). (2014). *Waste Classification Guidelines. Part 1: Classifying Waste.* EPA, Sydney.

NSW Environment Protection Authority (EPA). (2016). *Addendum to the Waste Classification Guidelines (2014) - Part 1: Classifying Waste*. Retrieved from https://www.epa.nsw.gov.au/your-environment/waste/classifying-waste.

NSW Environmental Protection Authority (EPA). (2017). *NSW Industrial Noise Policy*. EPA, Sydney.

NSW Environment Protection Authority (EPA). (2017). *Contaminated land, record of notices*, Retrieved from http://www.epa.nsw.gov.au/prclmapp/searchregister.aspx. Accessed 22 November 2017.

NSW Fisheries Scientific Committee (NSW FSC) (2008a). *Final determination: Galaxias rostratus – flathead galaxias*. July 2008, Ref. No FD 39. New South Wales Department of Primary Industries.

NSW Fisheries Scientific Committee (NSW FSC) (2008b). *Final determination: Nannoperca australis - Southern pygmy perch*. January 2008, Ref. No FD 34. New South Wales Department of Primary Industries.

NSW Heritage Office. (2001). *Assessing Heritage Significance.* NSW Heritage Office, Sydney.

NSW Heritage Office & NSW Department of Urban Affairs and Planning. (1996). *NSW Heritage Manual.* NSW Heritage Office & NSW Department of Urban Affairs and Planning, Sydney.

NSW National Parks and Wildlife Service (NPWS). (2003). *The Bioregions of New South Wales: their biodiversity, conservation and history.* NSW National Parks and Wildlife Service, Sydney.

NSW Office of Environment and Heritage (OEH). (2010). *Reconnaissance Soil and Land Resources of the Murray Catchment.* NSW Office of Environment and Heritage, Sydney. Retrieved from: https://datasets.seed.nsw.gov.au/dataset/reconnaissance-soil-and-land-resources-of-the-murray-catchment

NSW Office of Environment & Heritage (OEH). (2011). *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW.* NSW Office of Environment and Heritage, Sydney.

NSW Office of Environment & Heritage (OEH). (2012). *The land and soil capability assessment scheme – second approximation.* NSW Office of Environment and Heritage, Sydney.

NSW Office of Environment & Heritage (OEH). (2014). *Soil condition and land management in New South Wales: final results from the 2008-09 monitoring, evaluation and reporting program.* NSW Office of Environment and Heritage, Sydney.

NSW Office of Environment and Heritage (OEH). (2015). *Hydrogeological Landscapes for the Murray Catchment Management Authority – Eastern Murray Catchment.* NSW Office of Environment and Heritage, Sydney. Retrieved from: https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Land-and-soil/eastern-murray-catchment-150240.pdf.

NSW Office of Environment and Heritage (OEH). (2016). *Hydrogeological Landscapes of New South Wales and the Australian Capital Territory.* NSW Office of Environment and Heritage, Sydney. Retrieved from: https://datasets.seed.nsw.gov.au/dataset/hydrogeological-landscapes-nsw-act.

NSW Office of Environment & Heritage (OEH). (2016). *NSW – the bioregional landscape.* Retrieved from http://www.environment.nsw.gov.au/bioregions/BioregionsNswoutlineLandscape.htm

NSW Office of Environment & Heritage (OEH). (2016a). *NSW Guide to Surveying Threatened Plants.* NSW Office of Environment and Heritage, Sydney.

NSW Office of Environment and Heritage (OEH). (2017). *Estimated Inherent Soil Fertility of NSW.* NSW Office of Environment and Heritage, Sydney. Retrieved from: https://datasets.seed.nsw.gov.au/dataset/estimated-inherent-soil-fertility-of-nswd793e

NSW Office of Environment and Heritage (OEH). (2017a). *Land and Soil Capability Mapping for NSW*. OEH, Sydney.

NSW Office of Environment and Heritage (OEH). (2017b). *Digital soil maps for key soil properties over New South Wales.* NSW Office of Environment and Heritage, Sydney.

NSW Office of Environment and Heritage (OEH). (2018a). *Species credit threatened bats and their habitat – NSW survey guide for the Biodiversity Assessment Methodology*. Retrieved from https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/species-credit-threatened-bats-survey-guide-180466.pdf

NSW Office of Environment and Heritage (OEH). (2018b). *Salinity.* Retrieved from: https://www.environment.nsw.gov.au/topics/land-and-soil/soil-degradation/salinity/

NSW Office of Environment and Heritage (OEH). (2018c). *Types of salinity and their prevention.* Retrieved from: https://www.environment.nsw.gov.au/topics/land-and-soil/soil-degradation/salinity/type-of-salinity-and-their-prevention

NSW Office of Water. (2012). *Water Sharing Plan for the Murray Unregulated and Alluvial Water Sources.*

NSW Rural Fire Service (RFS). (2006). *Planning for Bushfire Protection: A guide for Councils. Planners, Fire Authorities and Developers.* NSW Rural Fire Service.

NSW Rural Fire Service (RFS). (2018). Draft *Planning for Bushfire Protection: A guide for Councils. Planners, Fire Authorities and Developers.* NSW Rural Fire Service.

Pager Power. (2018). *Solar Photovoltaic Glint and Glare Study: Solar Farm near Jindera*. Prepared for Eco Logical Australia.

Pogson, D. J. and Hitchins, B. L. (1973). *New England 1:500,000 Geological Sheet.* Geological Survey of NSW, Sydney.

Rengasamy, P. & Churchman, G.J. (1999). *Cation exchange capacity, exchangeable cations and sodicity*. In Soil analysis: An interpretation Manual. Eds K.I. Peverill, L.A. Sparrow, D.J Rueter CSIRO Publishing, Collingwood VIC.

Robinson, S. I., *et al*. (2018). Soil temperature effects on the structure and diversity of plant and invertebrate communities in a natural warming experiment. *Journal of Animal Ecology 87*(**3**): 634-646.

Solar Choice. (2013). *Solar farm projects near airports: Is glare an issue?* September 19, 2013 in ACT, Commercial solar power, Positioning solar PV panels, Solar Farms

Spaven Consulting. (2011). *Solar Photovoltaic Energy Facilities: Assessment of potential for impacts on aviation.* January 2011. Report No. 10.344/RPS/1

Strahler, A. N. (1952). Hypsometric (area-altitude) analysis of erosional topography. *Geological Society of America Bulletin, 63*(11): 1117 – 1142.

South East Region of Renewable Energy Excellence (SERREE). (2016). *Renewable Energy Trail*. Retrieved from http://serree.org.au/projects/renewable-energy-trail/

The Landscape Institute and Institute of Environmental Management and Assessment. (2013). *Guidelines for Landscape and Visual Impact Assessment, 3rd Edition.*

United Nations Environment Programme (UNEP). (2018). *The Emissions Gap Report 2018*. United Nations Environment Programme, Nairobi

Urbis (2016). *Review of the Impact of Wind Farms on Property Values*. Prepared for Office of Environment and Heritage.

U.S. Army Corps of Engineers (2018). *HEC-RAS 5.0.5 User Manual.*

State Government of Victoria. (2020). *VicPlan: Wind and Solar Farm Layer*. Retrieved from https://mapshare.vic.gov.au/vicplan/

WaterNSW. (2018). *Real-time data – All Groundwater*. Retrieved from https://realtimedata.waternsw.com.au/

eco
logical
AUSTRALIA
A TETRA TECH COMPANY

1300 646 131
www.ecoaus.com.au