ENVIRONMENTAL IMPACT STATEMENT

Dunedoo Solar Farm

September 2020

Project Number: SSD-8847

DOCUMENT VERIFICATION

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Final	24/09/2020	Zeina Jokadar Jorge Van Den Brande Martin Kim	Jorge Van Den Brande	Zeina Jokadar & Natascha Arens

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CERTIFICATION

For submission of an environmental impact statement (EIS) under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979*.

EIS prepared by: NGH Pty Ltd

Applicant: Sun Spot 4 Pty Ltd

Proposed Development

The Dunedoo solar farm Proposal includes the construction, operation and decommissioning of a photovoltaic solar farm that would produce around 55 megawatts AC of electricity. Associated infrastructure would include a substation, Battery Storage and 66-kV overhead Transmission Line.

Land to be developed

The Dunedoo solar farm would be located on approximately 79 hectares, comprising of parts of Lot 137 DP 754309, Lot 140 DP754309, Lot 1 DP 854326, Lot 80 DP 754309 and Lot 1 DP 1260716. Castlereagh Highway and All Weather Road junction upgrades would occur on Lot 1 DP 535659 and All Weather Road Reserve.

The Transmission Line easement would be located on All Weather Road's Road Reserve, Lot 7012 DP93290, Lot 80 DP 754309, Lot 37 DP 754309 and Crown Land for the Talbragar River. This would join Lots 181 -186 and Lots 196-201 DP754291 of the Essential Energy Substation. This solar farm site is located in Warrumbungle Shire, New South Wales.

Certification

I certify that I have prepared the contents of this Environmental Impact Statement in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*. To the best of my knowledge, this assessment contains all available information that is relevant to the environmental assessment of the development, activity or infrastructure, and that information in the EIS is neither false nor misleading.

Name: Zeina Jokadar

Signature:

Date: 24/09/2020

TABLE OF CONTENTS

FIGURES

TABLE

ACRONYMS AND ABBREVIATIONS

ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
AC	Alternating Current
ACHA	Aboriginal Cultural Heritage Assessment
ACHCRP	Aboriginal Cultural Heritage Consultation Requirements for Proponents
AEP	Annual Exceedance Probability
AER	Australian Energy Regulator
AFT	Artefact Scatter
AGO	Australian Greenhouse Office
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
APZ	Asset Protection Zone
ARENA	Australian Renewable Energy Agency
ARI	Average Recurrent Interval
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
ASL	Above Sea Level
AV	Articulated Vehicle
AWS	Automatic Weather Station
BAL	Basic Left Turn
BAM	Biodiversity Assessment Methodology
BAR	Basic Right Turn
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BCC	Biobanking Credit Calculator
BCD	Biodiversity Conservation Division (formerly OEH)
BDAR	Biodiversity Development Assessment Report
BFMC	Bush Fire Management Committee
Biosecurity Act	*Biosecurity Act 2015* (NSW)

BOM	Australian Bureau of Meteorology
BOS	Balance of System
BS	Battery Storage
BSAL	Biophysical Strategic Agricultural Land
CCP	Community Consultation Plan
CEC	Clean Energy Council
CEMP	Construction Environmental Management Plan
CER	Clean Energy Regulator
CHMP	Cultural Heritage Management Plan
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cwth	Commonwealth
DA	Development Application
DAWE	Department of Agriculture, Water and the Environment
dB(A)	Decibels, a measure of A-weighted *(c.f.)* sound levels.
DC	Direct Current
DECCW	Department of Climate Change and Water
DEMP	Decommissioning Environmental Management Plan
DIS	Department of Industry and Science
DoEE	(Cwth) Department of the Environment and Energy
DPI	Department of Planning and Infrastructure (now DPIE) (NSW)
DPIE	Department of Planning, Industry and Environment (NSW)
EEC	Endangered Ecological Community – as defined under relevant law applying to the proposal
EIA	Environmental impact assessment
EIS	Environmental Impact Statement
ELF	Extremely Low Frequency, in relation to Hz *(c.f.)*
EMF	Electromagnetic Field
EMP	Environmental Management Plan
EMS	Environmental Management Strategy
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000* (NSW)

EPA	Environment Protection Authority (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwth)
EPC	Engineering Procurement and Construction
EPI	Environmental Planning Instruments
EPL	Environment Protection Licence, issued under the POEO Act *(c.f.)*
ERP	Emergency Response Plan
ESD	Ecologically Sustainable Development
FM Act	*Fisheries Management Act 1994* (NSW)
FPL	Flood Planning Level
GDE	Groundwater Dependent Ecosystem
GHG	Greenhouse Gas
GWh	Gigawatt Hours
ha	Hectares
HBT	Hollow Bearing Tree
Heritage Act	*Heritage Act 1977* (NSW)
HV	High Voltage
Hz	Hertz
IBRA	International Bioregions of Australia
ICNG	Interim Construction Noise Guideline
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEA	International Energy Agency
IF	Isolated Find
ISEPP	*State Environmental Planning Policy (Infrastructure) 2007* (NSW)
KFH	Key Fish Habitat
kl	Kilolitres
km	Kilometres
kV	Kilovolts
kW	Kilowatts
LALC	Local Aboriginal Land Council
LCA	Life Cycle Assessment

LEMC	Local Emergency Management Committee
LEP	Local Environment Plan
LGA	Local Government Area
LLS	Local Land Services
LPG	Liquified Petroleum Gas
LUCRA	Land Use Conflict Risk Assessment
m	Metres
ML	Megalitres
mm	Millimetres
MNES	Matters of National Environmental Significance under the EPBC Act (*c.f.*)
MW	Megawatt
MWh	Megawatt Hours
NEM	National Electricity Market
NML	Noise Management Level
NPI	Policy for Industry (NSW)
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
NSW	New South Wales
NTNDP	National Transmission Network Development Plan
O&M	Office and Maintenance
OEH	Office of Environment and Heritage (formerly DECCW) (NSW)
OEMP	Operation Environmental Management Plan
PBP	Planning for Bushfire Protection
PCS	Power Conversion Station
PCT	Plant Community Type
PEA	Preliminary Environmental Assessment
POEO Act	*Protection of the Environment Operations Act 1997* (NSW)
PV	Photovoltaic
RAPs	Registered Aboriginal Parties
RBL	Rating Background Level - the level of background noise
RE Act	*Renewable Energy (Electricity) Act 2000* (Cwth)

REF	Review of Environmental Factors
REP	Regional Environmental Plan
RET	Renewable Energy Target
RFP	Request for Proposal
RFS	Rural Fire Service
RNP	Road Noise Policy (DECCW, 2011)
Roads Act	*Roads Act 1993* (NSW)
SAII	Serious and Irreversible Impacts
SCS	Soil Conservation Service
SEARs	Secretary’s Environmental Assessment Requirements
SEIFA	Socio Economic Indexes for Areas
SEPP	State Environmental Planning Policy
SHI	State Heritage Inventory
SIS	Species Impact Statement
SOE	State of the Environment
sp/spp	Species/multiple species
SRD SEPP	*State Environmental Planning Policy (State and Regional Development) 2011* (NSW)
SSD	State Significant Development
SWMP	Soil and Water Management Plan
TEC	Threatened Environmental Communities
TL	Transmission Line
TMP	Traffic Management Plan
TfNSW	Transport for NSW (formerly Roads and Maritime Services)
V	Volts
VIA	Visual Impact Assessment
VOC	Volatile Organic Compound
WAL	Water Access License
WARR Act	*Waste Avoidance and Resource Recovery Act 2001* (NSW)
WHO	World Health Organisation
WMP	Waste Management Plan

TABLE OF DEFINITIONS

Proposal	The construction, operation and decommissioning of a 55-MW AC solar farm generally comprising a solar array, access roads, underground and above ground cables, on-site substation and associated operational facilities including the construction of a 66-kV Transmission Line (TL) from the proposed on-site substation to the existing Essential Energy Dunedoo Substation, as set out in this EIS.
Proponent	ib vogt GmbH on behalf of Sun Spot 4 Pty Ltd
Development Footprint	Surface area of land that would be impacted by the operations of the Proposal upon subdivision of lots. The Development Footprint encompasses approximately 79 ha, comprising parts of the following lots: For the PV Field: Lot 137 DP 754309, Lot 140 DP 754309, Lot 1 DP 854326, Lot 1 DP 1260716, and the portion of Lot 80 DP 754309 north of All Weather Road. For the Castlereagh Highway / All Weather Road intersection upgrade: Lot 1 DP 535659 and All Weather Road's road reserve. For the 66-kV TL and associated infrastructure: Lot 80 DP 754309, Lot 7012 DP 93290, Lot 37 DP 754309, Talbragar River Reserve 56146 and All Weather Road's road reserve. For the extension of the existing Essential Energy Dunedoo substation: Lots 181-186 and 196-201 DP 754291.
Development Site	The Development Site is the immediate boundary and buffer around the Development Footprint, that includes immediate and adjacent land that are subject to direct activities from the proposal, of up to 10 metres from the Development Footprint. The Development Site encompasses approximately 112 ha.
Subject Land (Biodiversity Assessment)	The Subject Land is a terminology used in the Biodiversity Assessment, which includes land the Development Site and Development Footprint combined, and land where the Biodiversity Assessment Methodology (BAM) has been applied. A buffer of up to 5 metres has been applied for the Subject Land on the northern boundary of the Development Footprint The Subject Land is similarly defined within the Aboriginal Heritage Assessment and is referred therein as the 'proposal area'. The Subject Land encompasses a total approximately area of 158 ha.

Study Locality (Biodiversity Assessment)	10km search area around the Development Footprint. Only used by the Biodiversity Assessment.
Operator	Responsible for the operation and management of the solar farm and would implement the requirements of the development consent, EIS and OEMP and associated management plans.
Sub- contractor	Construction and operation subcontractors are contractually bound to implement the development consent, EIS, CEMP, OEMP, and associated management plans provided by the Contractor and/or Operator.
Intersection upgrade at Castlereagh Highway and All Weather Road	Based on swept path analysis for the 30.0m A-double truck, the intersection of Castlereagh Highway / All Weather Road would require widening of the north-eastern corner to facilitate turn movements from simultaneous inbound and outbound largest predicted vehicle movements. The work would occur in Lot 1 DP 535659 and All Weather Road's Road Reserve.
Essential Energy Substation	The existing Essential Energy substation would be expanded to accommodate the electricity generated by the Proposal. The expansion would be built on Lots 181-182 and Lots 200-201 of DP 754291 and the existing substation in Lots 183-186 and Lots196-199 of DP 754291 may also be augmented, located on 5-19 Evans Street Lane as identified on the map provided herein this EIS. It is proposed that the substation extension will be assessed under Part 4 of the EP&A Act. There are currently two (2) options for the 66- kV TL corridor. The land where the works will take place for the TL, will be registered in favour of Essential Energy via an easement where the works is undertaken outside land owned by Essential Energy. The TLs will be handed to Essential Energy upon completion of the construction. The assessment of these options is included in this EIS

EXECUTIVE SUMMARY

Introduction

NGH Pty Ltd has prepared this Environmental Impact Statement (EIS) to support the Development Application (DA) for the 55-Megawatt (MW) of Alternating Current (AC) Dunedoo solar farm (the 'Proposal') by ib vogt GmbH on behalf of Sun Spot 4 Pty Ltd (the Proponent). This EIS identifies and assesses the potential planning and environmental impacts associated with the construction, operation and decommissioning of the Proposal, and fulfils the requirements of the applicable legislation, including Part 4 of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) and Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation). This Proposal is considered to be State Significant Development (SSD).

The Proponent has engaged NGH to prepare this EIS and other independent consultants have been contracted to carry out specialist technical assessments as required. This EIS contains the assessment and recommendations for the State Government to make an informed decision in its assessment process.

This EIS has been structured to addresses the Secretary's Environmental Assessment Requirements (SEARs) provided by NSW Department of Planning, Industry and Environment (DPIE) on 9 April 2020 as well as other NSW Government relevant policies and guidelines for the preparation of an EIS.

The Proposal

The Proposal is to construct and operate solar photovoltaic panels solar farm that would have a capacity of up to 55 MW AC to generate power from a renewable source. The solar farm component of the Proposal includes:

- Approximately 173,000 PV solar panels, mounted on single axis tracking systems, powered by approximately 2,850 tracker motors.
- Electrical cables and conduits.
- Inverter/transformer stations, containerised or skid mounted, distributed across the site.
- Battery storage units, containerised, distributed across the site.
- On site substation containing transformer, synchronous condenser, associated HV switchgear, switch room, control room and lightning protection masts.
- Communications tower (up to 25 metres high), within the facility connection substation fenced area.
- Site office, compounds, storage shed, parking, access tracks and perimeter fencing.
- Two (2) access points via All Weather Road.
- Internal access tracks.
- Lighting, CCTV system, security fencing.
- Vegetative screening.
- A new hybrid Transmission Line (TL) to connect the solar farm into the Essential Energy transmission network, which will be handed to Essential Energy upon completion. Two (2) TL options are being considered.
- Construction of a passing bay along All Weather Road and upgrade to the Castlereagh Highway and All Weather Road junction.
- Subdivision and consolidation of lots.
- A new bay in the Dunedoo Substation and any required augmentation within the existing Dunedoo Substation. A new communications tower up to 15m tall.

The panels would be arranged in rows and would comprise of a metal or similar frame mounting system with a maximum height of approximately 3 metres above the natural ground level. Spaces between rows (edges of panel) may vary between approximately 3 metres and 9 metres.

The mounting systems would require approximately 30,000 piles that would be driven or screwed into the ground on a depth of approximately 2.5 metres. Depth will be defined following detail geotechnical investigations. Pile heights would vary according to topography and expected flood level.

The Proposal would require a connection to the Essential Energy Dunedoo Substation and the Proponent is currently considering two (2) connection options using existing and new Essential Energy TL easements. Option 1 would join the existing 852 66-kilovolt (kV) feeder easement (utilising existing infrastructure if possible) that runs south of the Development Site into the Dunedoo Substation. Option 2 would join the existing 85A 66-kV feeder easement (utilising existing infrastructure where possible) that runs southeast-northwest across the southern section of Lot 80 DP754309. The Proposal also requires upgrading/expanding the existing Dunedoo Substation for both connection options.

The Proposal would potentially require the subdivision of three (3) lots within the Development Site to be consolidated into two (2) lots for the purpose of the solar farm array area while facilitating existing landowner operations. One (1) lot would be subdivided for the purpose of Essential Energy's eventual ownership of the proposed facility connection substation, if required. The arrangements would be made under lease and purchase agreement with the involved landowners.

The Proponent would undertake the necessary works for upgrading and constructing the connection infrastructure, and once constructed, the infrastructure will be handed to Essential Energy to own and operate throughout the lifecycle of the Proposal.

The Development Site would be accessed through two (2) access points via All Weather Road, which runs adjacent to the solar array area and provides access to Castlereagh Highway and Digilah Road. The intersection of Castlereagh Highway and All Weather Road would be upgraded as part of the Proposal to facilitate safe construction vehicle access to and from the site.

The Proposal is expected to operate for 30 years and construction is expected to take 10-12 months, commencing indicatively in Spring 2021. After the operating phase, the Proposal would either be decommissioned, returning the site to its existing land use; or upgraded with new photovoltaic equipment, pending any required approvals.

Proposal's Benefits

The Proposal, if approved, would have a series of benefits to the community overall. These include:

- Assist Australia in transitioning from coal based to renewables power generation and consequently achieving its Paris greenhouse gas targets in order to abate greenhouse gas emission in the energy sector; as generation of electricity from renewable sources have a much faster construction and commissioning time compared to other industries.
- Provision of embedded electricity generation closer to local consumption centres, and thus contributing to a more diverse mix of energy sources. This would contribute to the reduction of energy prices through the operation of a large-scale renewable energy generation project within the NSW Renewable Energy Zone (REZ).
- Assist in the provision of network reliability and security by potentially regulating inputs (including improving the security of supply) to the grid through the "energy smoothing" by storing energy through its proposed Battery Storage (BS) system.
- The Dunedoo Solar Farm Project will involve $76 million in investment during the construction phase and will support 100 direct and 160 indirect positions over the construction period. Once operational,

3 direct and 9 indirect jobs will be supported by the Proposal. Many of these jobs will be supported in the regions local to the project

- The proposal will provide significant participation opportunities for businesses and workers local to the project and provides opportunities that are a good match of skills and resources available. Major investment projects, such as the Dunedoo Solar Farm, will play an important role in revitalising the regional economy in the post-COVID-19 recovery phase.
- The 'external' Project labour requirement would be expected to generate an accommodation need for 40 workers at the peak of construction and therefore provide economic stimulus to local hoteliers in major centres and smaller townships such as Dunedoo, Mendooran, Coolah, and Gulgong.
- Construction workers relocating to the region would be expected to inject approximately $1.0 million in additional spending into the economy over the construction phase, supporting approximately 10 jobs in the service sector across the Study Area defined in the Economic Impact Assessment.
- No loss of employment associated with the Subject Site is anticipated, either directly (on-site) or through the supply chain. The proponent is exploring the possibility of sheep grazing on the Subject Site, which would ensure agricultural activity is retained on the host land.
- Ongoing economic stimulus associated with the operation of the solar farm is estimated at approximately $12.6 million (over 30 years, CPI adjusted) associated with landowner returns and operational wage stimulus. Net land tax revenue to Council would be in addition to this value.
- The Project has the capacity to supply sufficient clean energy to power the equivalent of approximately 24,400 homes pa, which represents approximately 68% of the total annual residential requirements of the Study Area (36,130 homes).
- Operation of the Dunedoo Solar Farm will not impact on the Siding Spring Observatory and could potentially support small-scale tourism and educational opportunities in the future.

Consultation

Community feedback has been sought through two (2) community open days and direct engagement through letters, emails, phone calls and face to face meetings. 23 people provided feedback forms where feedback has been overwhelmingly positive. Concerns expressed varied between visual impact, effect on natural areas and the impact on land value of near neighbours of the proposed development, noise and biodiversity. These matters are addressed in specific sections of the EIS.

A 3rd event planned for 26 March 2020 was cancelled due to COVID-19 concerns. The local community were advised, and community feedback was requested via online forms (and other methods). A dedicated website and email address were created for the provision of information and for seeking feedback from the general public. The community open days were advertised in local newspapers as well as in the Mudgee Guardian, and in the Council’s newsletter.

Key Environmental Issues

A detailed investigation of risks and impacts was undertaken specific to the construction, operation and decommissioning phases of the Proposal. In addition to addressing the project-specific SEARs, a risk assessment was carried out to identify key environmental risks of the Proposal in order to guide the depth of investigation that would be undertaken in this EIS. The risk assessment identified four (4) environmental aspects as key risks, and detailed investigations were subsequently undertaken in these areas:

- Biodiversity
- Aboriginal heritage
- Visual impacts and landscape amenity
- Hydrology and flooding.

Biodiversity

NGH prepared a Biodiversity Development Assessment Report (BDAR) to investigate and assess the potential impacts of the Proposal on biodiversity. The Development Site is within Interim Biogeographical Regionalisation of Australia (IBRA) subregion *Inland Slopes* within the broader IBRA region *South Western Slopes*. Cleared and highly modified agricultural land occupies the majority of the site.

Three (3) Plant Community Types (PCTs) were identified in the Development Site which correspond to two (2) Threatened Ecological Communities (TECs):

- *White Box, Yellow Box, Blakely's Red Gum Grassy Woodland* (BC Act-Endangered and EPBC Act-Critically Endangered)
- *Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions* (BC Act-Endangered).

Impacts to these TEC's were identified as being potentially Serious and Irreversible Impacts (SAII), however, the Proposal has been designed to minimise impact to these communities; and the determining authority will assess whether these impacts are serious and irreversible.

25 threatened species required targeted survey. None of these species were detected within the Development Site upon completion of targeted surveys.

Ten (10) threatened species and five (5) migratory species listed under the EPBC Act were considered likely to occur in the Development Site. One (1) EPBC Act-listed Marine species, Dollarbird *Eurystomus orientalis*, was identified in proximity to the Development Site. Based on the bird surveys undertaken and evaluation of habitat, this species is not considered likely to occur in the Development Site regularly or rely on the habitats present. No other EPBC Act-listed species were recorded during the field surveys. Assessments of significance were completed for these species. These concluded that a significant impact was unlikely, and therefore, no referral is considered necessary to the Federal Department of Agriculture, Water and the Environment (DAWE).

The Development Site has been selected to avoid or minimise impacts to biodiversity where possible, including potential SAII. Most areas of TECs in the Development Site have been avoided through the iterative design process. Where biodiversity impacts could not be avoided, an offset credit requirement has been generated:

- Ecosystem credits:
  - 20 ecosystem credits were generated from the removal of approximately 0.9 ha of native vegetation for Option 1
  - 19 ecosystem credits for the removal of approximately 0.85 ha of native vegetation for Option 2.
- Species credits – no species credits were generated from impacts due to no observations of such species requiring credits within the Development Site.

These credits would be retired through an appropriate regulated offset mechanism.

Potential direct and indirect impacts to biodiversity values of the site could result from the Proposal and have been considered. A range of mitigation measures would be implemented to ensure that impacts on biodiversity during the construction phase are avoided where possible and minimised where they cannot be avoided.

Aboriginal Heritage

A search of the Aboriginal Heritage Information Management System (AHIMS) database was conducted over a 64 sq km area centred on the Subject land and identified 95 Aboriginal sites and no declared

Aboriginal Places. Two previously recorded open artefact sites (# 36-2-0049 and # 36-2-0048) were identified within the Subject land in the AHIMS search. While site # 36-2-0049 is listed on AHIMS as valid, a recent survey by OzArk in 2012 for the proposed Beryl to Dunedoo 66kV TL noted that the site has been previously legally impacted under two (2) permits issued under the NPW Act and that their field survey confirmed that this site no longer exists.

The initial archaeological investigation area for this project was originally significantly larger than the Subject land. Following the initial survey undertaken for the Proposal in January 2018, additional areas were identified for possible impacts for the intersection upgrade and Transmission Line options which were also subsequently surveyed. The survey strategy objective during all survey works undertaken for this Proposal covered as much of the ground surface within the proposed development area as possible.

Following redesign of the Proposal and reduction of its Subject Land, an Aboriginal Cultural Heritage Assessment (ACHA) was prepared to provide an assessment of the Aboriginal cultural values associated with the Subject land, and to assess the cultural and scientific significance of any Aboriginal heritage sites recorded. Aboriginal community consultation was undertaken as part of the ACHA in accordance with the relevant guidelines. Seven (7) Aboriginal groups registered their interest in the project whose representatives later participated in the fieldwork components of this assessment. The draft report was provided to the Registered Aboriginal Parties (RAPs) for comment prior to finalising.

Despite the variable visibility encountered during the surveys undertaken for the Dunedoo Solar Farm a total of nine (9) isolated finds and 14 artefact scatters were recorded (Dunedoo Solar AFT1 to Dunedoo Solar AFT 23). Three (3) areas of potential archaeological deposits (PADs) were also identified, including the previously recorded site AHIMS # 36-2-0049 (DTG/OC27 - Dunedoo 1), however no artefacts were identified at this site, and the RAPs commented that the site had previously been significantly impacted and destroyed. Subsurface testing was undertaken to investigate the presence and extent of archaeological material within the PADs. The results of the survey and subsurface testing programme substantially increased the number of stone artefact sites recorded in the local area.

A total of nine (9) isolated finds and 15 artefact scatters (with surface and/or subsurface artefacts) were recorded during the archaeological investigations. From these, a total of six (6) isolated finds, nine artefact scatters (with surface and/or subsurface artefacts) and the single previously recorded AHIMS site would be impacted by works proposed for the construction of the Solar Farm. The impact to these 16 sites with stone artefacts is likely to be most extensive where earthworks occur which is considered a direct impact on the Aboriginal sites.

While all the stone artefact sites within the Subject land are assessed as having total loss of scientific value due to development impact, it is argued that there are likely to be a number of similar sites in the local area and therefore the impact to the overall local archaeological record in the region is considered to be low. Given that that the Development Footprint for the Proposal has been reduced, eight (8) sites with stone artefacts which were recorded during archaeological investigations for the Proposal would be avoided.

Given the low density of the subsurface material recovered from the testing program undertaken across the solar array area, mitigation in the form of salvage excavation is deemed not be feasible or warranted in this instance. However, the high-density subsurface material recovered from the substation area suggests that further mitigation measures such as an excavation salvage programme is warranted. Aboriginal representatives also requested that an excavation salvage programme at the substation works area is undertaken. These have been included as part of the mitigation measures. Further mitigation measures include recommendations to collect the surface artefacts prior to development where they cannot be avoided and buried at a suitable location within the property outside the development footprint.

Visual Amenity and Landscape Character

NGH engaged MOIR Architects and Associates Pty Ltd to undertake a Visual Impact Assessment (VIA) and model the viewshed of proposed infrastructure. The VIA also included an on-ground assessment of the Proposal's operational visual impact.

Five (5) Landscape Character Units (LCU) were identified:

- Land Use
- Roads
- Topography
- Vegetation
- Cultural Heritage

Representative viewpoints considering the LCUs were identified and modelled. The predicted potential visual impact was assessed for 15 viewpoints. The Proposal would be visible from all 15 viewpoints, however the Visual Impact Rating concluded that out of the 15 viewpoints seven (7) will have 'low' visual impacts and eight (8) will have 'moderate' visual impacts.

The assessment also concluded that the closest viewpoint to the site (VP05) would experience 'moderate' visual effect, however a negligible impact as the viewpoint is a low-use road with a limited number of potential viewers on a daily basis.

In terms of visual sensitivity, seven (7) viewpoints will have high sensitivity rating due to the number of viewers associated with the population of the town. From these viewpoints it is likely that the solar farm will be visible, however at a distance of over 2.5 km from most viewpoints the solar farm will not be a dominant element in the view. Although determined to be 'moderate' in impact, it is more likely that the impact of the Proposal from these viewpoints will be negligible. No viewpoints were assessed to have a high impact.

The potential for glare and reflectance are considerably low as the proposed solar panels are designed to absorb 82% to 93% of the sun's energy and directly convert it to electricity thus effectively reducing reflectivity. In addition, thin slivers of metal stripping on the face of the panels further reduce any potential glare issues that may occur.

In terms of night lighting, the Proposal involves closed-circuit television (CCTV) security cameras, movement sensor or infrared security lighting and task night lighting within each power conversion station (PCS) for conducting night maintenance. No permanent night lighting is proposed within the array. This also meets Dark Skies requirements.

Hydrology and Flooding

The Proponent engaged BMT WBM to complete a Flood Impact Assessment (FIA).

The Proposal is located north of the Talbragar River, which is a major tributary to the Macquarie River and forms part of the broader Murray-Darling Basin. The contributing catchment area of the Talbragar River at Dunedoo is approximately 2,000 km^2.

Monitoring gauges for the river located near the Proposal, provided discharge records dating back to 1998, however; no discharge was recorded for 2018 and 2019, which is indicative of the severe drought experienced in the last years. The maximum recorded discharge was in 1998 at 264,366 ML and no discharge data has been recorded since January 2018.

Historic flood records of the Warrumbungle Shire Council dating back to the 1970s reveal that flooding is infrequent and levels are generally low. In specific regards to the Talbragar River, flooding is known to occur on a periodic basis, however the severity of the floods is too low to cause any damage to buildings and infrastructure. In Dunedoo, flooding can occur in the north portion of the town and across the low flats, but not within the town itself.

A TUFLOW FLIKE extreme value analysis package was undertaken to analyse flood frequency, which revealed that peak flow would be 4,000 m^3/s in a 0.0002% AEP (1 in 5000 year). Modelled at 1% AEP peak flood velocities within the Talbragar River channel are typically between 1.5 m/s and 2.5 m/s and between 0.5 m/s and 1.0 m/s within the major flood runners. The riparian corridor of the Talbragar River conveys most of flow. However, velocities on the floodplain in the vicinity of the proposal are less than 0.5 m/s.

As the Proposal is located north of the Talbragar River, where gradients are very low and there is no evidence of soil erosion or channel instability, run-off of surface waters from precipitation is unlikely. However, there is still a risk for flooding as the Proposal is close to the floodway network for events greater than 5% AEP that would overflow onto the floodplain.

The modelled peak flood levels were gathered from reporting locations A, B and C, which are located outside the Development Site. These locations were selected to map the existing flood course across the Development Footprint. The results of the Dunedoo Solar Farm Flood Impact Assessment is presented in the table below:

Design Event	Location A	Location B	Location C	Average Flood Levels (m AHD)	Average Flood Levels (m)
Ground Surface	380.5	380.7	379.2	380.1	N/A
20% AEP	380.9	380.9	379.2	380.3	0.2
10% AEP	381.0	380.9	379.3	380.4	0.3
5% AEP	381.1	381.0	379.3	380.5	0.4
2% AEP	381.2	381.1	379.4	380.6	0.5
1% AEP	381.3	381.2	379.4	380.6	0.5
0.5% AEP	381.6	381.3	379.5	380.8	0.7
0.2% AEP	381.8	381.4	379.6	380.9	0.8
PMF	382.5	381.7	380.3	381.5	1.4

The average flooding across the Development Site for each design event ranges from 380.3 metres AHD to 381.5 metres AHD. With the average elevation of representative locations being 380.1 metres AHD, this would represent an average flooding of 0.2 metres for a 20% AEP event to 1.4 metres for a Probable Maximum Flood (PMF) event. The average flood level across the Development Site for a 0.2% AEP would be 380.9 metres AHD.

Therefore, the results of the modelling study conclude that the Development Site is not located within an area of high flood risk and that during construction and operations the risks will be managed by the implementation of appropriate erosion and sediment control measures, including the development of a Site Drainage Plan covering the construction and operation phases prior to commencement of works.

Lower Risk Issues

Soils and Landforms

Soil Management Designs prepared a soil report to provide an assessment of the existing landforms and the soil types and characteristics of the proposed Development Site. This was intended to confirm land capability and characteristics that may affect design, construction or rehabilitation of disturbed soils. It included a desktop and field study for the Development Site.

Two soil landscapes were identified at the Development Site and to occur on the 'Talbragar' alluvial deposits. The soils were classified as Vertosols and Chromosols. Based on observations from the site visit, soils at the site have been extensively disturbed by paddock levelling, repeated cultivation and stock grazing. However, no evidence of soil erosion (surface or tunnel) or salination was apparent. The risk of erosion of soils at the Development Site is considered low given the very low sloping aspect of the site. However, it should be noted that along the riverbanks, the risk of erosion is higher.

No contamination of land was identified in the Development Site during background searches except one (1) site listed in the Dunedoo area, the former Shell Depot, on the corner of Bolaro and Redbank Street. No contamination from associated agricultural activities were identified within the Development Site. Consequently, the contamination risk at the site is considered to be very low. There is a low probability for Acid Sulphate Soils to occur on the southern portion of the Development Site and no traces of Acid Sulphate Soils were found.

The proposed activities for the construction, operation and decommissioning stages of the solar farm have the potential to damage soil through loss of organic matter, structural breakdown and compaction, alteration of hydrological conditions, contamination with pollutants and imported material, mixing of profiles and wind/water erosion. However, impact to soils during operation would be minimal, as maintenance activities and vehicles would be mostly confined to formalised tracks, and the volume and variety of hazardous materials used at the Proposal would be negligible.

Overall, the risk of soil and erosion impacts resulting in soil loss or contamination is considered low during construction, operation and decommissioning if the mitigation measures provided to address the potential impacts are appropriately implemented.

Land Use

LUCRA assessment

The DPI Land Use Conflict Risk Assessment (LUCRA) system is intended to identify and assess the potential for land use conflict between neighbouring land uses. The environmental assessment presented in this EIS is consistent with the LUCRA approach, by defining the development, site and locality characteristics, proactively consulting stakeholders and neighbours and systematically identifying risks and potential impacts. An impact risk assessment for the Proposal is provided in Section 7. The identification and assessment of impacts which may affect neighbours and other stakeholders is provided in sections 8 and 9. The assessments conclude that impact risks to neighbours are not likely to be significant, and manageable using continuing consultation and notification, best practice works methods and identified mitigation measures.

The current land use of the Development Site is RU1 Primary Production in the Warrumbungle LEP. The Development Site is also mapped as being 90% Biophysical Strategic Agricultural Land (BSAL), however on site soil survey investigation undertaken as part of this EIS showed that the land is only 30% BSAL (details in Section 9.2.2 and Appendix I). All of the remaining land on the site is classified as Class 2 land approximately 5.9 ha, Class 3 approximately 70.5 ha, and Class 5 is approximately 2.4 ha. These areas respectively represent 0.01%, 0.04% and <0.001% respectively of the total area of Class 2, Class 3 and

Class 5 soils in the Warrumbungle Shire LGA. As such, in terms of surface area losses, the impacts would negligible.

It should be noted that BSAL identification was originally developed to ensure that mining or coal seam gas would be subjected to an additional level of scrutiny via an independent, upfront and scientific assessment. However, the construction and operation activities of a solar farm are significantly less intrusive than mining or coal seam gas developments as all disturbances to soils are occurring in the top 2 metres layer of soil, and once the solar farm is decommissioned the former land use of the site can be re-instated. With mining activities, the changes to the soil are permanent and irreversible.

As only 30% of the Development Site is BSAL, the site is not considered to have Important Agricultural Land as defined in existing mapping, and is not land that is 'highly suitable for important agricultural industries at a local and regional scale'.

The Development Site is zoned RU1 land for primary production. The land surrounding the Development Site is also RU1 (Primary Production). Surrounding agricultural land consists of cattle grazing, sheep grazing, horse stud, and oat growing.

The Development Site and surrounding land is subject to one (1) mineral exploration licences which is pending renewal. There are no further licence applications or lease applications for the Development Site.

A land use conflict risk assessment was undertaken to consider potential conflicts between the Proposal and surrounding land uses. Potential construction conflicts such as the impacts of contaminated surface water runoff, fire/bush fire, traffic generation, dust and visual amenity had moderate to high risk rankings. These potential conflicts have been addressed with appropriate management strategies and now have low revised risk ratings.

During operation of the Proposal it is considered that all potential land use conflicts could be adequately managed through the implementation of land management mitigation measures.

Water Use and Water Quality

The Development Site is within the floodplain of the Macquarie-Castlereagh River Catchment. The Talbragar River is the closest waterway to the Development Site, which demarcates the western and southern boundaries of the Development Site.

There are two (2) small dams located within the Development Footprint. The Development Site is not located in an area identified as having groundwater vulnerability. Two (2) bores are situated within the Development Site. There are no listed aquatic or terrestrial Groundwater Dependent Ecosystems within the Development Site.

Water during construction would require approximately 41,760 KL to potentially be sourced, depending on availability, from a new bore within the Development Site, purchased from Warrumbungle Shire Council locally to the site or transported from another township.

Under the EP&A Act, SSDs do not require a water use nor water management work approval for activity approvals as per the WMA (refer to Section 5.1.9). However, a permit for aquifer interference as per section 4.41(g) of the EP&A Act would be required to penetrate the aquifer. This amount of water would have a negligible impact on the remaining available water, based on this year's figures.

During operation, water for panel washing and other maintenance activities would similarly be sourced from similar locations as for construction. It is expected 171.4 KL per year of water would be required for these activities. A 20-KL rainwater tank would be installed on site to provide water for irrigation and other non-potable uses, such as sanitary/domestic water and cleaning of equipment and plant. Additionally, the Proposal's draw on this supply would be a low percentage and may form part of the unutilised proportion of the allocation. As such, the potential impact on agricultural users especially those who rely on low cost water is likely to be minor.

The Proposal would not directly affect the surface water quality. Indirectly, the proposed works would involve a range of activities that could disturb soils. This could potentially lead to erosion and sediment laden runoff. This could impact surface water quality in local waterways during rainfall events. The impacts are considered low for this Proposal and standard mitigation measures are expected to be employed.

No construction or operational activities would affect the groundwater. It is considered that this project would have negligible impact on groundwater.

Noise and Vibration

Renzo Tonin and Associates Pty Ltd was engaged to complete a Noise and Vibration Assessment (NVA) for the Proposal.

Noise management levels (NMLs) were calculated for the Proposal and were based on the measured rating background noise level (NSW Noise Policy for Industry (NPI) 2017) and the NSW Interim Construction Noise Guideline (2009). Construction road traffic noise levels were assessed against the Road Noise Policy (2011). Modelling was used to quantify project noise emissions to neighbouring receivers for typical construction activities and operations.

Construction activities are proposed to be progressive and would occur at several locations simultaneously. Noise emissions were modelled for the following scenarios:

- Solar farm construction including:
  - Access road construction
  - Trenching, cabling, and piling for PV installation
  - Construction of ancillary buildings
- TL construction including pole installation.
- Dunedoo substation extension construction.

Noise emissions from the construction phase of the Proposal were predicted to generally comply with the construction noise management levels at the nearest affected receivers; however, some exceedances were predicted for Receivers R2 (involved receiver) and R4 (external receiver) during the construction of the solar farm and Receivers R7 and R8 during the construction of the TL and substation(for both TL options). These impacts are expected to be manageable through standard construction mitigation measures.

Noise emissions from the operational phase of the solar farm were predicted to generally comply with the nominated project noise trigger levels at the nearest affected receivers. However, exceedances of up to 2 dB(A) for R2 (involved receiver) and 1 dB(A) for R4, which are considered to be negligible in accordance with the NPI and no further noise mitigation is recommended.

The Proposal does not pose a risk to sleep disturbance as noise emissions at the identified receivers will be similar to the predicted operational noise levels. This noise will be from the tracking motors, inverters, and air conditioning units are considered to be continuous with no potential for high peak noise level events operating during the night time period (before 7am during summer months). Hence, it is expected that both the $L_{Aeq,15min}$ and L_{AFmax} will be well below the nominated sleep disturbance criteria of 40 dB(A) and 52 dB(A), respectively.

The construction road traffic noise levels are predicted to comply with the applicable noise criterion at the nearest affected receivers along All Weather Road and Digilah Road. As the construction traffic noise levels are temporary and comply with the RNP criteria, it indicates that the traffic noise levels due to the construction works for the solar farm would not adversely affect the existing residences along All Weather Road and Digilah Road.

No vibration impacts are predicted to impact nearby receivers.

The results of the NVA demonstrate that construction noise levels satisfy relevant regulatory construction. Several opportunities to further minimise the noise impacts of the Proposal during construction are provided as mitigation measures, and if these are appropriately applied, residual noise impacts if any, would be able to be managed effectively. Operational noise levels generally comply with requirements with predicted exceedances less than 2 dB(A) which is deemed imperceptible to the receiver and therefore no specific mitigation is required.

Socio-economic and Community

The Proposal would have both positive and negative socio-economic impacts. Positive socio-economic impacts from the Proposal which are also considered benefits, include:

- The Proposal will involve $76 million in investment during the construction phase and will support 100 direct and 160 indirect positions over the construction period. Once operational, 3 direct and 9 indirect jobs will be supported by the Proposal. Many of these jobs will be supported in the regions local to the project
- The Proposal will provide significant participation opportunities for businesses and workers local to the project and provides opportunities that are a good match of skills and resources available. Major investment projects, such as the Proposal, will play an important role in revitalising the regional economy in the post-COVID-19 recovery phase.
- The 'external' Project labour requirement would be expected to generate an accommodation need for 40 workers at the peak of the Project. This represents only 2% of total commercial accommodation in major centres and smaller townships such as Dunedoo, Mendooran, Coolah, and Gulgong.
- Construction workers relocating to the region would be expected to inject approximately $1.0 million in additional spending into the economy over the construction phase, supporting approximately 10 jobs in the service sector across the Study Area.
- No loss of employment associated with the Subject Site is anticipated, either directly (on-site) or through the supply chain. The proponent is exploring the possibility of sheep grazing on the Subject Site, which would ensure agricultural activity is retained on the host land.
- Ongoing economic stimulus associated with the operation of the Proposal is estimated at approximately $12.6 million (over 30 years, CPI adjusted) associated with landowner returns and operational wage stimulus. Net land tax revenue to Council would be in addition to this value.
- The Proposal has the capacity to supply sufficient clean energy to power the equivalent of approximately 24,400 homes pa, which represents approximately 68% of the total annual residential requirements of the Study Area (36,130 homes).
- Operation of the Proposal will not impact on the Siding Spring Observatory and could potentially support small-scale tourism and educational opportunities in the future.

Potential adverse impacts to the community include those associated with temporary increased traffic on the roads, a change in the rural landscape and visual amenity of the area. These potential impacts are likely to be reduced during the operation and decommissioning stages of the project, as these stages would require less staff that would consequently reduce traffic numbers.

Therefore, the Proposal provides far more positive socio-economic impacts than negative; and any residual impact would be minimal and able to be managed through the appropriate implementation of the mitigation measures.

Traffic, Transport and Road Safety

The potential traffic, transport and road safety impacts associated with construction of the Proposal relate primarily to the increased numbers of large vehicles on the road network, which may lead to:

- Increased collision risks (other vehicles, pedestrians, stock and wildlife)
- Damage to road infrastructure
- Associated noise and dust (particularly where traffic is on unsealed roads) which may adversely affect nearby receivers
- Disruption to existing services (public transport and school buses)
- Reduction of the level of service on the road network caused by 'platooning' of construction traffic.

All vehicles other than trucks are proposed to enter the Development Site via Digilah Road and All Weather Road. It is proposed that trucks enter the Development Site via the Castlereagh Highway and All Weather Road. Vehicle access to the Development Site would generally be confined to the standard hours of construction with approval sought in advance for any early or late deliveries. Exceptions would occur as staff arrive and leave the site before and after shifts. Digilah Road is prone to flooding during periods of heavy rain. In the rare occasion of a flooding event of Digilah Road all vehicles are proposed to enter site via the Castlereagh Highway and All Weather Road.

The Proposal proposes to upgrade the Castlereagh Highway / All Weather Road intersection to facilitate construction vehicle movements to and from the Development Site. The existing intersection currently does not facilitate a Basic Right Turn (BAR) and Basic Left Turn (BAL) for construction vehicles such as an Articulated Vehicle (AV). Options to upgrade the southeast and northeast corner of the junction have been considered in some detail to facilitate the safe use of this junction by the construction vehicles. The southern option could facilitate 20.6m vehicles but has been deemed inappropriate due to the proximity of a bridge immediately south of the intersection. The northern option designed for 30 m vehicles is therefore preferred and has the added benefit of allowing simultaneous in and out access through the junction to maximise road safety.

Internal access tracks would remain unsealed but would be re-sheeted with gravel or crushed, and compacted soil to maintain their condition during the construction phase.

During operation, vehicles would use the designated public road network to access the site. When within the site, internal roads and designated parking areas would be used . Current vehicle movements along All Weather Road and Digilah Road are estimated to be 10 to 20 vehicles per day (VPD). These activities have a minor impact on vehicle movements per day. Activities undertaken during the operation phase would include travelling to the site office or maintenance building via these roads and carrying out maintenance activities on the solar farm infrastructure.

Overall, the additional traffic associated with the construction, operation and decommissioning of the solar farm would be a small component of the existing traffic local and state roads. No substantive increased collision risk, damage to road infrastructure, noise or dust impacts, disruption to existing services or reduced level of service is expected to accompany construction, operation or decommissioning.

Overall, traffic impacts from the Proposal are expected to be low and manageable.

Hazards

SEPP 33 Hazardous and Offensive Development requires a Preliminary Hazard Assessment (PHA) to be prepared for potentially hazardous or offensive development and considers the quantity of dangerous goods stored or transported, the frequency of transportation movements, and in some cases the distance of the materials from the site boundary. The guidelines require goods to be classified according to the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code).

A development which exceeds the screening thresholds in the guidelines would be considered potentially hazardous and a PHA would be required. For quantities that fall below the stated thresholds, and in the absence of other risk factors; the SEPP indicates that there is unlikely to be a significant off-site risk.

Screening was undertaken assuming the Proposal would use up to 2-5 tonnes of LPG and fuel (petrol) each. This is below the threshold of 10 tonnes for LPG and 5 tonnes of fuel (petrol) and a PHA is therefore not necessary.

There is low potential for EMF impacts during the construction, operation and decommissioning phases of the project. The maximum magnetic field of the proposed TL is expected to be well under the 200 µT and 1000 µT limits respectively recommended for public and occupational exposure, and staff exposed to EMF's over intermittent periods during works at and around the existing 66 kV overhead TL would be short term. The construction site would be fenced to protect the public from construction health and safety risks.

During operations, the potential for health impacts from EMFs would be minimal as the existing and proposed overhead TLs are less than the recommended 5 kV/m and 10 kV/m limits and EMFs are not likely to interfere with local mobile phone, radio or television reception.

No private airstrips are located within 1km of the Development Site. The two closest national airports are located in Dubbo (90 km west of the site) and Mudgee (77 km south of the site).

Risk to aviation would be very low as the proposed PV panels do not involve mirrors or lenses that are known to cause glint and glare. PV solar panels are designed to absorb as much solar energy as possible in order to maximise electricity generation. The panels would also have an anti-reflective coating to further reduce the potential for glare and glint.

Fire and Bushfire

The Development Site is generally flat, located 2 km from the Talbragar River and has been levelled for agricultural activities. The site has been cleared and cropped with little to no overstorey or shrub storey present, except for isolated remnants and tree clusters. Talbragar River comprises of a dense riparian habitat along the riverbanks, this river runs south and west of the boundary of the Development site.

Specific construction and operational activities can cause or increase the risk of bush fire. Considering the scarce and low vegetation cover as a fuel source, over the Development Site, it is considered unlikely that construction of the solar farm would pose a significant uncontainable bush fire risk. If standard mitigation measures are appropriately implemented, the bush fire hazard associated with the activities listed above is considered very low and manageable through standard site protocols.

Historic Heritage

The Subject Land (referred to as Proposal area within Appendix E) has been cleared and utilised for grazing since European settlement in the mid 1800's. It has therefore been subject to impacts from farming for many decades. Overall, the area would be categorised as disturbed through consistent farming practices over many decades through ploughing and tree clearing.

NSH SHI Database searches were undertaken to identify if the Proposal would pose a risk to any potential items. The searches indicated one (1) previously recorded heritage site, the Dunedoo Railway Station and yard group, listed under the *NSW Heritage Act* within Dunedoo in the Warrumbungle Shire LGA. This site is not located within the Subject Land and will not be impacted by the Proposal. This site was also identified through the Australian Heritage Database search, in addition to an Indigenous Place in Dunedoo. No other information is provided about the Indigenous Place in Dunedoo so its location to the Subject land is unable to be ascertained

NSH SHI Database also indicated the following:

- three (3) previously recorded Aboriginal Places listed under the *National Parks and Wildlife Act* within the Warrumbungle LGA. None of these recorded Aboriginal Places are within Dunedoo or in close proximity to the Subject land. Refer to Section 8.2 for details regarding Aboriginal heritage.
- four (4) previously recorded heritage sites listed by the Local and State Agencies within Dunedoo in Warrumbungle Shire LGA however none are located within or in close proximity to the Subject land.

As the previously recorded sites are relatively distant from the Proposal, no impacts are considered likely on heritage values by the proposed solar farm development.

Air Quality and Climate

Existing sources of air pollution at the site include vehicle emissions, dust from surrounding unsealed roads, and agricultural activities.

During construction and decommissioning there could be an increase in dust generation and air emissions from earthwork activities and vehicles. However, earthworks associated with construction and decommissioning are likely to be relatively minor and would be managed to keep dust to a minimum. Also, the piling machines used for the installation of the solar arrays are typically designed to reduce soil disturbance and corresponding dust pollution. It is expected that existing groundcover vegetation would remain where possible to assist in minimising dust. Should residual excessive dust generation occur, dust mitigation such as watering of dry surfaces, would be implemented.

Operation of the Proposal would generate minimal emissions and air quality impacts. Vehicle use at the site during operation and maintenance would be minimal. The impacts on local and regional air quality are expected to be negligible.

No substantive impact for any of these aspects is expected from the Proposal.

Waste

Proposal includes resource management options that consider the principles of avoidance of unnecessary resource consumption, resource recovery and disposal. These principles would act as a guide to achieve efficient use of resources and reduce costs and environmental harm. Any remaining waste would be recycled where possible. All waste would be disposed of using appropriately licensed facilities.

No substantive impact for any of these aspects is expected from the solar farm.

Cumulative Impacts

There are another eight (8) solar developments within 100km of the Proposal, however the closest is 64 km. In addition, it is likely that construction timeframes for these projects will be staggered further reducing potential for cumulative impacts. In combination with these other developments and given their distance to the Proposal and timing for when they would occur, cumulative impacts on noise, visual and traffic are not expected. During construction and decommissioning, the Proposal is most likely to generate positive cumulative socio-economics impacts.

Dubbo is a large regional centre with a population exceeding 36,000 as of the 2016 census. In combination with other towns in the region, it is expected that there would be capacity to supply requirements like housing, public services, materials and accommodation etc. Socio economic benefits are also likely to occur through local direct and indirect employment.

Management of Impacts

The Proposal has been designed to prevent environmental impacts by:

- Avoiding the majority of biodiversity values, in particular native vegetation including threatened biota.
- Avoiding known Aboriginal heritage items, where possible.
- Incorporating screening and landscaping elements to reduce visual impact.
- Selecting technologies that minimise noise and vibration outputs.

A range of additional management and mitigation measures have been developed to further reduce any residual impact. These strategies centre on the development of management plans and protocols to minimise impacts and manage identified risks include but are not limited to:

- Traffic management measures during construction.
- A range of standard construction mitigation measures to minimise dust, soil erosion, waste and noise impacts.
- Protocols in place for managing Aboriginal heritage and biodiversity.
- All stages of the development would be designed and operated in accordance with Australian Standards to minimise any risks to the health and safety of the public and employees.

Conclusion

Overall, the Proposal, located within the Central West Orana Renewable Energy Zone, would represent an important contribution to Australia’s transition to a low emission energy generation economy. It has the potential to significantly benefit the ability of NSW government to meet net zero goals as well as result in significant investment in the Warrumbungle Shire region through direct and indirect employment and opportunities for local suppliers. The Proposal is considered compatible with existing land uses and highly reversible upon decommissioning, returning the site to its current agricultural capacity.

Site design has been undertaken to avoid impacts where possible. A suite of management measures has been developed to address and mitigate remaining environmental, physical and social impacts to an acceptable level therefore making the proposal justifiable and acceptable.

1 INTRODUCTION

1.1 PURPOSE AND SCOPE OF THIS DOCUMENT

This Environmental Impact Statement (EIS) identifies and assesses the potential planning and environmental impacts associated with the construction, operation and decommissioning of the proposed 55-Megawatt (MW) Alternating Current (AC) Dunedoo solar farm (the 'Proposal'). NGH Pty Ltd (NGH) has prepared this EIS on behalf of Sun Spot 4 Pty Ltd (the 'Proponent').

This EIS has been prepared in accordance with Part 4 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act) to support a Development Application (DA) to be lodged with the New South Wales (NSW) Department of Planning, Industry and Environment (DPIE).

The objective of this EIS is to fulfil the requirements of Schedule 2 of the Environmental Planning and Assessment Regulation 2000 (EP&A Regulation) and Section 4.15 of the EP&A Act. The structure and content of the EIS addresses the Secretary's Environmental Assessment Requirements (SEARs) provided by DPIE on 9 April 2020 (Appendix A). The EIS also addresses the assessment requirements of the *NSW Biodiversity Conservation Act 2016* (BC Act) and the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Other independent consultants have been contracted to carry out specialist technical assessments as required. This EIS would be independently evaluated by the NSW Government, considering input from the community that will be provided during the public exhibition period. The development assessment process places the onus on the Proponent to provide the information required for the State Government to make an informed decision. The process provides for public transparency, accountability and participation in the decision-making process of development approvals.

1.2 PROPOSAL OVERVIEW

The Proponent proposes to develop a utility-scale solar farm in the Central Western Region of NSW and is located on agricultural land 2 km north of Dunedoo. Refer to Figure 1-1 for the regional context.

The Proposal would be accessible via All Weather Road which runs east-west through the Development Site. Refer to Figure 1-2 for the outline of the Development Site and associated elements.

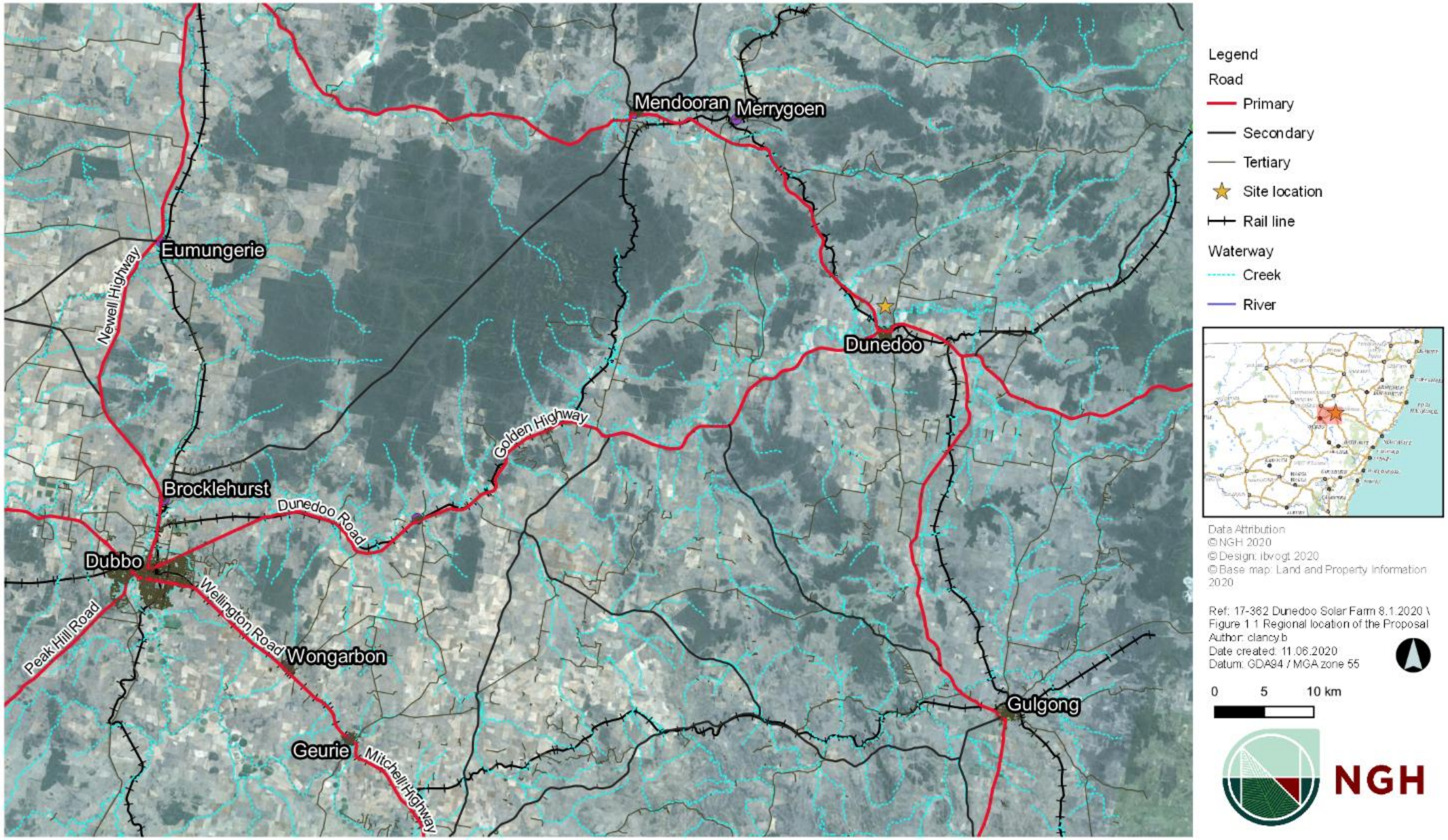

Figure 1-1 Proposal regional context

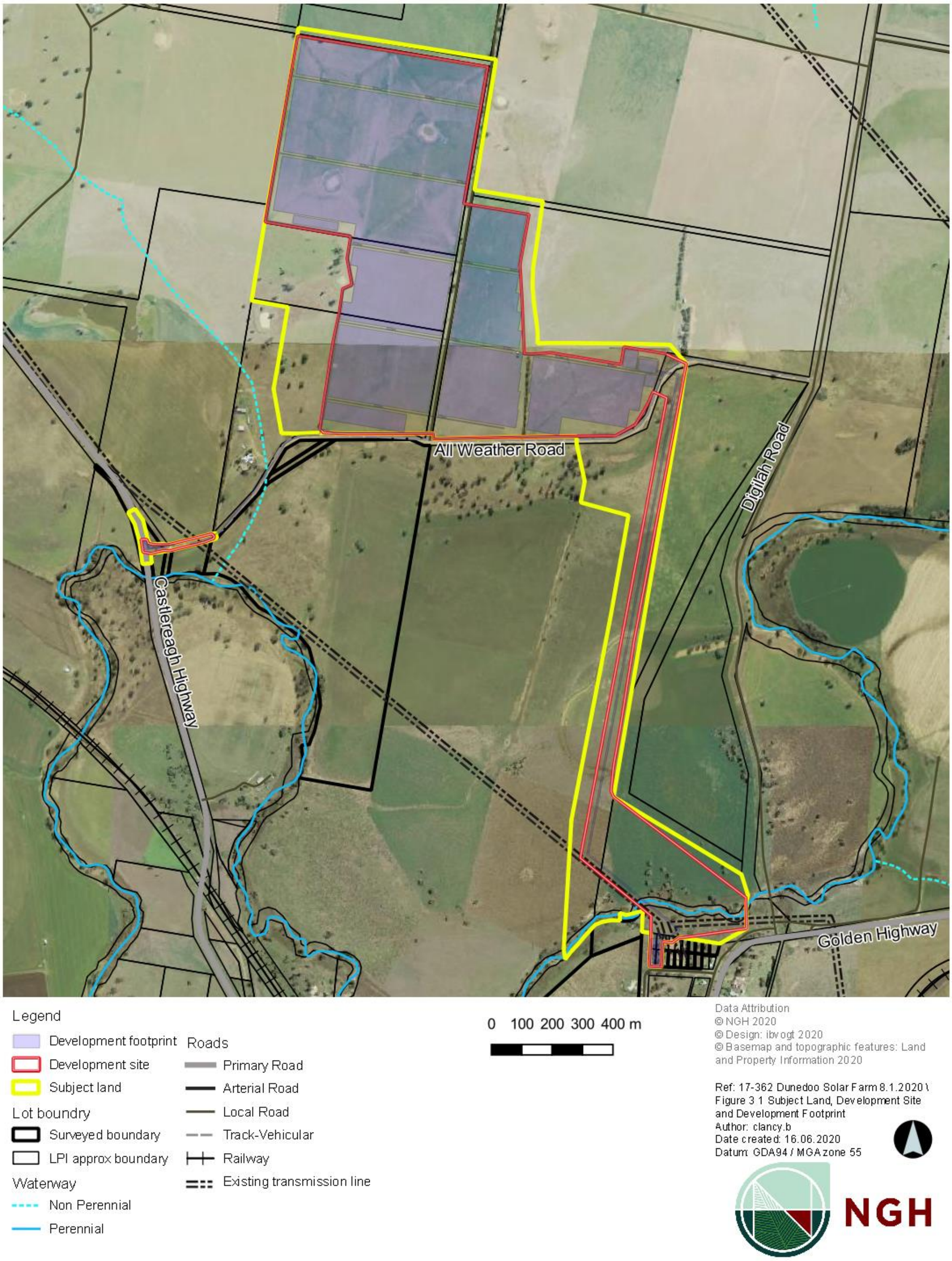

Figure 1-2 Proposal boundaries and surrounding features

Note the Subject Land includes the Development Site and a buffer of up to 5 metres to the north, within which, and following detailed design, the Development Footprint would be sited and areas of land that are subject to potential direct and indirect impacts from the Proposal.

This Proposal covers the construction, operation (including any upgrades during the operational life) and decommissioning of the solar farm and associated infrastructure as detailed in detail within this EIS, The Proposal would have a generation capacity of 55 MW AC and would include a facility connection substation, Battery Storage (BS) and required ancillary infrastructure including inverter/transformer stations, operations and maintenance buildings, control room, passing bay on All Weather Road, Castlereagh/All Weather Road junction upgrade, internal access tracks, above ground and underground electrical cabling, security fencing, closed-circuit television (CCTV), lighting, landscape screening, perimeter fencing and communication tower (in both solar farm substation and Essential Energy Dunedoo Substation).

In order to accommodate the Proposal's power output a new Transmission Line (TL), would be constructed to the existing Essential Energy Dunedoo Substation. The Dunedoo Substation would also require expansion and augmentation works. There are currently two (2) proposed options for the 66-kV TL corridor. These options are assessed within the EIS and would have an approximately 40-metre clearing easement. Upon construction and commissioning of the Proposal, the TL, including the substation extension, will be handed back to Essential Energy.

The construction phase of the Proposal is expected to take 10 to 12 months and the Proposal would have an operational life of up to 30 years. During decommissioning, all below ground components to a depth of less than 500 mm would be removed and the land would be restored to its existing use. Should the Proponent seek to extend the life of the Proposal or refurbish the site, a further planning application would be made prior to the expiry of any approvals existing at that time.

The Proposal would require subdivision of three (3) lots within the Development site for lease and purchase agreement purposes with the involved landowners as detailed within this EIS. It is also proposed that a number of lots within the solar farm area will be consolidated to provide larger lot areas. Lot 80 DP754389 would require subdivision for the purpose of the Solar Farm substation if required by Essential Energy.

Section 3 and Section 4 Provide more detail on the design, infrastructure and works required for the Proposal.

1.3 IB VOGT GMBH / SUN SPOT 4

Sun Spot 4 Pty Ltd is a registered subsidiary of ib vogt GmbH in Australia, created for Dunedoo Solar Farm. Established in 2002, ib vogt GmbH specialises in the development, design and engineering, financing, operation and maintenance, and asset management of solar power plants. The company provides high-quality turnkey solar power plant solutions designed and engineered in Germany, to investors internationally.

ib vogt GmbH is a manufacturer-independent integrated developer, focusing on tailor-made solar power plant solutions that maximise lifecycle performance and investor returns. The company employs over 250 experts in all areas along the solar power plant value chain. The company operates internationally from offices in Australia, Germany, the United Kingdom, the USA, the Netherlands, Panama, Eastern Europe, India and southeast Asia, as well as several joint ventures across Africa.

1.4 THE STATE SIGNIFICANT DEVELOPMENT PROCESS

The Proposal is considered State Significant Development (SSD) under *the State Environmental Planning Policy (State and Regional Development) 2011* (refer to Section 5.2.3). SSD applications require the preparation of an EIS (this document).

The SSD approval pathway is characterised as follows:

- The proponent lodges an application for Secretary's Environmental Assessment Requirements (SEARs) for the EIS, accompanied by supporting scoping information. The SEARs incorporate input from government agencies, including local Councils
- SEARs are issued and the EIS is prepared after consultation with Council(s), agencies and the community, and submitted to DPIE with the DA
- The SSD application and EIS is publicly notified in the local newspaper, on DPIE major projects website, to public authorities, to adjoining landowners or occupiers, and exhibited for a minimum of 30 days. Submissions are received by DPIE
- Proponents may be required to provide a written response to issues raised in submissions
- If a Proposal is not supported by the local Council, or DPIE has received more than 50 unique public objections, the Proposal is referred to the Independent Planning Commission (IPC) accompanied by the DPIE's Environmental Assessment Report with proposed conditions of consent, for determination.
- The IPC makes a determination setting out reasons for consent/refusal in a Statement of Reasons.

The SSD requirements provide a streamlined process for major projects. Integrated development provisions requiring the concurrence of other state agencies do not apply – consultation with relevant state agencies occurs before the SEARs are issued. Certain approvals under other legislation are not required for SSD Proposals (refer to Section 1).

The DA and Scoping Report for the Proposal was submitted to DPE on 24 October 2017 (prior to becoming DPIE), and subsequent SEARs for the assessment were issued by DPIE on 24 November 2017, whereupon updated SEARs were issued on 9 April 2020 (refer to Appendix A). The current SEARs and corresponding sections in the EIS are shown in Table 1-1.

Table 1-1 SEARs and EIS references

Secretary's Environmental Assessment Requirements	EIS reference
A stand-alone executive summary.	Executive summary
A full description of the development, including: • 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 separate approvals process); • a detailed constraints map identifying the key environmental and other land use constraints that have informed the final design of the development.	Section 4
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 2 Section 11
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 in the region, taking into consideration any relevant legislation, environmental planning instruments, guidelines, policies, plans and industry codes of practice; • a description of the measures that would be implemented to avoid, mitigate and/or offset the impacts of the development (including draft management plans for specific issues as identified below); and • a description of the measures that would be implemented to monitor and report on the environmental performance of the development.	Section 7 Section 8 Section 9
A consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS.	Section 10
The reasons why the development should be approved having regard to: • relevant matters for consideration under the Environmental Planning and Assessment Act 1979, including the objects of the Act and how the principles of ecologically sustainable development have been incorporated in the design, construction and ongoing operations of the development; • the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses; and • feasible alternatives to the development (and its key components), including the consequences of not carrying out the development.	Section 11 Section 2
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 2.1
A detailed evaluation of the merits of the project as a whole.	Section 2.1
The EIS must address the following specific issues:	
• Biodiversity – including: • 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);	Section 8.1

Secretary's Environmental Assessment Requirements	EIS reference
• **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**;	
• Heritage – including 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***;	Section 8.2 Section 9.9

• Land – including:
  • 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, quarries, mineral or petroleum rights;
    ▪ a soil survey to consider the potential for erosion to occur;
    ▪ current and potential Agricultural Land;
    ▪ 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 Conflict Risk Assessment in accordance with the Department of Industry's ***Land Use Conflict Risk Assessment Guide***;
	Section 8.4
	Section 9.1
	Section 9.2
	Section 4.2

• Visual – including an assessment of the likely visual impacts of the development (including any glare, reflectivity and night lighting) on surrounding residences, scenic or significant vistas, air traffic and road corridors in the public domain, including a draft landscaping plan for on-site perimeter planting, with evidence it has been developed in consultation with affected landowners;	Section 8.3
• Noise – including 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), cumulative noise impacts (considering other developments in the area), and a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria;	Section 9.4

• Transport – including:
  • an assessment of the peak and average traffic generation, over-dimensional vehicles, construction worker transportation and transport of materials by rail;
  • as assessment of the likely transport impacts to the site access route (including Castlereagh Highway and All Weather Road), site access point, 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 impacts during construction;
	Section 9.6

• Water
  • an assessment of the likely impacts of the development (including flooding) on surface water and groundwater resources (including the Talbragar River, 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; and
	Section 8.4
	Section 9.1
	Section 9.3

Secretary's Environmental Assessment Requirements	EIS reference
• 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);	

• Hazards and risks
    • Battery Storage – include a Preliminary Hazard Analysis (PHA) prepared in accordance with ***Hazard Industry Planning Advisory Paper No.6 – Guidelines for Hazard Analysis*** (DoP, 2011) and ***Multi-Level Risk Assessment*** (DoP, 2011); and
    • an assessment of potential hazards and risks including but not limited to bushfires, spontaneous ignition, electromagnetic fields or the proposed grid connection infrastructure against the International Commission on Non-Ionizing Radiation Protection (ICNIRP) ***Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields.***
	Section 9.7

• Socio-economic – including an assessment of the likely impacts on the local community and consideration of the construction workforce accommodation.	Section 9.3 Section 6
• Waste – identify, quantify and classify the likely waste stream to be generated during construction and operation, and describe the measures to be implemented to manage, reuse, recycle and safely dispose of waste.	Section 9.11
During the preparation of the EIS, 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. In particular, you must undertake detailed consultation with affected landowners surrounding the development and Warrumbungle Shire Council. The EIS must describe the consultation process and the issues raised, and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided.	Section 6
The development application must be accompanied by: • a signed report from a suitably qualified person that includes an accurate estimate of the capital investment value of the development (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*), including details of all the assumptions and components from which the capital investment value calculation is derived • the consent in writing of the owner/s of the land (as required in clause 49(1)(b) of the *Environmental Planning and Assessment Regulation 2000*).	Provided with the Proponent's DA

2 OBJECTIVES, ALTERNATIVES AND BENEFITS

2.1 PROPOSAL OBJECTIVES

This Proposal 's objectives, have been developed in consideration of Australia's Federal and State of New South Wales policies and international agreements to which Australian is cosignatory.

The Proposal's objectives are to:

Generate electricity to approximately 24,415 homes from a clean and renewable energy source with minimal negative cultural and environmental impacts, through an energy generation facility that has been developed in a manner acceptable to the local community.

Emissions from Photo Voltaic (PV) technologies generate far less GHG emissions per GWh than conventional fossil-fuel-based electricity generation technologies (Finkel et al. 2008, NREL 2012). These emissions are limited only to the duration of the production of the module, which account for 50 to 80% of the GHG (Weisser n.d.). In addition, PV modules emit no pollution, produce no GHGs during plant operation for the production of electricity, and use no finite fossil-fuel resources.

Assuming an average household consumption of 5,920 kWh pa, the Dunedoo solar farm Proposal would provide electricity to approximately 24,415 homes through the generation up to 144,540 MWh per year. In addition, the area where the Dunedoo solar farm is proposed, has been identified by the AEMO as a Renewable Energy Zone (REZ), and if approved, the Proposal would provide electricity close to an identified consumption centre, thus, providing local and regional employment opportunities and other social benefits during all stages of the project.

Assist in the reduction of Australia's GHG emissions intensity in relation to the gross domestic product (GDP) and contribute to State and Federal efforts to meet climate change mitigation targets.

Under the United Nations Paris Agreement on climate change, Australia has committed to a reduction of GHG emissions with specific targets to be reached by 2020, 2030 and the second half of the century.

In addition, the NSW Climate Change Policy Framework (State of NSW and Office of Environment and Heritage 2016) endorses and is intended to complement the Paris Agreement target, to make NSW more resilient to a changing climate.

Moreover, Australia developed the Commonwealth Renewable Energy Target (RET) Scheme to achieve large-scale renewable generation of 33,000 GWh in 2020, by encouraging additional generation of electricity from renewable sources, thus reducing emissions of GHG in the electricity sector.

In contributing for Australia meeting the above, renewable energy technologies have the capacity to provide faster results due to their shorter potential construction and commissioning times (CER 2017). Solar projects are part of these technologies which are also rapidly improving.

As the Proposal is expected to generate around 144,540 MWh per year, and assuming that generation would otherwise be made by brown coal with a carbon factor of 0.33372 tonnes per MWh (DOEE 2016), the Proposal would save approximately 48,236 tonnes of carbon dioxide per year. Precise generation figures may change subject to final site design.

2.2 PROPOSAL ALTERNATIVES

Various options relating to location, design and technology were evaluated in the planning of the Proposal taking into account strategic needs and benefits and Proposal objectives.

2.2.1 The 'Do Nothing' Option

The direct consequence of not proceeding with the Proposal would be to forgo the benefits outlined in Section 2.1. This would entail:

- Loss of opportunity to reduce GHG emissions in the electricity generation sector and contribute to state and national climate change targets and commitments
- Loss of electricity network reliability and security benefits
- Loss of direct and indirect social and economic benefits, including employment and increased demand for local goods and services.

Doing nothing would avoid the environmental impacts associated with the development and operation of the Proposal. These include construction noise, traffic and dust, visual impacts the site for the life of the solar farm. However, these impacts are considered manageable and would not likely result in a substantive negative impact to the environment or community over the medium and long term (refer Section 8).

Given the clear benefits of the Proposal and the acceptability or manageability of environmental impacts, 'do nothing' is not the preferred option from a strategic, economic, social, and environmental standpoint.

2.2.2 Alternative Locations and Layouts

The Proponent has reviewed the solar generation potential of many areas in NSW by identifying grid connectivity capacity, planning constraints, biodiversity impacts and other site constraints. A number of renewable energy projects are required in NSW to meet the strategic framework outlined in Section 1

The selected Development Site provides the optimal combination of:

- Low environmental constraints (predominantly cleared cropping land)
- Level terrain for cost effective construction
- High quality solar resource
- Low density population and limited neighbouring properties
- Suitable planning context
- Acceptable flood risk
- Road access
- Access to the distribution network.
- High levels of available capacity on the grid distribution system
- Supportive local community towards a utility scale solar project
- Flexibility to design the site to avoid impacts where possible
- Ability to effectively mitigate and manage residual impacts through the EIS process
- Benefits that can be provided to the local region through economic development.

The design of the Proposal is the result of an iterative process and has been adapted progressively as information regarding site constraints, and the potential impacts and risks associated with the development of the Proposal have become available. Constraints related to cultural heritage, electricity network easements, and biodiversity values in particular have been taken into account in developing the proposed layout.

Based on biodiversity, heritage and other studies carried out for the EIS, the proposed layout achieves the objective of efficient electricity production while avoiding and minimising environmental impacts.

2.2.3 Alternative Technologies

Alternative technologies for renewable energy generation encompass generation technology (principally solar or wind), PV solar equipment and the Battery Storage (BS).

Generation technology

PV solar technology was chosen for electricity generation because it is cost-effective, low profile, durable and flexible regarding layout and siting. It is a proven and mature technology which is readily available for broad scale deployment at the site. Solar generation is well suited to the particular characteristics of the Development Site and can be rapidly deployed to assist in meeting both state and national climate change targets.

Solar farm components

Technology options considered for the Proposal include:

- The type of solar panels
- Solar panel mounting system - fixed tilt or tracking
- The type and number of inverters/transformers and BS.

Solar panels

The Proposal will require approximately 173,000 solar panels of, mounted on single axis trackers and in rows, with approximately 3-9 metre row spacing, and with a maximum height of approximately 3 metres above the natural ground level. The PV mounting structure would comprise piles driven approximately 2.5 metres (depending on geotechnical requirements) into the ground using a pile driver.

As solar panel technology evolves rapidly, specification of the exact make of the solar panels will be defined during detailed design. Notwithstanding, solar panels being considered for the Proposal would be expected to absorb 82% to 93% of the sun's light and would involve low reflective surface material that would limit glint and glare.

Mounting System Array

The PV mounting structure can be fixed or incorporate a mechanism that enable the modules to track the path of the sun:

- **Fixed**: the modules are fixed and installed at an optimal orientation and tilt/angle for the site
- **Single axis tracking system**: a mechanism enables the modules to track the sun from east to west, following the path of the sun. The tilt/angle of the module is fixed. This is the preferred option.
- **Dual axis tracking system**: a mechanism enables the modules to track the sun from east to west and north to south. This tracking ensures the module surface is always presented perpendicular to solar radiation, and therefore achieves maximum exposure.

The mounting options are compared in Table 2-1. The mounting system is installed on piles that have been driven or screwed into the ground, with ideally very little ground disturbance or pre-installation preparation. The total production, including generation window, would also be subject to the final solar panel selection.

Table 2-1 Comparison of mounting options

Element	Fixed	Single axis tracking system	Dual axis tracking system
Land area required	Low	Medium	Very high
Production	Medium	High	High
High generation output window	Noon ± 2 hours	From sunrise + 30 min to sunset -30 min	From sunrise + 30 min to sunset -30 min
Investment	Low	Medium	Very high
Operational expenses	Low	Low	High
Wind resistance	Very high	Very high	Low
System reliability	Very high	Very high	Medium

Energy storage technology

There are several alternative technologies that could be used for the proposed BS. Battery technology was selected over mechanical or physical storage methods (flywheel, pumped hydro, liquid air, compressed air) or thermal storage (such as hot water or molten salt) because it enables modular installation without major infrastructure or specialised landform features. Batteries generally have lower weight and physical volume and better scalability compared to other technologies. Disadvantages of batteries include their relatively limited life, some batteries are made from hazardous materials, and sensitivity to climatic conditions (Finkel et al. 2017).

The lithium-ion (‘Li-ion’) battery is currently the preferred technology for storing energy generated from wind and solar sources (Nova, Academy of Science 2017), and is likely to dominate battery chemistry for the next 20 years (Randell Environmental Consulting 2016). The shift to Li-ion batteries is because of their greater energy density (which means they are smaller and lighter), expected longer life spans and ability to undergo deeper discharges, reducing the capacity required (Helen Lewis Research 2016). Li-ion batteries have a very long lifetime compared to other battery technologies, with 5,000 or more charge cycles (Finkel et al. 2017).

Alternative battery technologies include lead acid and relatively new technologies such as hydrogen, molten-state, sodium-ion, flow (vanadium redox, hydrogen bromide or zinc bromide) and saltwater batteries. Many of the competing technologies are either still in technical or commercial development, environmentally unfriendly or offer low energy and power density compared to Li-ion.

Li-ion battery cells were selected for the Proposal because they provided the optimal combination of:

- Proven ability to complement to solar generation developments
- Ability to support the network to increase renewable energy penetration
- Ability to provide energy during periods of peak demands
- Minimal environmental impact
- Safety and ease of integration
- Demonstration and maturity of technology
- Value for money.

Li-ion technology is established and proven, compact, lightweight, highly efficient, very high energy density, economically attractive, commercially available and easily installed with low maintenance requirements.

2.2.4 Scale of the Proposal

The scale of the Proposal has been influenced by:

- Land available from involved landowners, and availability of agricultural land from landowners willing to enter into lease or purchase agreements
- Constraints within the Development Site that have arisen during the EIS investigations to avoid significant impacts to the land or solar farm infrastructure
- Demand for new renewable electricity generation to meet generation targets
- Commercial investment and viability considerations
- Transmission grid capacity.

The proposed scale of the solar farm successfully responds to the constraints and opportunities inherent in these factors.

As part of the site selection process, the Proponent has undertaken detailed electrical load-flow modelling of the NSW electricity transmission system. This detailed modelling has shown the available capacity on this section of the 66-kV and 132-kV grid system to be sufficient to support a solar farm of this scale. These assessments have been discussed with Essential Energy as part of the ongoing grid connection consultation and agreement process.

2.2.5 Preferred Option

The preferred option is to develop an appropriately sited, designed and scaled project to achieve the Proposal objectives (refer to Section 2.1). The Proposal balances technological, energy and environmental aspects, while retaining the flexibility and adaptability required in the final design stage of the Proposal.

The preferred option represents a commercially viable, technologically feasible contribution to the need to reduce carbon emissions intensity in the energy sector, while achieving a low level of environmental impact. Solar generation using PV panels is particularly well-suited to the topographical and climatic conditions of the Proposal's Development Site.

2.3 PROPOSAL BENEFITS

2.3.1 Electricity Reliability and Security

While most of Australia's electricity is currently provided by coal-fired power stations, as many as three-quarters of these plants are operating beyond their original design life (DIS 2015). Nine (9) coal-fired power stations have closed since 2011-2012, representing around 3,600 MW of installed capacity (AER 2015 in Commonwealth of Australia 2016). All five (5) operating NSW coal-fired power stations are scheduled for retirement between 2023 and 2043 (based on assumed 50-year technical life), beginning with Liddell Power Station in April 2023, followed by Vales Point B in 2029, Eraring in 2031, Bayswater in 2035 and Mount Piper in 2043.

Governments and regulators are now looking at effective, commercially viable and environmentally sensitive ways of replacing the coal generation that will be lost in the coming years. Increasingly, renewable generation such as solar photovoltaics and storage is being proposed and built to fill the gap. With the influx of new generators, significant effort is now being spent ensuring the transition to renewables is smooth and the electricity network is able to accept increased penetrations of variable electricity supply.

Recently, the Australian Energy Market Operator (AEMO) has assessed 34 candidate REZs across the National Energy Market (NEM). The assessment identified which REZs currently offer the most opportunities based on a range of resource, technical and engineering considerations, in particular, the requirements for least-cost integration of REZs into the existing transmission system.

AEMO has identified the Central West NSW Tablelands as a REZ development area, supported by existing transmission strength and capacity. The area where the Dunedoo solar farm is proposed, is located within this REZ. The Dunedoo solar farm Proposal would generate around 144,540 MWh per year, which represents the power consumption of approximately 24,415 homes.

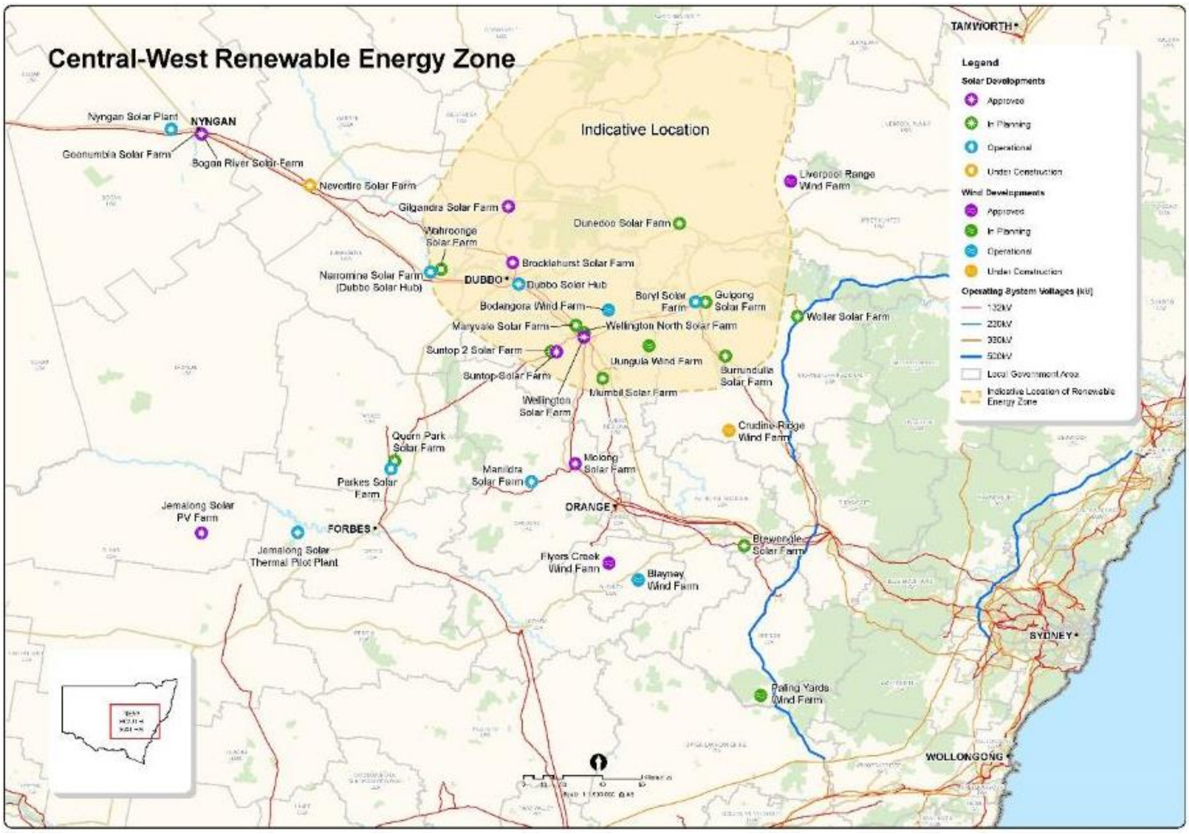

Figure 2-2-1 Dunedoo location and REZ categorization by AEMO.

The transition to renewable energy sources based on variable wind and solar PV generators has implications for reliability and security; these sources lack usable inertia to support power system security (Finkel et al. 2017). The National Energy Market grid is long and linear, with much less network meshing than many international systems. Geographic and technological diversity in the network can improve security and smooth out the impacts of variability (Finkel et al. 2017).

While grid-supplied electricity consumption is expected to remain stable (AEMO 2016), the Proposal would benefit network reliability and security by providing embedded electricity generation closer to local consumption centres, contributing to a more diverse mix of energy sources and potentially regulating inputs (including improving the security of supply) to the grid using a BS.

Energy storage using batteries and power conversion systems are one of the technical solutions for the integration of non-synchronous, variable renewable energy sources into the network (Finkel et al. 2017). Energy storage can improve reliability by storing electricity when it is cheap and supply is high, and discharging at times of peak demand, and when supply from variable generators is low. Storage can also support power system security, by providing services such as frequency control (including ‘fast frequency response’) and voltage control (Finkel et al. 2017).

Battery Storage (BS) which may be constructed for the Proposal would be capable of storing energy for release when the use or cost is beneficial. The BS would have an approximately 85.88MWh/60.48MW rated capacity, provided by banks of lithium-ion batteries. The BS, depending on available revenue streams at the time, would provide network services including ‘energy smoothing’ and frequency control integration, improved reliability as well as energy arbitrage. ‘Energy arbitrage’ is the price mechanism allowing energy to be stored during periods of low demand and then discharged during periods of high demand.

Energy smoothing would help to overcome the intermittency limitations of renewable energy sources such as solar and wind. Energy storage systems can also provide ramp control – acting as a buffer while the power output from a large generation source is ramping up or down – and on-demand distributed power generation, contributing to overall generating capacity while adding resiliency to the grid (Tesla 2017).

2.3.2 Socio-economic

Employment

In 2019, more than 10,800 jobs were created by large-scale renewable construction (CEC, 2020). Large scale renewable projects create long term skilled employment opportunities, which are rare in many rural communities. The employment benefits extend through the local supply chains to fuel supply, vehicle servicing, uniform suppliers, hotels/motels, B&B’s, cafés, pubs, catering and cleaning companies, tradespersons, tool and equipment suppliers and many other businesses.

The Proposal would support 100 direct jobs as well as indirect supply chain jobs of over 160 over the construction period. It would employ up to three (3) full time staff during operation and up to nine (9) indirect service contractors. Additionally, previous projects have tended to spend approximately 15% of the capital cost in the local region, expected to be $11.4m based on construction cost of approximately $76m.

The Proposal would deliver solar energy into the national electricity system at Dunedoo to assist in powering and in assisting the resolution of the power supply issue in the Warrumbungle LGA.

Electricity Prices

Household electricity bills increased 61% between 2008-09 and 2012-13, due mainly to network expenditure (ABS 2016 in Commonwealth of Australia 2016). Australian households would pay $510 million more for power in 2020 without renewable growth through the RET and up to $1.4 billion more per year beyond 2020 (Roam Consulting 2014). Renewables increase diversity and competition in the wholesale energy market – and as in any market, less competition means higher prices.

Variable renewable energy generation such as PV solar operates with no fuel costs and can, with the right policy framework and technological development to manage variability, be used to reduce overall wholesale prices of electricity (Finkel et al. 2017).

Several studies on the impacts of increased large-scale renewable energy generation under the RET have indicated that this is likely to put downward pressure on electricity prices (Australia Institute 2015). To the extent that competition amongst retailers is limited, and to the extent that the RET creates greater contestability through the creation of economically sustainable new entrant retailers, there would be further downward pressure on the retail margins (Sinclair Knight Merz 2013).

New solar energy generation is at least as cheap as coal in Australia, and the levelised cost of electricity from solar is set to drop another 66% by 2040. Solar would beat the cost of existing, fully depreciated and unrefurbished coal plants by 2032 (BNEF 2017). Solar is also cheaper than ‘clean coal’; the cost per MWh of new solar is \$78-\$140, whereas new ‘ultra-supercritical’ coal is \$134-\$203 and coal with carbon capture and storage is \$352 (Climate Council 2017).

3 SITE DESCRIPTION

3.1 THE DEVELOPMENT SITE

The Proposal is located approximately 2 km north of the township of Dunedoo and approximately90 km northeast of the city of Dubbo, within the Warrumbungle Shire LGA. All Weather Road runs east-west along the southern boundary of the Development Site, therefore providing direct access. All Weather Road connects to Digilah Road to the east and the Castlereagh Highway to the west (refer Figure 3-1).

The Proposal's Development Site is the land that would be used for the construction and operation of the solar farm and has a total approximate area of 112 ha. This comprises the land required to construct the facility connection substation, the solar array, proposed internal access tracks and other onsite ancillary infrastructure. The intersection of Castlereagh Highway and All Weather Road is proposed to be upgraded to facilitate construction vehicle movements.

Upon operation, the Proposal's Development Footprint would be approximately 79 ha. There are currently two (2) options for a 66 kV TL corridor both proposed with an approximately 40-metre clearing easement. Options for the proposed TLs would traverse several lots that include private and Crown land, and land owned by Essential Energy to facilitate expansion of the Dunedoo Substation. Refer to Table 3-1 for a summary of the Proposal's associated lots and Figure 3-1 for the identification of the Subject Land comprising the involved lots.

Table 3-1 Lots associated with the Proposal

Proposal	Owner 1	Owner 2	Owner 3	Owner 4	Crown
Development Footprint	Lot 137 DP754309 Lot 140 DP754309 Lot 1 DP 854326 Lot 1 DP 1260716	Lot 80 DP754309			
Transmission Line (*) (Option 1 and 2)	-	Lot 80 DP 754309	Lot 37 DP 754309	Lots 181-186 DP 754291 Lots 196-201 DP 754291	Lot 7012 DP 93290 Talbragar River All Weather Rd Reserve
Castlereagh Highway / All Weather Road intersection upgrade and passing bays along All Weather Rd					Lot 1 DP 535659 All Weather Road Rd Reserve

(*) including Essential Energy Dunedoo substation augmentation and extension

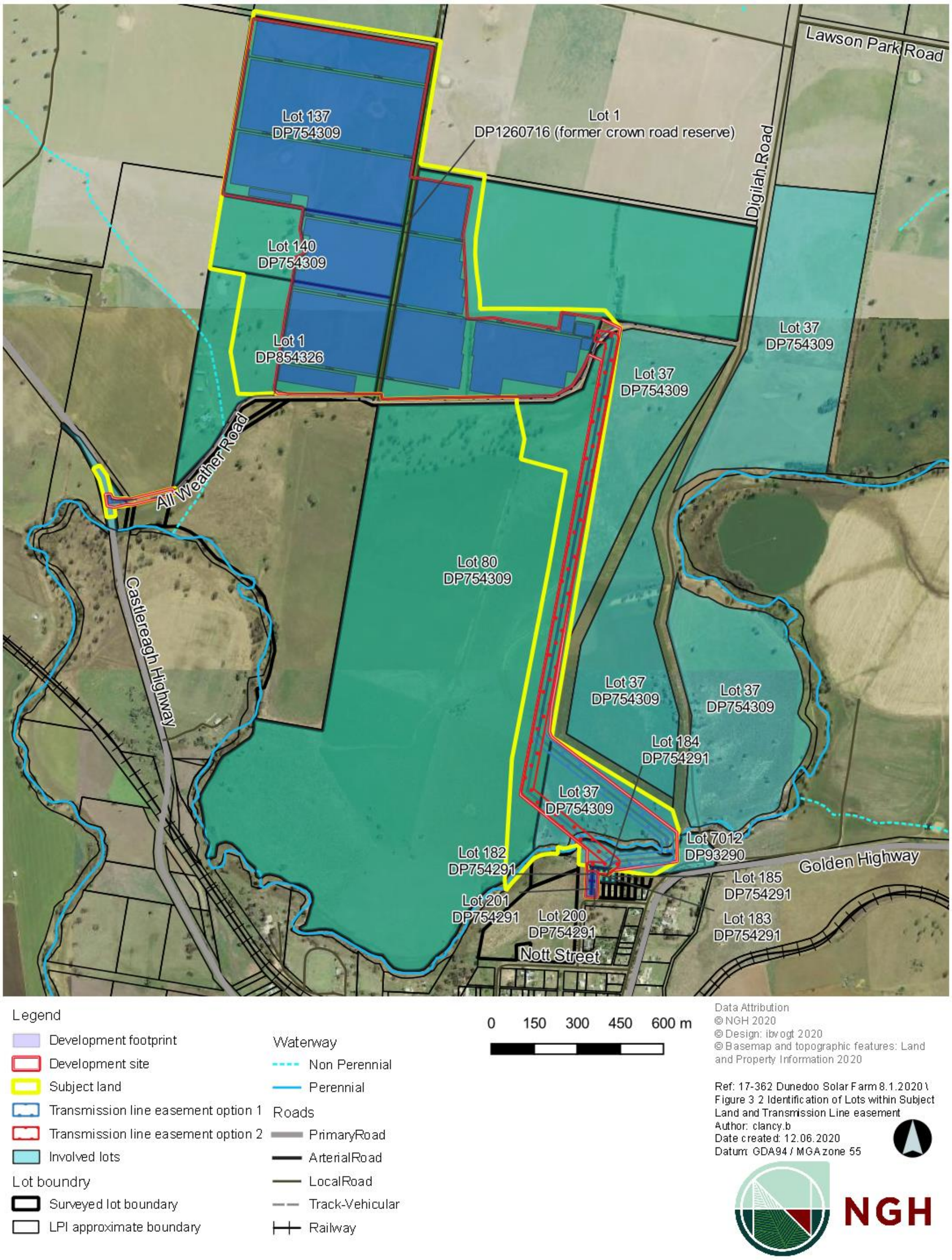

Figure 3-1 Identification of lots associated with the Proposal

The Proposal has been designed to comply with setback and other requirements in the Macquarie Bogan Unregulated and Alluvial Water sources Water Sharing Plan (DPI, 2012) and TransGrid and

Essential Energy guidelines (TransGrid and, Essential Energy 2013) as well as setback and access requirements obtained from the Rural Fire Service (RFS) (refer to Sections 9.3, 4.3 and 9.8).

The majority of the land within the Development Site is cleared of trees, with two (2) planted rows of trees along fence lines and scattered paddock trees.

The Development Site is farmland with a long history of grazing and limited cropping, with small remnants of scattered Fuzzy box (*Eucalyptus conica*). This woodland community is considered to form part of the Box Gum Woodland Endangered Ecological Community (EEC), and specifically the *Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions*. Although the woodland identified on site is in a degraded condition, it is still regarded as a high constraint.

The Development Site is generally flat, with a slight increase in elevation toward its northern end. Four (4) small stock dams are located within the involved lots, from which two (2) are located outside the Development Site and are used by grazing cattle and sheep; and the other two (2) dams are within the Development Site, specifically where the solar panels will be located and proposed to be filled to allow construction. An unnamed drainage line is also within the western periphery of the Development Site.

The Talbragar River runs along the southern and western boundary of the Development Site (Figure 3-2). This river is part of the Macquarie Catchment within the Murray-Darling basin. The area of land south of All Weather Road for Lot 80 DP 754309 (over which the TL is proposed to run) is located within the floodplain of the Talbragar River. No irrigation channels run through the Development Site; however, surface hydrology, landform and soils have been heavily modified by paddock development.

The applicable water sharing plan for Dunedoo is the Macquarie Bogan Unregulated and Alluvial Water Sources, and the water licenses for the Development Site rely on the Talbragar Alluvial Groundwater source (NSW Water).

The location of the Proposal's infrastructure elements has taken into consideration the risk of flooding at the Development Site. As such, a flood impact study was carried out which identified the potential areas which may be susceptible to flooding events ranging from 1-in-5 years to 1-in-500 years. Consequently, the land located north of All Weather Road was identified as most suitable to contain the solar array and associated infrastructure.

The Proposal design has also incorporated recommendations from the Visual Impact Assessment (VIA) regarding setbacks between the proposed infrastructure and sensitive receivers Figure 3-2 illustrates the nearest sensitive receivers (uninvolved with the project) to the Proposal, which are located approximately:

Receiver R1	Lot 157, DP754291, Dunedoo – Polocrosse Club Commercial property located 1,150 metres south
Receiver R2	202 All Weather Road, Dunedoo (Involved receiver) Residential property located approximately 220 metres west
Receiver R3	485 Castlereagh Highway, Dunedoo – Stud Manager's residence Residential property located approximately 620 metres west
Receiver R4	485 Castlereagh Highway, Dunedoo – Farm Manger's residence Residential property located approximately 310 metres northeast
Receiver R5	332 Digilah Road, Dunedoo Residential property located approximately 1,570 metres northeast
Receiver R6	126 Lawson Park Road, Dunedoo Residential property located approximately 1,730 metres east

Receiver R7	1 Evans Street, Dunedoo Residential property located approximately 1,730 metres south of the PV footprint, 120 metres south of Option 1 easement
Receiver R8	Lot 2, DP749515, Dunedoo Residential property located approximately 1,780 metres south of the PV footprint, 150 metres south of Option 2 easement
Receiver R9	27 Nott Street, Dunedoo Residential property located approximately 1,900 metres south of the PV footprint, 280 metres south of the Option 2 easement

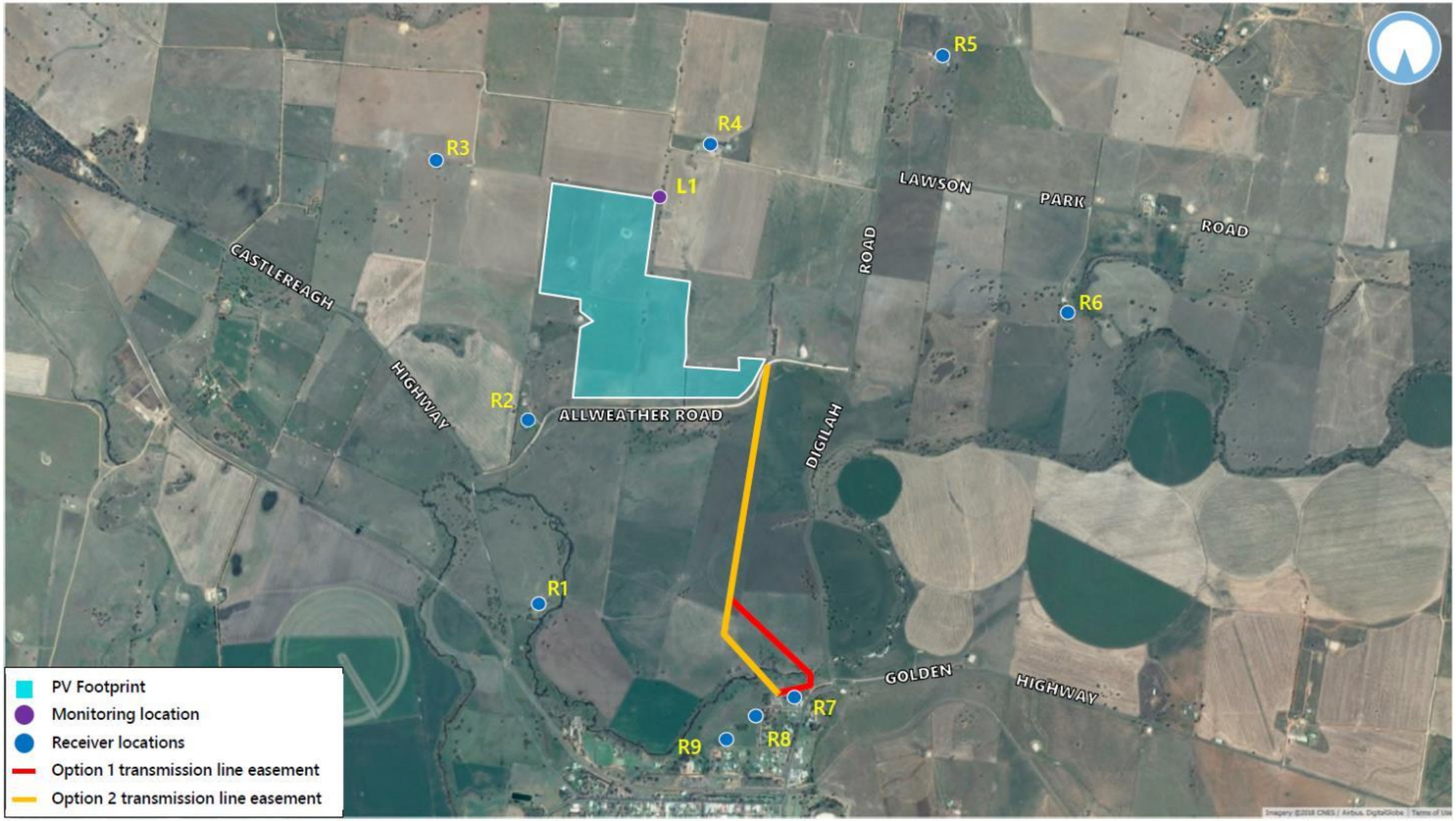

Figure 3-2 Location of nearest sensitive receivers (Renzo Tonin, 2020)

Within the Development Site, an involved dwelling (R2), accessible from Castlereagh Highway and All Weather Road, is present near the west entrance of the solar farm. A second involved derelict building is located near the eastern boundary of the solar farm, accessed from Digilah Road and All Weather Road.

All Weather Road and Digilah Road are Category 1 roads, managed by Warrumbungle Shire Council. Category 1 roads have a higher priority for scheduled road maintenance activities, generally around every 15 months. The road surface is compacted dirt and the road widths are less than 6 metres. Therefore, the proposal incorporates a passing bay between Access Point 1 and the Castlereagh Highway and a widening of the Castlereagh Highway and All Weather Road junction to allow two (2) large trucks to pass safely.

An Essential Energy low voltage distribution line runs through the Development Site. Works required for this line, due to the development of Dunedoo Solar Farm, is subject to detailed design before and during construction.

An Essential Energy TL (85A feeder) runs diagonally across Lot 80 DP754309 within the Development Site, south of All Weather Road. The feeder travels from the north west, crosses over the Talbragar River and associated crown land and connects to the Essential Energy Dunedoo Substation. The easement for this feeder is being considered for the Proposal's intended connection (Option 2) to the existing Essential Energy network.

3.2 THE LOCALITY

The Warrumbungle Shire LGA is located in the Far West and Orana region of Central Western Region of NSW, approximately 340 km northwest of Sydney. It encompasses the townships of Baradine, Binnaway, Coolah, Coonabarabran, Dunedoo, and Mendooran (Warrumbungle Shire Council 2016). The Warrumbungle LGA has a population of 9,541 people covering an area of 12,380 km^2 (ABS and Warrumbungle Shire Council 2016).

Warrumbungle Shire is a largely rural area, and the primary land use is sheep and cattle grazing, and crop growing, with some viticulture and horticulture. Tourism is also an important industry.

The Development Footprint is located approximately 2 km north of the northern extent of the town of Dunedoo. Dunedoo is a rural community on the Golden Highway, 90 km east of Dubbo, and 230 km west of Singleton, and approximately 77 km north west of Mudgee, NSW. The district was home to the Wiradjuri and Kamilaroi nations, who gave it is name, which means "Place of the Black Swan" (Dunedoo.org.au).

The majority of Dunedoo residences are located 2 to 3.5 km south from the Development Footprint. The 2016 population census of Dunedoo was 1,219 and is comprised of approximately 20.1% youth (0-15years) and 29.6% seniors (65+). Dunedoo has an unemployment rate of 6.5% compared to the NSW rate of 4.6% (community profile.com.au/warrumbungle).

The main industries people from Dunedoo work in are 34.4% Agriculture, forestry and fishing, 11.5% Health care and social assistance, 9.3% Education and training, 7.3% Retail trade, 5.5% Accommodation and food services, 5.1% Construction, 3.7% Transport, postal and warehousing, 3.5% Other services, 3.1% Inadequately described/Not stated. (ABS 2016 Dunedoo)

Community facilities and services in the locality include the Coonabarabran District Hospital, Dunedoo Multi-Purpose Service (Hospital), TAFE New England (Coonabarabran Campus), and Rural Fire Service Castlereagh Zone. Major natural features of the Shire include Coolah Tops National Park, Pilliga National Park, Warrumbungle National Park, Binnaway Nature Reserve, Dapper Nature Reserve, Pilliga Nature Reserve, Weetalibah Nature Reserve, Piliga Forest, the Castlereagh River, the Talbragar River, and numerous state forests.

Dunedoo is at the northern edge of the South Western Slopes Bioregion of NSW, which generally experiences sub-humid climate characterised by hot summers and no dry season (OEH 2016). The mean temperature ranges from a maximum of 31.4ºC to a minimum of 2.2ºC at Dunedoo (BOM 2017). The town falls within the Central West Catchment Management Board (CMB). The vegetation communities fall within the Northern Slopes and Plains biodiversity community and is characterised by Red Stringybark (*Eucalyptus macrorhyncha*) on upper slopes with Black Cypress Pine (*Callitris endlicheri*), Kurrajong (*Brachychiton populneus*), Red Ironbark (*E. sideroxylon*), White Gum (various *Eucalyptus spp.*), White Box (*E. albens*), Yellow Box (*E. melliodora*) and Blakely's Red Gum (*E. blakelyi*) on lower slopes. Merging west to Yellow Box (*E. melliodora*), Grey Box (*E. microcarpa*) and White Cypress Pine (*C. columellaris*). Rough-barked Apple (*Angophora floribunda*) on flats with River Oak (*Casuarina cunninghamiana*) on upper tributaries and River Red Gum (*E. camaldulensis*) on lower and larger streams.

4 THE PROPOSAL

4.1 SUMMARY TABLE

The key features of the Proposal are summarised in Table 4-1. Note that component specifications are subject to detailed design and product selection.

Table 4-1 Summary of the key features of the Proposal

Proposal element	Description
Proposal	Dunedoo solar farm
Proponent	ib vogt GmbH on behalf of Sun Spot 4 Pty Limited
Capacity	Solar panel generation of up to 55 MW of Alternating Current (AC). Note: the approximate capacity is based on the proposed technology available at the time of the EIS but may change through the life of the solar farm as advances in technology occur.
Local government	Warrumbungle Shire Council
Subdivision	The Proposal would require three (3) lots to be subdivided with some later consolidated that would result in an overall increase in the average lot size. Please refer to Section 4.2 for detail.
Development Footprint	Surface area of land that would be impacted by the operations of the Proposal upon subdivision of lots. The Development Footprint encompasses approximately 79 ha. Comprising after completion of the solar array, onsite substation, site compound, internal road, and transformer, and the easement for the Transmission Line (TL) track and towers, fence, and Essential Energy substation expansion.
Development Site	The Development Site is a buffer of the development footprint, and areas of land that are subject to direct activities from the Proposal. The Development Site encompasses approximately 112 ha.
Battery storage	The Proposal would include approximately 85.88 MWh / 60.48 MW rated capacity units. The Proposal would comprise lithium-ion (Li-ion) batteries housed across the site in up to 18 customised containers.
Inverters/transformers	The Proposal would include up to 18 containerised or skit-mounted inverter/transformer stations across the site.
Facility connection substation	An on-site facility connection substation occupying around 0.24 hectares with gravelled hardstand, security fencing, control and switch room and associated high voltage, communication equipment and communication tower.
Transmission Line	The powerline built between the Proposal and the Dunedoo substation to facilitate connection to the electricity network. Two (2) connection options are proposed. Further details on these options are provided in Section 4.3.7. The Dunedoo substation comprises solar farm assets as well as potential parts to be transferred to Essential Energy after completion.

Proposal element	Description
Dunedoo Substation expansion and augmentation	Expansion of the existing Dunedoo Substation (and potential augmentation of the existing substation) owned by Essential Energy is also proposed to allow the Proposal to connect to the electricity network.
Intersection upgrade	The proposed widening of the Castlereagh and All Weather Road to allow for simultaneous in and out flow of delivery trucks. Further detail is shown in Section 9.6.
Internal access tracks	Internal access tracks constructed of engineered fill topped with crushed stone pavement would connect the solar farm infrastructure for construction and maintenance. Internal access roads to material storage compounds and the substation would be approximately 4–6 metres wide (including shoulders and any required drainage), whilst general internal roads would be approximately 3.5–5 metres wide.
Operations and maintenance buildings	Buildings would be constructed to provide control, switch room and storage facilities for the solar farm as well as facilities such as toilets etc for solar farm workers
Security fencing, lighting and CCTV	Movement sensor or infrared based security lighting and CCTV cameras would be installed on posts up to 3.5 metres high adjacent to the perimeter security fencing and around the operation and maintenance buildings. Security fencing installed around the site.
Construction hours	Standard daytime construction hours would be 7.00am to 6.00pm Monday to Friday and 7.00am to 1.00pm on Saturdays. In general, no construction activities would occur on Sundays or public holidays; however, in cases of emergency, major asset inspection or maintenance programs may be undertaken outside standard construction hours. Warrumbungle Shire Council and surrounding landholders would be notified of any works expected to be performed outside standard daytime construction hours that may be expected to cause noise exceedance to neighbouring dwellings.
Construction timing	10-12 months indicatively commencing late 2021.
Workforce	Construction: Peak of approximately 100 - 125 workers Operation: up to 3 full time equivalent staff and up to 9 indirect service contractors
Operation lifespan	Up to 30 years from completion of construction
Operational hours	Once constructed and operative, standard work hours would be undertaken as shown below: • Monday – Friday 7am to 6pm • Saturday 8am to 1pm. in cases of emergency or for works that are not expected to provide a noise exceedance to neighbouring dwellings may proceed outside operational hours.
Decommissioning	The site would be returned to its pre-construction land use. All below ground infrastructure would be removed to a depth of 500 mm. Above ground infrastructure will also be removed. The site would be rehabilitated in consultation with the landowner consistent with land use requirements.
Capital investment	Estimated $76 million.

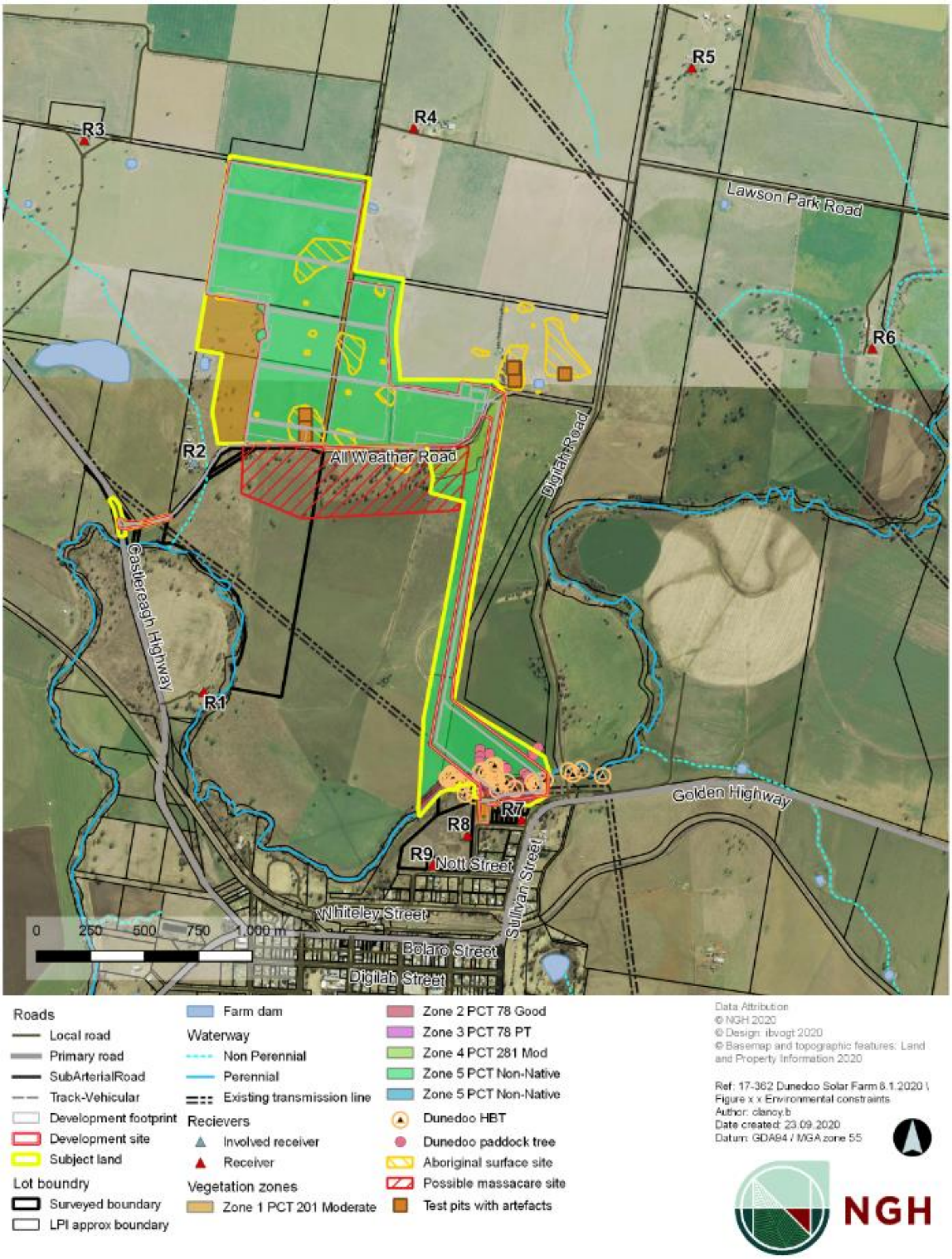

Figure 4-1 Environmental Contraints Map

4.2 SUBDIVISION

The Proposal would require subdivision and/or consolidation of a number of lots as shown in Figure 4-2.

The Warrumbungle LEP 2013 allows for lands under Zone RU1 Primary Production to be subdivided to create a lot of a size that is less than the minimum size of 600 ha, as long as no dwelling is present nor erected on such lot. Notwithstanding and should the agricultural activity be viable or substantially maintained on the allotment, the flexibility component of the LEP generally allows for subdivision into smaller lots for agricultural purposes and for these to be absorbed into adjoining properties. The proposed subdivision and consolidation is consistent with WSC strategic planning objectives including promoting economic development. the following summarises the proposed subdivision and consolidation also captured in Figure 4-1.

Landowner West

Subdivision of Lot 140 DP754309 and Lot 1 DP854326 is proposed. Land retained by the landowner of Lot 140 DP754309 and Lot 1 DP854326 (western portions) would be consolidated into one (1) larger ‘Lot A’ of 23.5 ha. Consolidation of Lot A will result in an existing dwelling being situated on this land.

The balance of the subdivided land from Lot 140 DP754309 and Lot 1 DP854326 (eastern portions) and Lot 137 DP754309, Lot 1 DP1260716 would be consolidated into one (1) larger ‘Lot B’ of approximately 65 ha within which would be the Development Site. No dwelling is currently located nor proposed on this land.

Landowner East

Lot 80 DP754309 would be subdivided to provide ‘Lot C’; a 0.6-ha parcel of land for the facility connection substation if it is to be owned by Essential Energy. The residual land of 42.6 ha north of All Weather Road, ‘Lot D’, would also be subdivided to allow for the Development Site.

The remaining portion of Lot 80 DP754309 south of All Weather Road is 164.7 ha and will hold the TL easement to connect the Proposal to the Dunedoo substation. This portion of Lot 80 DP754309 would not be subdivided. No dwelling is currently located on nor proposed on Lot 80 DP754309.

Justification

Lot A would allow continuation of existing practices as it remains owned by the existing landowner. Lot B also retains agricultural capability with the potential for grazing sheep between the rows of the panels. Therefore, it is considered that the subdivision allows a maintenance of agricultural practices. Any reduction in agricultural output would be expected to be negligible in the overall capability of the region.

It is also considered that the inherent capability of the land in the region would not be affected as the Proposal would not significantly impact the agricultural operations of neighbouring landholders given the relatively low impacts associated with the Proposal (refer to Section 7).

Consolidation as described above would result in larger average size lots that the current lot configuration. Specifically, existing is four (4) lots of approximate areas 40, 29, 16 and 2.4 ha and the proposed subdivision/consolidation would result in two (2) lots with approximate areas of 64.4 and 23 ha. Furthermore, the consolidation reduces potential fragmentation and alienation of land, allowing continued agricultural practices by the landowner during and after the operation of the Proposal. The proposed subdivision would not have a negative impact on surrounding land uses, would not be incompatible with a preferred land use, and would facilitate the management of an approved land use on the Development Site. The proposed subdivision and consolidation plan is also consistent with WSC strategic objective such as economic development.

The subdivision envisaged to form Lot C would be undertaken if required by Essential Energy for the facility connection substation. Lot D, would, however, may be subdivided as required under section 7A of the *Conveyancing Act 1919* since the lease required for the Proposal of Lot 80 DP754389 is longer than 5 years.

The Proponent has signed a lease or purchase Option Deed with the owners for the lots proposed to be subdivided and consolidated for the Proposal. A copy of the written consent for the Proposal from the landowners has been provided to DPIE (refer to Appendix C).

In accordance with section 89E(3) of the EP&A Act, development consent may be granted to the subdivision as part of this SSD application despite the proposed lot size being prohibited under the Warrumbungle LEP. This is addressed in further detail in Section 5.2.1 of this EIS.

Figure 4-2 Proposed lot consolidation plan

4.2.1 Council Consent

Support has been sought from Warrumbungle Shire Council who have stated they would be supportive of the solar farm development, although the Council have not supported the proposed subdivision.

A letter outlining the proposed subdivision was sent to Warrumbungle Shire Council on 6 April 2020. A response was received from Council on 14 May 2020 stating that it was not able to support the subdivision of the lots (refer to Appendix C). Warrumbungle Shire Council has indicated that it did not support the subdivision because the Proposal is contrary to the objectives of the 'minimum subdivision lot size' requirements with regard to rural land fragmentation and likely rural land use conflicts. Council also indicated that the subdivision proposal fails to meet the Rural Subdivision Principles with regard to the minimisation of rural land fragmentation and likely rural land use conflicts; and is contrary to rural land subdivision, in that all lots are proposed to be less than the minimum size permitted for the land, upon which an existing dwelling would also be situated on one of these lots. Council also stated that the proposed consolidation is likely to have a detrimental impact on the existing and future amenity of the locality, given the size of proposed lot with an existing dwelling, being utilised as rural/ residential.

Continued consultation with Council is being undertaken in order to obtain their support in the proposed subdivision and consolidation of lots. Further discussion regarding the permissibility of subdivision in accordance with section 89E(3) of the EP&A Act is addressed in further detail in Section 5.2.1 of this EIS.

4.3 PROPOSED INFRASTRUCTURE

The Proposal’s infrastructure includes:

- Approximately 173,000 PV solar panels, mounted on single axis tracking systems, powered by approximately 2,850 tracker motors.
- Electrical cables and conduits.
- Inverter/transformer stations, containerised or skid mounted, distributed across the site.
- Battery storage units, containerised, distributed across the site.
- On site facility connection substation containing transformer, synchronous condenser, associated HV switchgear, switch room, control room and lightning protection masts.
- Communications tower (up to 25 metres high), within the facility connection substation fenced area.
- Site office, compounds, storage shed, parking, access tracks and perimeter fencing.
- Two (2) access points via All Weather Road.
- Internal access tracks.
- Lighting, CCTV system, security fencing.
- Vegetative screening.
- A new hybrid Transmission Line (TL) to connect the solar farm into the Essential Energy transmission network, which will be handed to Essential Energy upon completion. Two (2) TL options are being considered.
- Construction of a passing bay along All Weather Road and upgrade to the Castlereagh Highway and All Weather Road junction.
- Subdivision and consolidation of lots.
- A new bay in the Dunedoo Substation and any required augmentation within the existing Dunedoo Substation. A new communications tower up to 15m tall.

The layout of the infrastructure components is shown in Figure 4-3 and the components are described below. Indicative plans and drawings of infrastructure components are provided in Appendix B. The plans and specifications of the components are subject to detailed design and product selection.

In total, the construction phase of the Proposal is expected to take approximately 10-12 months. The Proposal is expected to have approximately a 30-year operating life, at which point the solar farm would either:

- Be decommissioned, removing all above ground infrastructure and returning the site to its existing land capability; or
- Continue operation (which could involve reconditioning), subject to the lease agreement being renewed and any new approvals/consents that may be required. Reconditioning would involve replacing components that were originally installed with new components that reflect technology that is available at that time. Should the solar farm's life be extended, then a development application would be lodged.

Figure 4-3 Proposed Development Footprint

4.3.1 Solar Panels

The solar array would comprise approximately 173,000 PV panels mounted in rows on a single axis tracking system. The solar panels would be arranged in rows mounted on metal or similar frames with a maximum height of approximately 3 metres above the natural ground level (Figure 4-4). The PV mounting structure would comprise piles driven approximately 2.5 metres into the ground.

A single axis system, illustrated in Figure 4-5 and Figure 4-6 would be powered by approximately 2,850 tracker motors. A single axis tracker would have a typical maximum height of 3 metres, based on a 2-metre vertical height panel and 2-metre-high support posts. Row lengths would depend on the detailed design but could be up to 100 metres. Spaces between rows (edges of panel) may vary between approximately 3 metres and 9 metres. The indicative size of each PV panel is approximately 2x1 metres.

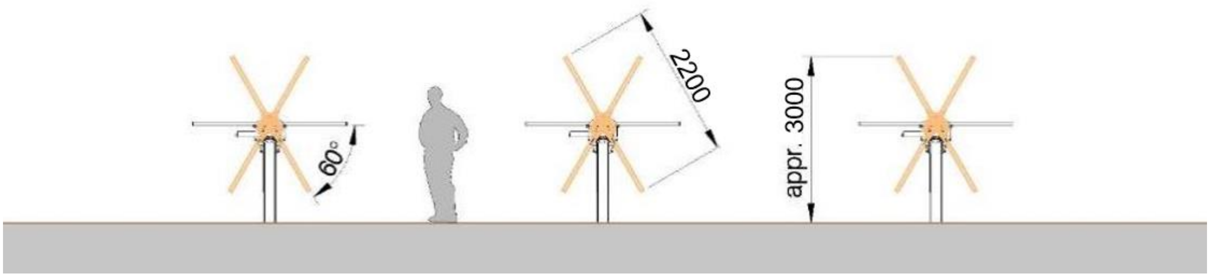

Figure 4-4 Schematic of a mounted PV panel

Figure 4-5 Example single axis tracking system (NexTracker)

Figure 4-6 Example single axis mounting system from Mount Majura solar farm, ACT

Approximately 30,000 piles would be driven or screwed into the ground to support the solar array's single axis tracker mounting system and solar panels. The pile depth would be determined following detailed geotechnical site investigation; depths are typically up to approximately 2.5 metres (depending on geotechnical requirements). Pile heights would vary according to topography and expected flood level.

As solar panel technology evolves rapidly, specification of the exact make of the solar panels will be defined during detailed design. Notwithstanding, solar panels being considered for the Proposal would absorb 82% to 93% of the sun's light and not involve any reflective surfaces material that would cause glint and glare or loss of the resource.

4.3.2 Inverter/Transformers

The Proposal includes up to 18 containerised inverter/transformer stations across the solar array site (locations illustrated in Figure 4-3). Appendix B provides diagrams of the proposed inverter/transformer units and Figure 4-7 illustrates an example of the internal elements of the equipment. The majority of the inverter/transformer stations would be constructed on concrete footings approximately 300 mm above ground surface level or as required to provide suitable flood immunity. A 600 mm clearance is proposed at four (4) unit locations only for a comparable level of flood immunity. Refer to Section 8.4 for details.

Power from the solar panels would generate direct current (DC) electricity that would be inverted to alternating current (AC) via the inverters, with the voltages stepped up to 33 kV by the transformers.

There would be one (1) large high voltage transformer located within the facility connection substation which would step-up voltage to 66 kV (Appendix B).

Subject to detailed design and equipment selection, the containers would be installed across the site, each containing:

- A transformer to step the AC voltage up to high voltage for transmission to the substation
- Inverters
- HV switchgear
- Communications and ancillary equipment.

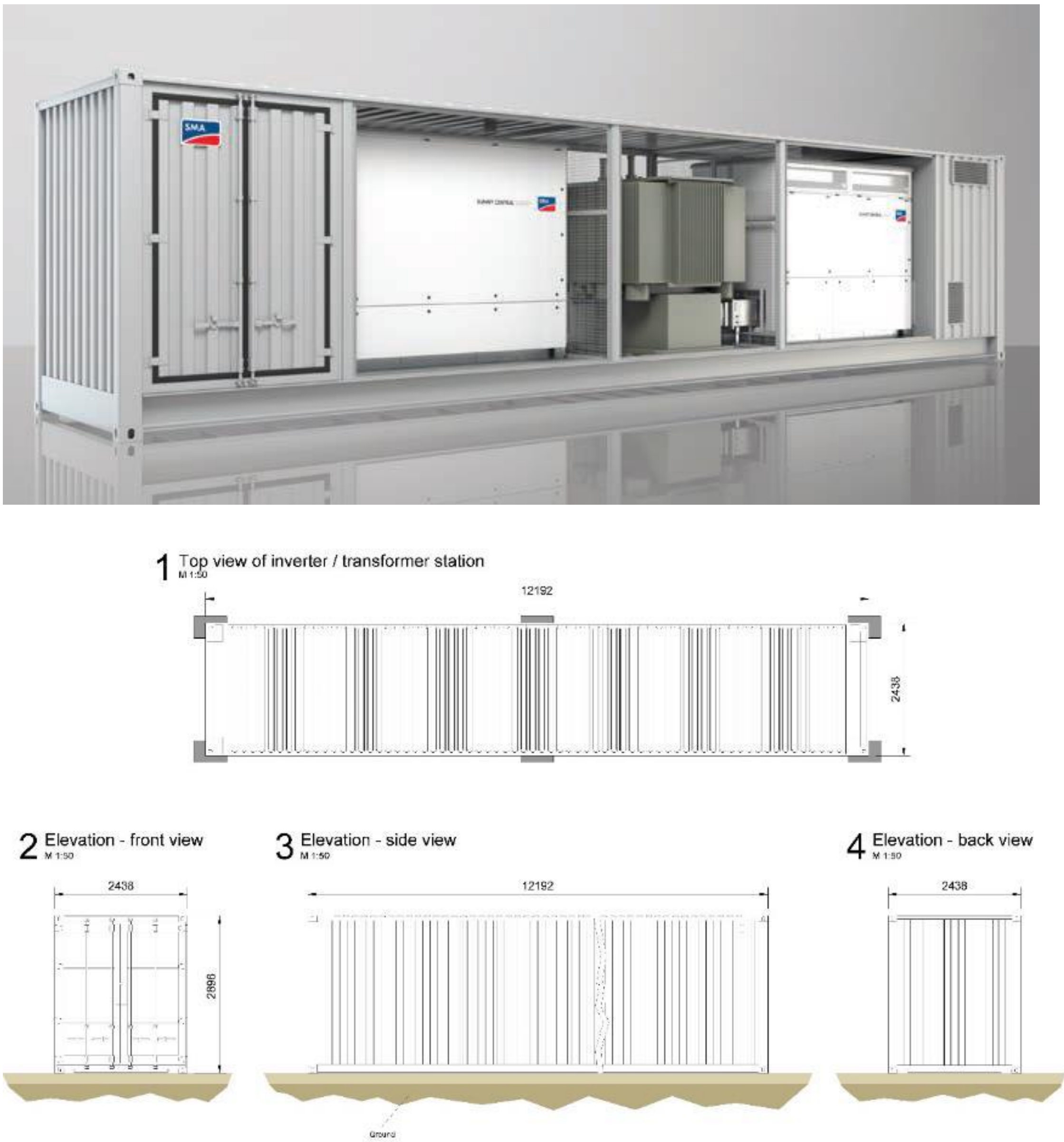

Figure 4-7 Typical container housing transformer, inverters and switchgear (source SMA)

4.3.3 Battery Storage

Unlike markets for storable commodities, the electricity market is reliant upon the real-time balance of supply and demand. Electric energy storage is the capability of storing electricity or energy to produce electricity and releasing it for use during other periods when the use or cost is more beneficial.

Subject to economic and technical considerations, the proposal would include approximately 85.88 MWh / 60.48 MW rated capacity units. The Proposal would comprise Li-ion batteries housed across the site in up to 18 customised containers. The batteries would be actively cooled by air-conditioning units, with spare air-conditioning units in storage on-site for replacement. Each container would be temperature monitored, and the automated control system would stop their operation if the temperature exceeds pre-set levels to prevent overheating (e.g. if all aircon units fail).

The Battery Storage (BS) unit would include an integrated fire suppression system involving the storage and release of an inert gas within each battery container, using either electrical detectors/ionisers, or a mechanical system in which the heat destroys a seal to release the gas.

The BS unit and Inverter/Transformer containers would also be surrounded by an Asset Protection Zone (APZ) including gravel surfacing to minimise the risk of fire escaping from the Proposal and the risk of external fire affecting the Proposal .

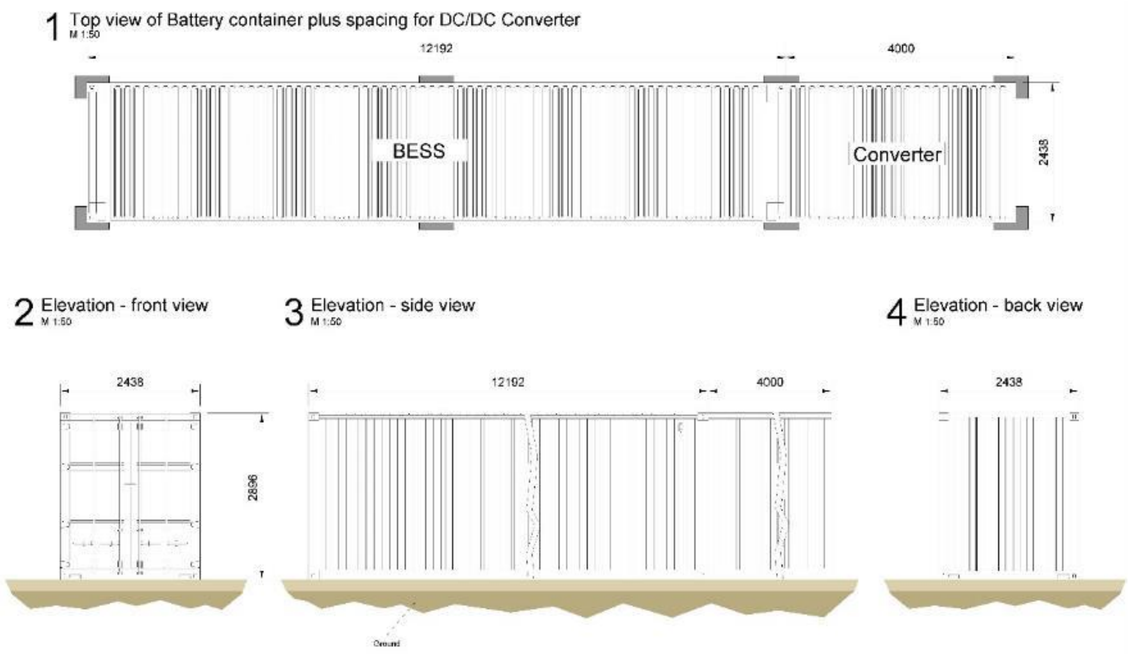

Figure 4-8 Container dimensions of BS unit

4.3.4 Overhead and Underground Cabling

Most cabling at the site would be buried and located along the access tracks. Underground cabling would be installed at a depth of at least 500 mm with the electrical reticulation typically buried to either 600 mm (low voltage) or 800 mm (high voltage) depth, in accordance with the relevant Australian Standard. Underground cables and pipes would be buried to ensure agricultural land capabilities are not reduced if underground infrastructure is left in situ after decommissioning.

Prior to excavating the cable trench, the topsoil would be stripped and stockpiled for use in rehabilitating the trench line. Depending on the quality of the excavated material, sand may be used in the trench to create a cable bed. Once the cables are installed another layer of sand may be placed above the cable prior to covers and markers being installed consistent with Australian Standards before and the trench being backfilled with excavated material. Finally, top soil would be replaced to assist revegetation of the disturbed areas. Cables would be protected in accordance with *Australian Standard (AS) 3000:2007 Electrical Installations*.

4.3.5 Facility Connection Substation

A facility connection substation would be constructed in the Development Footprint (refer to Figure 4-3) to step up the solar farm electrical output to match the transmission grid voltage (66 kV). While the design is yet to be finalised, it is expected that the substation would occupy approximately 60 x 40 metres (approximately 0.24 ha) and contain transformer, a synchronous condenser, associated high voltage switchgear and control and protection equipment as well as a communication tower, and drainage and oil containment system. The substation would be surrounded by a security fence. Gravel hardstand would be placed under and around the substation compound to restrict vegetation growth and provide a safe working environment in accordance with the relevant Australian Standards.

Internal structures include:

- Control building/control room, switch room – height approximately 5 metres.
- 66/33 kV power transformer – approximately 10 x 6 metres, height approximately 6 metres.
- 6 lightning protection masts – 20 metres high.
- Associated high voltage switchgear including busbars, circuit breakers, disconnectors – each with a height of approximately 8 metres.
- Communication tower (up to 25 metres high).

Photographs of example substations are provided below, Figure 4-9 and Figure 4-10.

Figure 4-9 Example internal solar substation

Figure 4-10 Example showing 132/33kV Nyngan solar farm substation

4.3.6 Associated Operations Buildings

Separate buildings would be required to provide control, switch room and storage facilities for the solar farm. Indicative descriptions of these buildings are provided below and the locations of the buildings at the Development Footprint are shown on Figure 4-3. The control room, switch room and storage shed would each contain essential fire safety equipment as required by relevant standards.

Control Room and Site Office

A single storey building up to approximately 30 x 20 metres with appropriately designed foundations, finishings and other features as required by relevant standards. Guttering and a water tank would be installed to collect rainwater. The control room building would contain an office and staff amenities (toilet, kitchen, first aid, potable water supply, etc.) as required for the safe operation of the site.

The control room and site office facility would include water supply as required for the services installed (including a septic system). Fire detection and suppression will be installed as required by relevant standards. Permanent parking facilities would be provided adjacent to the control building to facilitate up to 10 cars and light vehicles on site. The parking ground cover would be formed of crushed rock or similar.

Adequate rubbish waste/facilities would be established, which would be emptied weekly or as required and defined in operational management plans. No permanent or long-term storage of rubbish or waste would be on site.

Switch room

A building footprint of approximately 20 x 5 metres and approximately 5 metres high would be constructed for the HV switch room, with services, protection and control facilities. The building may be installed on stilts and will be designed and constructed to meet relevant standards. A communications tower could be installed adjacent to the building, approximately 25 metres high.

Storage Shed

A storage shed with footprint of approximately 20 x 15 metres and approximately 6 metres high would be constructed at the Development Site. The building will have appropriately designed foundations, finishings and other features as required by relevant standards. Guttering and a water tank would be installed to collect rainwater. Appropriate fire detection and suppression will be installed if required by relevant standards.

Synchronous Condenser

A synchronous condenser and associated auxiliary supply may be required within the switching station (depending on the outcome of the grid connection requirements). This would have a footprint of up to 20 x 30 metres, contained within a generator house of up to approximately 8 metres high.

4.3.7 Transmission Network Connection and Substation Extension

Additional electrical transmission infrastructure would be required to connect the solar panel infrastructure to the existing Essential Energy Dunedoo Zone Substation. The Proponent is currently considering two (2) connection options using either making part of Essential Energy 85A 66-kV Transmission Line (TL) infrastructure that traverses the southeast region of the Development Site double circuit or making use of the existing Essential Energy 852 66-kV TL easement and/or infrastructure (refer to Figure 4-11).

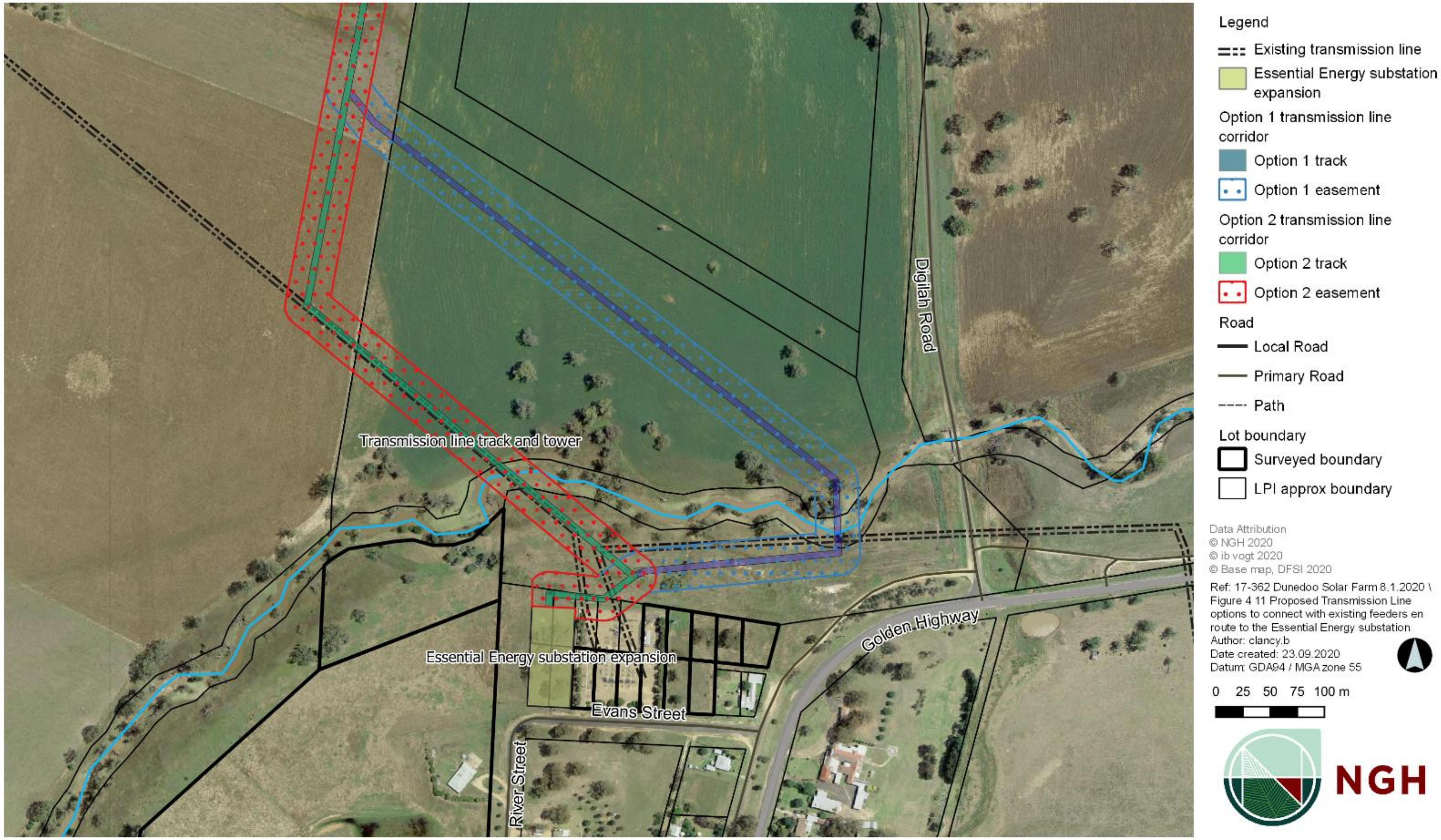

Figure 4-11 Proposed TL options to connect with existing feeders enroute to the Essential Energy substation

Option 1:

- Construction of up to 10 single-pole 66 kV TL poles approximately 24 metres high within a 40-metre easement within Lot 80 DP754309 (including passing over All Weather Road Reserve)
- Construction of an 66kV underground or overhead cable (approximately 500m) and associated underground/overhead (UGOH) pole structure over Lot 37 DP754309 to the junction with the existing Essential Energy 852 TL within Lot 7012 DP93290 (including passing overhead the Talbragar River)
- Replacement of the existing Essential Energy 852 TL poles with approximately 24-metre high poles to facilitate the additional solar farm TL (i.e. two separate circuits on the same pole) over Lot 7012 DP93290
- Construction of a substation extension within Lots 181 -182 and Lots 200-201 DP754291 adjacent to the existing Essential Energy substation including augmentation within the existing Essential Energy substation (Lots 183-186 DP754291 and 196-199 DP754309) to facilitate the TL as required by Essential Energy
- A t-off spur from the replaced Essential Energy 852 poles would connect to the substation extension within Lot 7012 DP93290 and Lots 181-182, 200-201 DP754291 via either underground or overhead subject to detailed design.

Option 2:

- Construction of up to 10 single-pole 66 kV TL poles approximately 24 metres high within a 40-metre easement to junction with the existing Essential Energy 85A TL within Lot 80 DP754309 (including passing over All Weather Road Reserve)
- Replacement of the existing Essential Energy 85A TL poles with approximately 24-metre high poles to facilitate the additional solar farm TL (i.e. two separate circuits on the same pole or two closely located poles) over Lot 80 DP754309, Lot 37 DP130889, Lot 7012 DP93290, and over the Talbragar River.
- Construction of a substation extension within Lots 181-182 and Lots 200-201 DP754291 adjacent to the existing Essential Energy substation including augmentation within the existing Essential Energy substation (Lots 183-186 DP754291 and 196-199 DP754309) to facilitate the TL as required by Essential Energy
- A t-off spur from the replaced Essential Energy 85A poles would connect to the substation extension within Lot 7012 DP93290 and Lots 181-182, 200-201 DP754291 via either underground or overhead subject to detailed design.

For both options, the TL would be similar to the 66 kV TL installed by Essential Energy with poles approximately 24 metres high and spaced approximately 150-200 metres apart subject to detailed design. The TL would be located within an easement approximately 40 metres wide (assuming single pole arrangement), as described in Essential Energy Easement Requirements CEOP8046. The TL routes have been selected to minimise the Proposals impacts.

For the substation extension, construction of a new bay within Lots 181-182 DP754291 and Lots 200-201 DP754291 would consist of a HV switching bay and associated control and protection equipment to connect with the existing Essential Energy substation. A communication tower approximately 15 metres high may be required as well as augmentation within the existing substation Lots 183-186 and 196-199 of DP 754291.

Once constructed, all new TL assets would become network assets to be owned and operated by Essential Energy.

4.3.8 Site Access and Internal Tracks

The site would be accessed from All Weather Road, which runs east to west across the Development Site. All Weather Road meets the Castlereagh Highway to the west of the site, providing access to the region's transport network (refer to Figure 4-12).

The Proponent engaged Stantec Pty to prepare a Traffic Assessment (TA) of the preferred access option to the Development Site. Four (4) options were considered and consulted between the Proponent and Council, which are summarised in Table 4-2. The TA can be found in Appendix K.

Table 4-2 Consideration of access points to the Development Site (Stantec, 2020)

	Options	Concern(s)	Proposed measure
1	Majority of staff to be bused/ride share to the site to minimise vehicle movements. All inbound and outbound movements via Castlereagh Highway.	Potential crash risk given the high-speed limit (100km/h). Relatively high number of construction worker movements will be generated if staff are not bused or do not ride share.	A traffic management(control) plan proposed to facilitate the turning movements of heavy vehicles at the intersection of Castlereagh Highway and All Weather Road. Potential upgrade required at the intersection of Castlereagh Highway / All Weather Road to facilitate heavy vehicle turning movements. It is noted that swept paths undertaken at this intersection shows that the proposed upgrade can accommodate simultaneous inbound and outbound movements.
2	All inbound and outbound movements via Digilah Road.	Relatively narrow, low-level bridge where Digilah Road crosses the Talbragar River; Council has raised concerns for potential bridge flooding.	A traffic management(control) plan proposed to facilitate vehicles movements across the bridge along Digilah Road. Potential bridge upgrade required along Digilah Road. Potential (widening) upgrade required at the Castlereagh Highway / Golden Highway/Digilah Road intersection to facilitate heavy vehicle turning movements.
3	Majority of staff to be bused/ride share to the site to minimise vehicle movements. All construction staff access via Digilah Road and all truck access via Castlereagh Highway.	Potential crash risk given the high-speed limit (100km/h). Relatively high number of construction worker movements will be generated if staff are not bused or do not ride share.	A traffic management(control) plan proposed to facilitate the turning movements of heavy vehicles at the intersection of Castlereagh Highway and All Weather Road. Potential upgrade required at the intersection of Castlereagh Highway / All Weather Road to facilitate heavy vehicle turning movements. (See Appendix A) It is noted that swept paths undertaken at this intersection shows that the proposed upgrade can accommodate simultaneous inbound and outbound movements.

	Options	Concern(s)	Proposed measure
4	All inbound movements towards the site using Digilah Road and all outbound movements to Castlereagh Highway.	Relatively narrow, low-level bridge where Digilah Road crosses the Talbragar River; Council has raised concerns for potential bridge flooding.	A traffic management(control) plan proposed to facilitate vehicles movements across the bridge along Digilah Road. Potential bridge upgrade required along Digilah Road. Potential (widening) upgrade required at: Intersection of Castlereagh Highway / Allweather road to facilitate heavy vehicle turning movements. Intersection of Castlereagh Highway / Golden Highway/ Digilah Road

Option 3 was chosen in discussion with Warrumbungle Shire Council, which includes two (2) construction and operation access points on All Weather Road (refer to Figure 4-3):

- Access Point 1 would be located approximately 750 metres northeast of the intersection with Castlereagh Highway.
- Access Point 2 would be located approximately 480 metres west of the intersection with Digilah Road.

The final design for the two (2) intersections with All Weather Road have not yet been completed and would developed to provide adequate sightlines for vehicles entering and exiting the site, in accordance with Austroads (Rural Basic BAR and BAL turn treatment, *Guide to Road Design, Austroad 2010*) and TfNSW guidelines. The final intersection designs would be completed in consultation Warrumbungle Shire Council following approval of the Proposal.

The Proposal also includes an upgrade the Castlereagh Highway / All Weather Road intersection to facilitate simultaneous inbound and outbound movements (refer to Section 4.4.5) of up to 30 m long A-Double vehicles

The road width of All Weather Road from its intersection with Castlereagh Highway to the proposed Access Point 1 is considered to be of insufficient width to allow for simultaneous two-way heavy vehicle movements. A passing bay is therefore proposed to be provided along this section of All Weather Road to accommodate two (2) heavy vehicles passing each other, as shown in Figure 4-13. Further discussion of the turning lanes and road condition is discussed in Section 9.6.

The internal access roads would involve a network of tracks accessing the solar farm infrastructure for installation and maintenance. Approximately 4.1 km of new access track would be constructed at the site. The internal tracks would be constructed of engineered fill topped with crushed stone pavement. Internal access roads to material storage compounds and the substation would be approximately 4–6 metres wide (including shoulders and any required drainage), whilst general internal roads would be approximately 3.5–5 metres wide. The locations of proposed internal tracks are shown in Figure 4-3.

Access tracks would be clearly marked on the site environmental management plan and passing lanes and turning circles would be provided to internal tracks in line with the bushfire management plan.

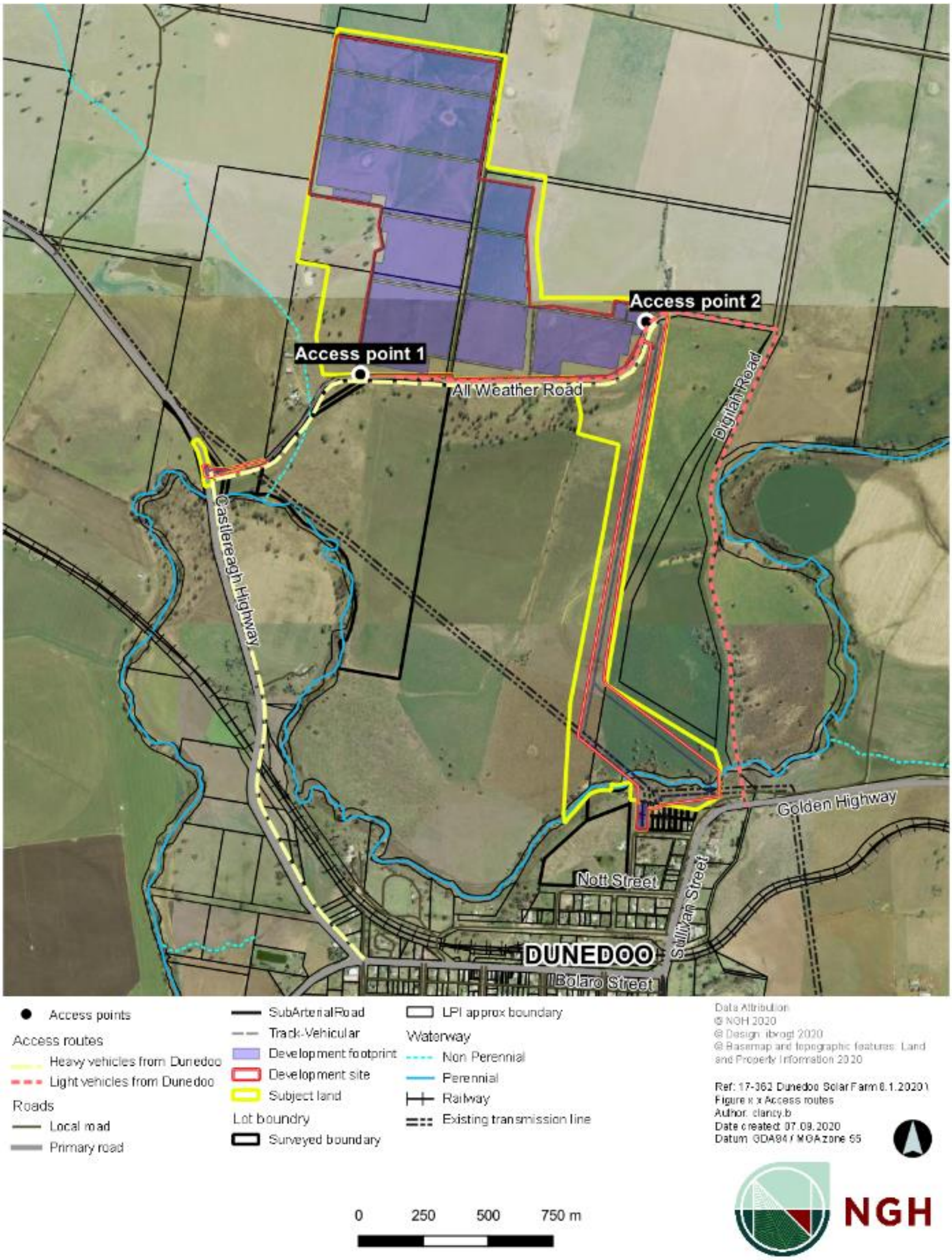

Figure 4-12 Proposal's transport routes

Figure 4-13 Proposed passing bay on All Weather Road, between Castlereagh / All Weather Road intersection and Access Point 1

4.3.9 Security CCTV, Lighting and Fencing

Continuously operating CCTV cameras (possibly with a pan function) would be installed with night time movement sensor or infrared security lighting (infra-red) on posts up to 3.5m high adjacent to the perimeter security fencing and around the operation and maintenance buildings. The number of cameras would be sufficient to cover the perimeter of the site and building areas.

4.3.10 Landscaping and Revegetation

Landscaping and screen planting would be undertaken in some sections of the perimeter of the Development Site to minimise visual impacts. This would entail two rows in moderate impact and three rows is high impact areas of native species planted to break up views of the infrastructure from specific receivers. Native tree and shrub species suited to site conditions would be used, placed and selected to avoid shading impacts on the array and to achieve effective screening of the solar farm infrastructure. Potential screening opportunities are discussed in Section 8.3 as recommended by the VIA.

The solar array would be mounted above the ground and suitable perennial ground cover would be established and maintained beneath the panels. Groundcover vegetation over approximately 33% of the total site area would be affected by shading, varying according to time of day and time of year. Groundcover grass species would be selected which are tolerant of these shading conditions and suitable for the soil type and climate at the Development Site.

The ten-metre minimum bushfire protection setback from solar farm infrastructure would be applied to around the perimeter of the solar farm, in accordance with *Planning for Bush Fire Protection* guidelines (RFS 2019). The setback area would include a four-metre-wide (plus shoulders and required drainage) perimeter access track (refer to Section 9.8 for details).

Areas disturbed during the construction phase would be stabilised and revegetated with suitable perennial grass species immediately after construction. Groundcover species would be selected to facilitate sheep grazing at the site to control grass height and bushfire hazard.

4.4 CONSTRUCTION

4.4.1 Construction Activities

The construction phase of the proposal is expected to last approximately 10-12 months with a peak construction period of 3 months. The main construction activities would include:

- Site establishment and preparation for construction - fencing, ground preparation, construction of the internal track system, upgrade of existing access points/intersections, carpark, preliminary civil works and drainage.
- Installation of pile and framing system for the solar panels.
- Installation of underground cabling (trenching) and installation of inverter stations.
- Installation of PV panels.
- Construction of associated operations buildings including the site office, control and switch rooms, communications tower and lightning protection masts.
- Construction of the facility connection substation.
- Construction of the Dunedoo Substation expansion including a new bay, communications tower and associated augmentation.
- Construction of the 66-kV TL and associated easement.
- Construction of inverter/transformers and BS units.

- Commissioning and testing.
- Removal of temporary construction facilities and rehabilitation of disturbed areas.

Pending the finalisation of the construction schedule, it is expected some stages of construction would occur concurrently. Temporary construction facilities would be housed in two (2) compounds (Figure 4-3). Refer to Figure 4-14 for the proposed Development Footprint within the Development Site.

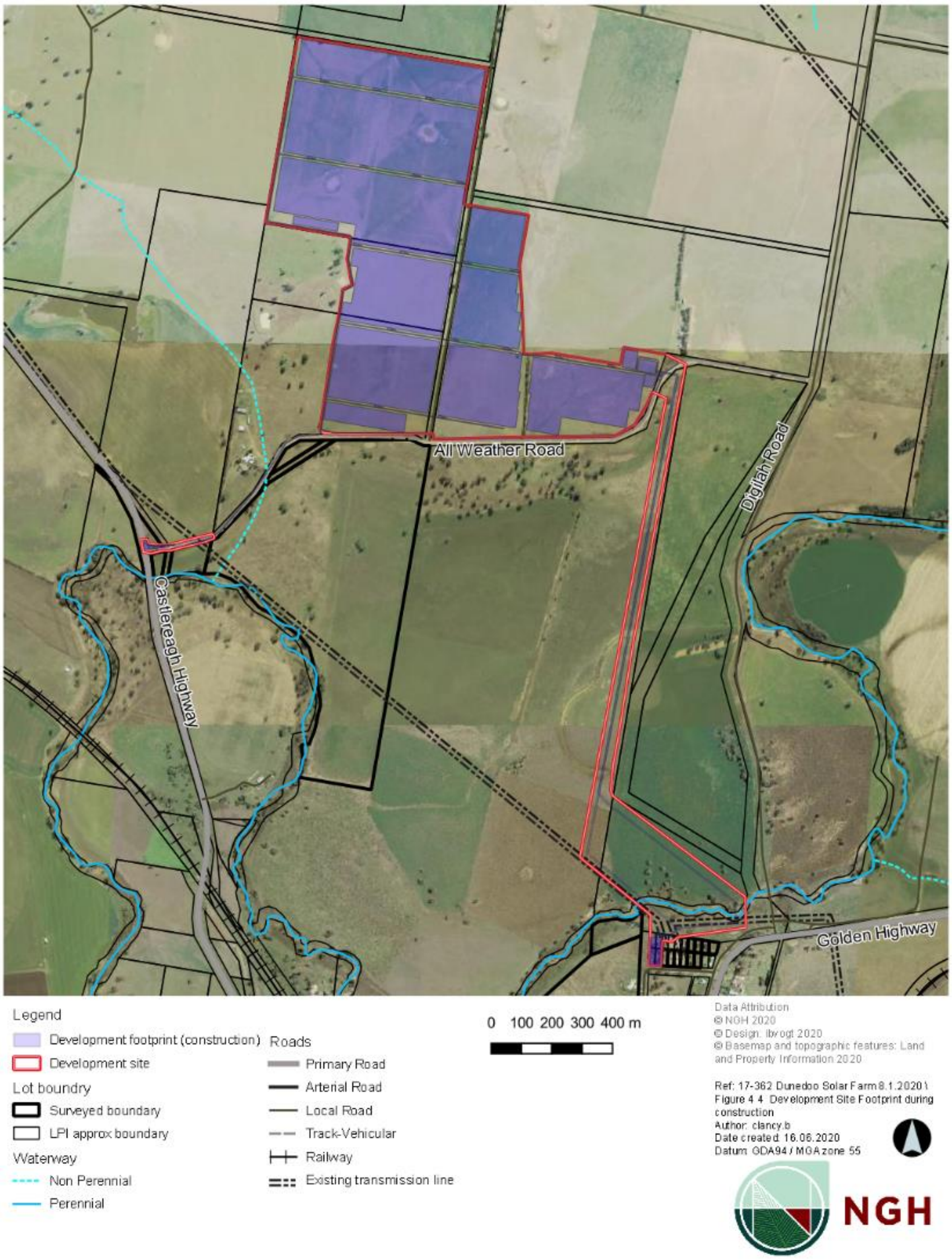

Figure 4-14 Proposed Development Footprint within Development Site

Battery Storage

The construction of the BS could be concurrent with construction of the other solar farm infrastructure or built as part of a different stage. Construction activities would include and not be limited to:

- Site establishment and preparations.
- Installation of suitable foundation.
- Installation of underground cabling (trenching) and energy storage compliant power conversion units and control systems.
- Delivery of the containers/units.
- Augmenting and connecting into inverters and site solar substation.
- Removal of any temporary works and/or replacement of hardstand areas.

4.4.2 Temporary Construction Facilities

Temporary facilities established at the site during the construction phase would include:

- Material laydown areas (approximately 120 x 120 metres)
- Bunded area for refuelling
- Skips with wind shield and lid
- Generator/s for construction compound power supply
- Temporary construction site offices
- Temporary car and bus parking areas for construction workers (approximately 30 spaces). Once the solar farm has been commissioned a small car park (approximately 10 spaces) would remain for the minimal staff required and occasional visitors
- Staff amenities (kitchen and toilet/s)
- Temporary security lighting and CCTV at construction compounds.

Temporary staff amenities would be designed to accommodate the number of workers at the peak of the construction period.

Two (2) compound areas would be established at the Development Site. Compound area 1 (4,000m^2) would be located approximately 700 metres northwest of Access Point 1. This compound would be used for storage of the large components. Compound area 2 (approximately 1,000m^2) would be located adjacent to the substation, near Access Point 2.

All construction compounds would be removed, and temporary hardstand areas and other disturbed areas would be revegetated/remediated following commissioning.

Chain link fencing practicable for security purposes would surround the construction compounds. Hardstand in the compound would consist of compacted stone to provide a clean, firm, level and free draining surface suitable for cabins, material storage and heavy traffic.

4.4.3 Site Preparation and Earthworks

Soils within the Development Site have been heavily disturbed by farming activities. Ground disturbance resulting from earthworks associated with the Proposal would be minimal and limited to:

- The installation of the piles supporting the solar panels, which would be driven or screwed into the ground to a depth of approximately 2.5 metres
- Earthworks (including drainage) that may be required to the ground level within the Development Site
- Construction of internal access tracks and access points and associated drainage
- Substation bench preparation
- Concrete or steel pile foundations for the inverter stations, substation and maintenance building
- Cable trenches consistent with Australian Standards and at least 500mm deep and typically 600-800mm deep
- Establishment of temporary staff amenities and offices for construction

- Construction of perimeter security fencing and CCTV.

Topsoil under the footprint of the array area would remain in-situ (if possible, based on earthworks requirements) during the construction of the solar farm. Topsoil salvaged from the construction of the access tracks and other works would be securely stored for use in site rehabilitation.

Where required weed treatments would be undertaken prior to earth works commencing in order to reduce the potential for spread of these species within the Development Site.

4.4.4 Materials and Resources

Key resourcing requirements for the Proposal would include machinery and equipment, steel (and possibly other metals), electrical components (including PV panels and cables), water, gravel and landscaping materials.

Machinery and Equipment

Equipment used during construction would include but not be limited to:

- Earth-moving equipment for civil works (excavators, graders)
- Small piling or drilling rigs for installation of the posts of the solar arrays
- Diesel generators
- Trucks
- Light vehicles
- Large transit vehicles, including delivery and waste removal vehicles
- Forklifts and/or manitous
- Cable trencher or excavator
- Cable laying equipment
- Cranes including 50-tonne (or as required for largest lifts on site) mobile crane.

Materials

Construction materials would be sourced as locally where possible. Dubbo is the closest city which is a possible source of the bulk of the aggregate material required for construction. Approximately 5,000 m^3 of gravel would be required to surface the access roads and internal service track network, inverter/transformer, BS and substation hardstand. Approximately 900m^3 of sand may be required for the bedding of underground cables, depending on electrical design and ground conditions.

Approximately 350 m^3 of concrete would be required to construct the inverter, substation, CCTV and BS foundations. A local cement batching plant in Dubbo is likely to be used as the main source of concrete.

The water source for the town of Dunedoo is Talbragar Alluvial (managed under the water sharing plan of the Macquarie Bogan Unregulated and Alluvial Water Source).The quantity of entitlements are 6,011 ML/year with 24 licences. The town water entitlements for Dunedoo is 400 ML/year.

Approximately 41,760 KL of non-potable water (equivalent to 41.76 ML or 10.4% of the town’s water entitlement) would be required during the 10-12-month construction phase. Primarily this would be used for dust suppression, cleaning, concreting, on-site amenities and landscaping. A number of water source options have been considered for construction activities (refer to Section 5.3.3).

A small amount of potable (drinking) water would be imported to the site during the construction period on an as-needs basis and stored within temporary water tanks at the staff amenities area.

4.4.5 Transport and Access

Access Route

Light vehicles would gain access to the site via the Golden Highway / Bolaro Street, to the intersection of Digilah Road (distance from Mudgee is approximately 77 km). Once light vehicles turn onto Digilah Road, they would travel a distance of 1.8 km to the intersection with All Weather Road. The distance from this intersection to Access Point 2 of the Development Site is 480 metres.

A Construction Traffic Management Plan (CTMP) would be prepared prior to commencement of construction to manage haulage traffic during the construction phase. Further information can be found in the TA prepared by Stantec Pty Ltd (refer to Appendix K).

Haulage Route

Where possible, goods and services for the solar farm would be sourced locally. The bulk of the imported and manufactured components of the solar farm would be sourced from Sydney or arrive across the docks at one of New South Wales' ports. The majority of these materials would be transported by road using the major road network, including the Golden and Castlereagh Highways. Rail transport to Dubbo, Mudgee or other appropriate location may also be used (if viable) after which road transport would be used along the major road network to the Development Site. Once trucks have turned onto Castlereagh Highway, they would travel a distance of 2.1 km from Dunedoo to the intersection of All Weather Road, turning right off Castlereagh Highway. The distance from this intersection to Access Point 1 of the Development Site is 750 metres.

Locally sourced materials, including from Dunedoo, Dubbo, Mudgee and Tamworth would be transported to the Development Site using the major road networks of Golden Highway and Castlereagh Highway. Sand, gravel, concrete and other materials would be sourced from appropriate quarries that could be in Dunedoo, Dubbo or further afield.

Traffic management would be undertaken during the construction phase to manage haulage traffic. The proposed timeline for the Proposal indicates that approximately 30 employees would be required during the first months rising to 100 employees during the peak construction period while the solar panels are erected and commissioned concurrently. The largest delivery trucks would be Articulated Vehicles (AV) up to A-Double with 30m length and are consistent with current use of the existing local roads in the area.

The construction phase traffic would not affect the ability of neighbouring landowners to access their land, including properties to the north of the site, as this is accessed via a private road, directly from Digilah Road or from Castlereagh Highway. However, road users may experience short delays caused by the movement of equipment and large vehicle traffic.

Intersection Upgrade

The junction of the Castlereagh Highway and All Weather Road will be the access point for heavy vehicles. The existing junction has been investigated and does not allow sufficient swept area for simultaneous in and out bound vehicle movements. The Proponent believes that the ability of vehicles to simultaneously enter and exit this junction is required to improve the road safety of the junction. Options to widen the intersection, considering Austroads Guide to *Traffic Management Part 6: Intersections, Interchanges and Crossings* have been considered on the south eastern and north eastern corners of the junction.

The south eastern corner (Figure 4-15) of the intersection design was based on a 20.6m vehicle length, however, would require reinforcement of the battens of the existing bridge over Talbragar

River. This is not a cost effective option and would require access to land that the Proponent is unable to include in the proposal.

The north eastern option involves widening of the junction wholly within land managed by the Warrumbungle Shire Council (Lot 1 DP 535659). The design has been performed based on a 30-metre long A-double vehicle which is a Road Train (Type 1) Turning Template (refer to Figure 4-16 and Figure 4-17) would facilitate simultaneous inbound and outbound movements from Castlereagh Highway onto All Weather Road and vice versa to maximise road safety of vehicle movements.

The final design would be determined in consultation with TfNSW and Warrumbungle Council during detailed design, and completed in accordance with TfNSW requirements. Further discussions of the intersection upgrade is provided in Section 9.6. Appropriate sightline distances of 262 metres would be maintained at the intersection.

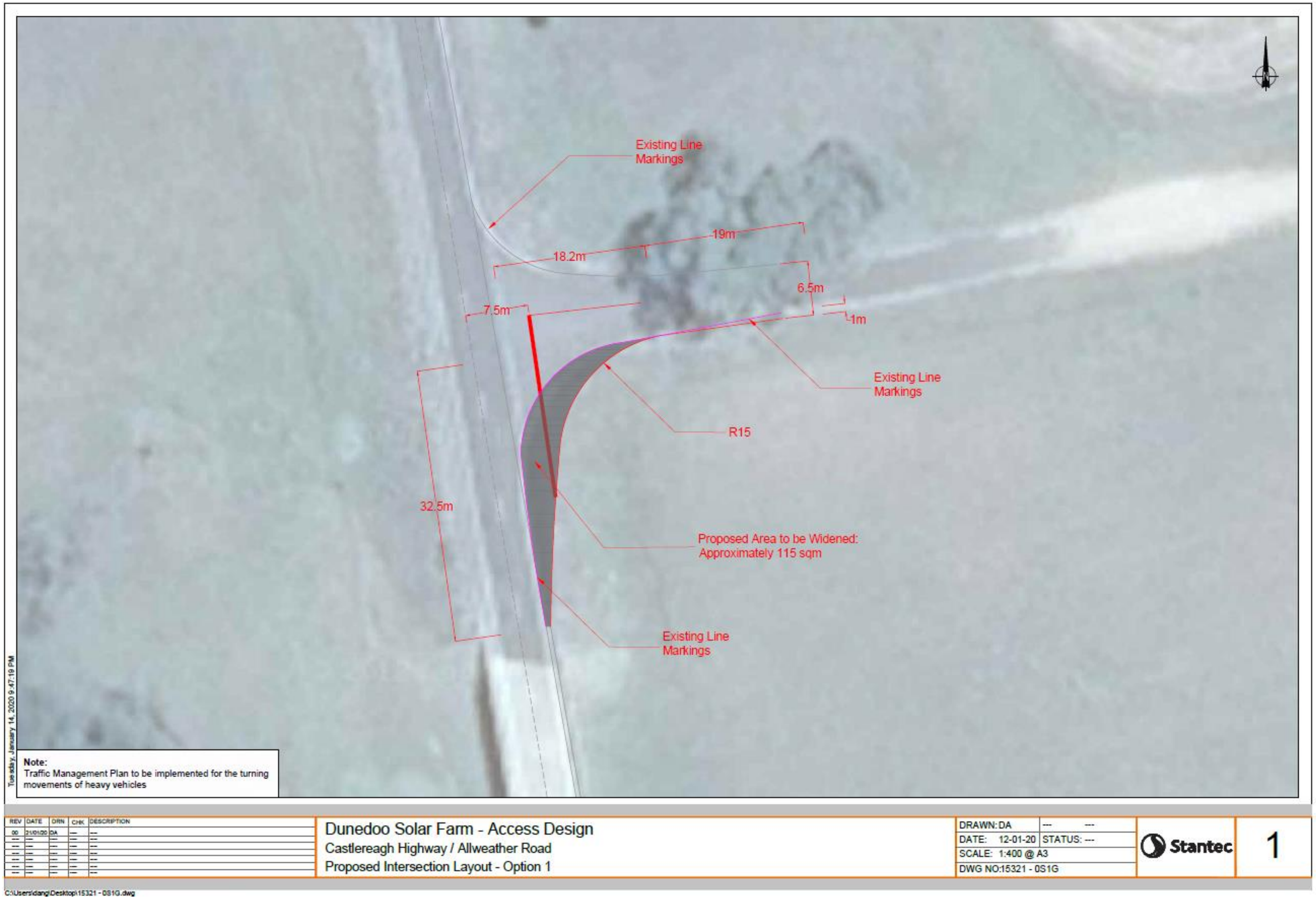

Figure 4-15 Proposed intersection upgrade of south-eastern junction (Stantec, 2020)

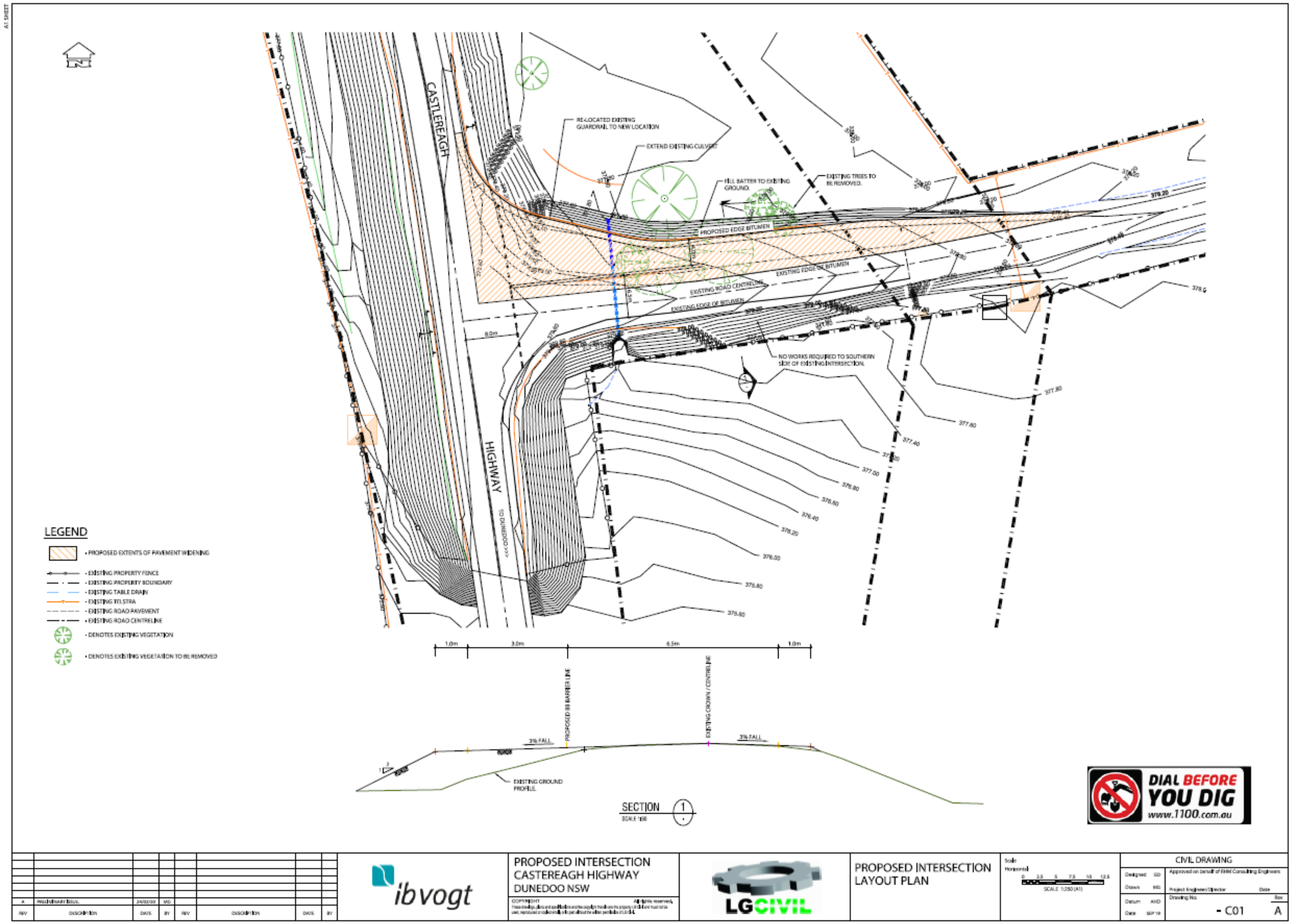

Figure 4-16 Proposed intersection upgrade of north-eastern junction (LG Civil, 2020)

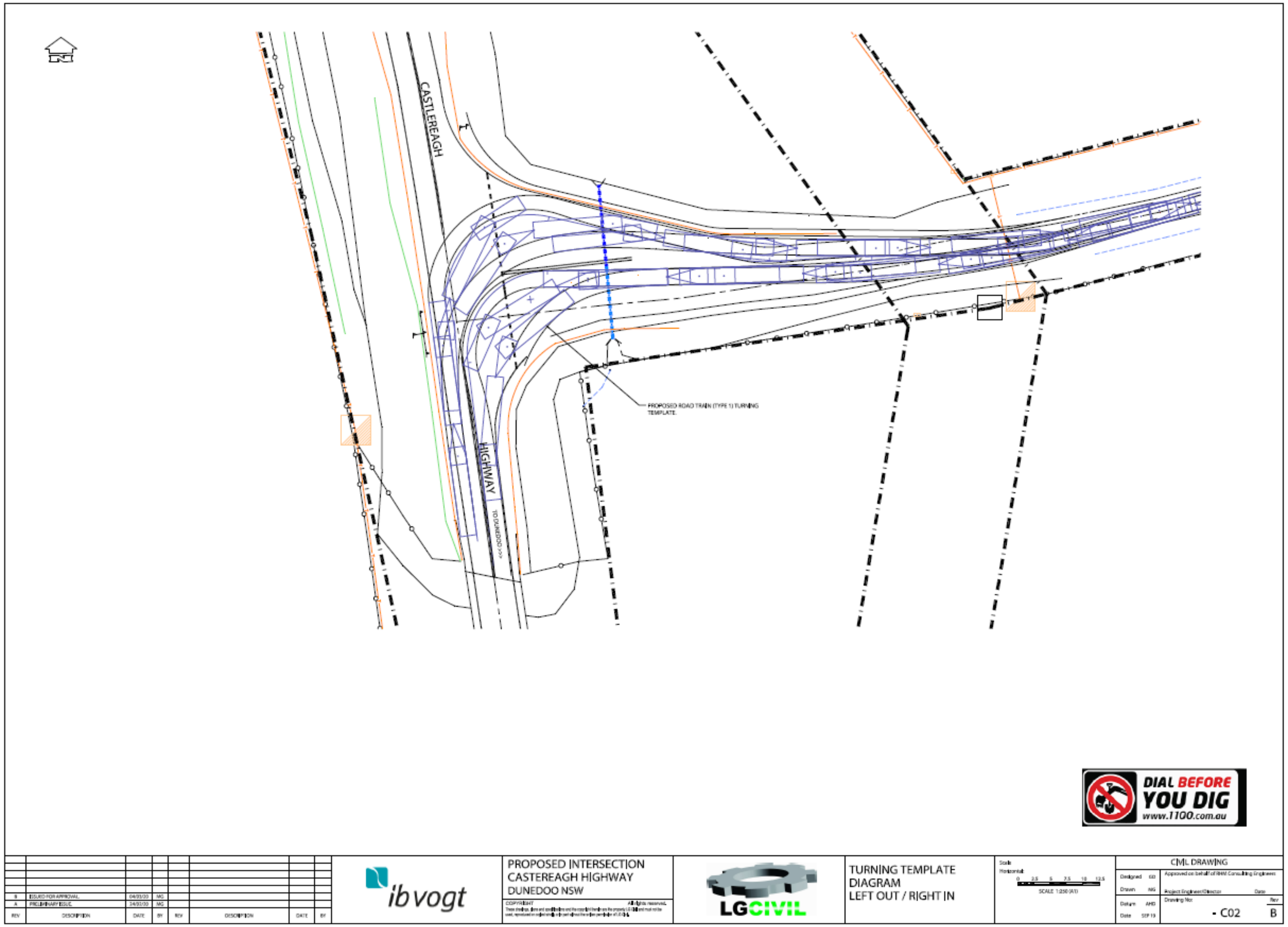

Figure 4-17 Turning template diagram of the north-eastern junction (LG Civil, 2020)

Road Condition Surveys

Prior to construction, a pre-condition survey of the relevant sections of the existing road network within the Development Site would be undertaken, in consultation with Warrumbungle Shire Council. These sections would include:

- All Weather Road
- Castlereagh Highway / All Weather Road intersection
- All Weather Road / Digilah Road intersection.

During construction the sections of the existing road network utilised by the Proposal within the Development Site would be monitored and maintained to ensure continued safe use by all road users, any faults attributed to construction of the solar farm would be rectified in consultation with Warrumbungle Shire Council.

The site access road and all internal tracks would be maintained throughout the construction and operation of the solar farm. Water trucks would be used as necessary to suppress dust on unsealed access roads and tracks during construction. Additional stabilising techniques and/or environmentally acceptable dust control may also be applied if required.

At the end of construction, a post-condition survey would be undertaken to ensure the road network within the Development Site is left in an equivalent or better condition that at the start of construction.

Traffic Movements

Table 4-3 provides an indication of the total traffic movements during the construction period. Over a 10-12-month construction period, the Proposal is expected to generate:

- Approximately 40 heavy vehicles per day, or 80 heavy vehicle movements per day. All of the heavy vehicle movements are proposed to arrive/depart to the south via the Castlereagh Highway / All Weather Road intersection.
- Approximately 12 light vehicles per day, or 24 light vehicle movements per day. All of the light vehicle movements are proposed to arrive/depart to the south via All Weather Road / Digilah Road intersection.

The largest design vehicle is expected to be a 30-metre long A-double truck, which would be used to transport larger plant and equipment. The majority of construction vehicles are expected to be up to and including 20.6 metre long AVs (Articulated Vehicles as defined in AS2890.2:2002). It is expected that a proportion of construction workers (skilled and technical workers) will utilise ride sharing commuting to/from the site, and it can be reasonably expected that these light vehicles will have an average of three (3) people per vehicle.

Table 4-3 Traffic volumes and requirements for the solar farm

Purpose	Week of construction period																																			Total
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	
Site facilities	6	4	4																															5	5	**24**
Ground works	100	100	100	100	100	100	100	85	50																				50	50	50	50	50	50	50	**1185**
Fence	5	5	5	5																																**20**
Mounting systems, racks etc.						25	15	15	15	15	15	15	15	15	15	15	10	8	10	10	10	10	10	10	10	10	8									**281**
Modules																			40	40	30	20	20	20	20	10	10	10	10	10	10	10	10			**270**
Electrical installation, cables, trenching			20	20	20	15	15	15	15	15	10	10	10	8	5														2	2						**182**
Inverter stations and crane						5		5		5		5		5																						**25**
Substation works			10	10	5	5																														**30**
Site maintenance, waste disposal	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	15	15	15	15	15	15	15	15	15	15	14	10	10	10	10	10	10	10	10	10	**404**
other / people movements	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	**1750**
Water Supply	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	**70**
Estimated deliveries per week	171	169	199	195	185	210	190	180	140	95	85	90	85	88	80	80	75	73	115	115	105	95	95	95	95	84	78	70	122	122	120	120	120	115	115	**4241**
Estimated average deliveries per day	35	34	40	39	37	42	38	36	28	19	17	18	17	18	16	16	15	15	23	23	21	19	19	19	19	17	16	14	25	25	24	24	24	23	23	**25**
Estimated average movements per day	70	68	80	78	74	84	76	72	56	38	34	36	34	36	32	32	30	30	46	46	42	38	38	38	38	34	32	28	50	50	48	48	48	46	46	**20**

4.4.6 Personnel and Work Hours

Personnel

The proposed timeline for the Proposal indicates that approximately 30 employees would be required during the first month rising to 100 employees during the peak three-month construction period. Construction supervisors and the construction labour force, made up of labourers and technicians, would be hired locally where possible. Non-local workers would use existing accommodation within the local area.

It is anticipated that all of the light vehicle movements would arrive/depart to the south via All Weather Road / Digilah Road intersection. It is expected that skilled construction workers would utilise ride sharing commuting to/from the site, and it can be reasonably expected that these light vehicles would have an average of three people per vehicle. Parking areas for light vehicles are proposed near the control room, within the Development Site. Preliminary plans for the site propose parking for approximately 30 vehicles during construction.

Work Hours

Construction activities would be undertaken during standard daytime construction hours:

- Monday – Friday 7am to 6pm
- Saturday 7am to 1pm.

In general, no construction activities would occur on Sundays or public holidays; however, in cases of emergency, major asset inspection or maintenance programs may be undertaken outside standard construction hours.

Warrumbungle Shire Council and surrounding landholders would be notified of any works expected to be performed outside standard daytime construction hours that may be expected to cause noise exceedance to neighbouring dwellings.

4.5 Operation

4.5.1 Operation Activities

Operation activities would include but not be limited to:

- Routine visual inspections, general maintenance and cleaning operations of the solar arrays as required
- Routine visual inspections, general maintenance and cleaning operations of the substation
- Vegetation management, using sheep to control grass growth beneath the panels if possible. Groundcover vegetation would be maintained over the site to minimise erosion, dust and weeds (subject to climatic conditions). Groundcover would be monitored and remediation (such as reseeding or soil protection) undertaken as required
- Site security response (24-hr) if required
- Site operational response (24-hr) if required
- Replacement of equipment and infrastructure as required
- Maintenance of landscaping and screening plantings as required
- Pest plant and animal control as required.

Refer to Figure 4-18 for the Development Footprint during operations within the Development Site.

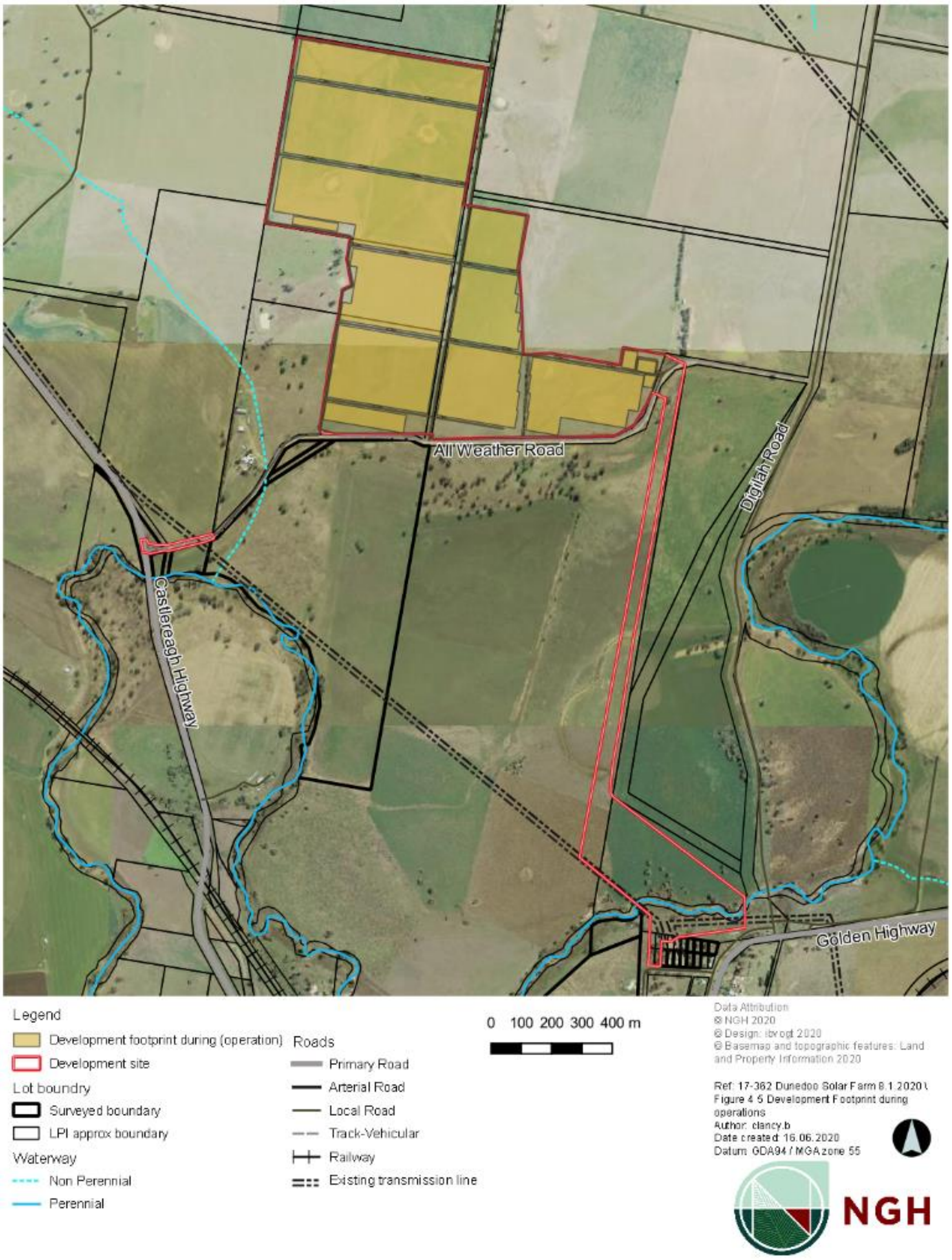

Figure 4-18 Development Footprint during operations within the Development Site

4.5.2 Materials and Resources

During operation, non-potable water would be required for cleaning panels, landscaping and animal care. Potable water would be required for staff using imported supplies or rainwater collected from tanks beside site buildings. Up to 171.4 KL per year would be required, and would be practicably sourced as per available options (refer to Section 9.3.3). A water tank would be installed at the site to store water for bushfire protection and other non-potable water uses, with a minimum of 20 KL reserved for fire-fighting purposes. Refer to Section 9.3.2 for details.

4.5.3 Transport and Access

It is expected that the up to 3 full time equivalent staff based at the site and up to 9 indirect service contractors during the operation phase would primarily use light vehicles (4x4).

Water for solar panel cleaning would be delivered to the site, requiring around 10 tanker visits per year, based on one wash per season using 0.8 litres/panel. Panel washing may not be required once groundcover has been established at the site.

Traffic associated with the operation and maintenance of the solar farm would also use the routes specified for the construction phase (refer to Section 4.3.8 and 0).

4.5.4 Personnel and Work Hours

The solar farm would be monitored and operated remotely and would require a small number of maintenance personnel (up to 3 full time equivalent staff and up to 9 indirect service contractors) to be based at the site.

Plant maintenance including inverter station, transformer and HV switchgear, PV arrays and the trackers (if fitted) would be undertaken by site staff on a rolling basis with activities scheduled consistently throughout the year. On some occasions, such as during a major substation maintenance shut down, that additional maintenance staff may be required on site. If required, the staff would work from the operations building at the site and additional traffic would be minimised through carpooling if possible.

Daily operations and maintenance by site staff would be undertaken indicatively during standard working hours of:

- Monday – Friday 7am to 6pm
- Saturday 8am to 1pm.

In general, no construction activities would occur on Sundays or public holidays; however, in cases of emergencies, major asset inspection or maintenance programs may be undertaken outside standard construction hours.

Warrumbungle Shire Council and surrounding landholders would be notified of any works expected to be performed outside standard daytime construction hours that may be expected to cause noise exceedance to neighbouring dwellings.

During summer months, the PV panels would produce electricity prior to 7am and after 6pm. Tracker units would similarly operate outside standard hours in summer. The operational noise impact of this equipment would be negligible to the nearest sensitive receivers.

4.5.5 Lighting

There would be no permanently lit night lighting installed within the array, and would comply with the Warrumbungle LEP Dark Sky Region conditions (refer to Section 5.4.1). Lighting would be included in each inverter station for night time maintenance or emergency purposes. There would also be maintenance lighting installed at the substation to be used in case of emergency or night maintenance. Movement sensor or infrared security lighting would also be installed at the operation and maintenance building and sensitive boundary positions. All operational lighting would be designed to reduce disturbance to neighbouring properties and would be used only when there are staff on site, as part of site security or during emergency situations.

Movement sensor or infrared security lighting and CCTV cameras would be installed on posts up to 3.5 metres high adjacent to the security fencing and operation and maintenance buildings.

4.5.6 Refurbishment and Upgrading

The solar farm operator may replace or upgrade solar panels or other infrastructure within the Development Site during the projected 30-year life of the solar farm. If any upgrade works during the life of the solar farm would extend beyond the existing impact footprint or alter the nature or scale of environmental impacts, the proponent would consult DPIE regarding the need for further assessment or approval. The Proponent would also consult DPIE regarding the need for further assessment and approval to continue the operation of the solar farm beyond the 30-year timeframe.

4.6 DECOMMISSIONING AND REHABILITATION

The solar farm is expected to operate for up to 30 years after construction is completed. After this period, the solar farm would either be upgraded (pending any additional approval requirements) or decommissioned.

Decommissioning would see the site returned to its pre-construction land use. All below-ground infrastructure would be removed to a depth of up to 500 mm. All above-ground infrastructure will also be removed. Key elements of decommissioning would include:

- The solar arrays would be removed, including the foundation piles. Materials would be sorted and packaged for removal from the site for recycling or reuse wherever possible
- All site amenities and equipment would be removed including buildings, inverter stations and substation, and materials recycled or reused wherever possible
- Posts/piles and cabling installed within 500 mm of the surface would be removed and recycled, equipment below this depth, such as cabling, would be left in situ
- Fencing would be removed including small concrete footings.

All areas of soil disturbed during decommissioning would be rehabilitated in consultation with the landowner consistent with pre-construction land-use. Traffic required for decommissioning would be similar in type but of shorter duration than that required for the construction phase. Wherever possible and practicable, materials removed from the site would be either re-used or recycled (for example, some internal access is likely to be retained).

A Decommissioning Environmental Management Plan (DEMP) with an indicative timeline would be prepared and submitted to DPIE for approval prior to the works. A Decommissioning Traffic Management Plan (DTMP) would be captured as part of the DEMP.

4.7 INDICATIVE TIMELINE

An indicative timeline for the Proposal is outlined in Table 4-4.

Table 4-4 Indicative timeline

Phase	Approximate commencement	Approximate duration
Construction	Autumn 2021	10-12 months
Operation	Autumn 2022	30 years
Decommissioning	Autumn 2021	4 months

4.8 CAPITAL INVESTMENT

The Proposal would have an estimated capital investment of $76 million. A quantity surveyor's report confirming the capital investment has been provided to DPIE.

5 PLANNING CONTEXT

5.1. STRATEGIC FRAMEWORK

5.1.1 Climate Change Mitigation

Paris Agreement

Under the United Nations Paris Agreement on climate change, Australia has committed to the following greenhouse gas (GHG) emission reduction targets:

- 5% below 2000 levels by 2020
- 26-28% below 2005 levels by 2030
- Net zero emissions in the second half of the century.

Electricity generation is the largest individual contributor of GHG emissions in Australia, representing 35% of emissions (DOE 2016). The transition to low carbon renewable energy sources would be critical to enable Australia is to meet its Paris commitments.

It has been argued that the electricity generation sector should aim to achieve considerably higher reductions than the general 26-28% target to reduce pressures on other industries (such as agriculture, construction and manufacturing), where abatement is more difficult and expensive. A more efficient abatement model would see the electricity sector reduce GHG emissions by 40-55% below 2005 levels, requiring renewable penetration in the order of 66-75% by 2030 (Australia Institute 2017).

In terms of renewable energy technologies, solar projects have the capacity to provide faster results because of potentially shorter construction and commissioning times (CER 2017). Rapid advancement of technology in this sector has resulted in the improved performance of solar energy projects.

The Proposal would generate around 144,540 MWh per year, saving approximately 48,236 tonnes of carbon dioxide per year. This assumes generation would otherwise be made by brown coal with a carbon factor of 0.33372 tonnes per MWh (DOEE 2016). Precise generation figures may change subject to final site design and product selection.

Renewable Energy Target Scheme

The legislated objectives of the Commonwealth Renewable Energy Target (RET) Scheme are:

- To encourage additional generation of electricity from renewable sources
- To reduce emissions of GHG in the electricity sector
- To ensure generation of electricity from ecologically sustainable renewable energy sources.

The RET works by creating a market for renewable energy certificates, which drives investment in the renewable energy sector. Renewable energy generators create certificates for electricity generated or displaced. Electricity retailers purchase these certificates to meet their renewable energy obligations.

The RET aims to achieve large-scale renewable generation of 33,000 GWh in 2020, meaning that about 23.5% of Australia's electricity generation would be from renewable sources.

The Large-scale Renewable Energy Target component of the RET requires an estimated 6,000 MW of new renewable power stations to be built by 2020, which is likely to consist of approximately 75% wind and 25% solar (CER 2015 in Finkel *et al.* 2016). This would represent a doubling of the total renewable capacity installed since 2001 (Ernst and Young 2016 in Finkel *et al.* 2016).

The additional committed new build capacity for renewable energy generation of 3,000 MW required in 2016 was not reached (CER 2017). For the 2020 target to be achieved, around 3,000 MW would need to be committed in 2017 and a further 1,000 MW in 2018. The 2020 target remains achievable provided investment momentum can be maintained throughout 2017 (CER 2017).

The proposed 55 MW AC Dunedoo Solar Farm would directly contribute to meeting the RET renewable energy generation target by generating around 144,540 MWh per year, which represents the power consumption of approximately 24,415 homes (assuming an average household consumption of 5,920 kWh pa).

RET certificates could be processed and made available to the Proponent in during the sales and commissioning period to encourage investment in the solar market.

NSW goals and policies through the Climate Change Policy Framework

The NSW Climate Change Policy Framework (State of NSW and OEH 2016) aims to 'maximise the economic, social 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 endorses and is intended to complement national Paris Agreement targets, and has the following aspirational long-term objectives:

- Achieve net-zero emissions by 2050
- NSW is more resilient to a changing climate.

Implementation of the framework encompasses emission reduction and adaptation, and includes the development of an advanced energy action plan, a new energy efficiency plan, a climate change adaptation action plan, and additional policy investigations for sectors with significant opportunities and risks.

The Proposal would directly contribute to the policy framework 's objectives in the following long-term directions:

- Provide private-sector investment to make the transition to a net-zero emissions economy for NSW more affordable
- Enhance energy and resource productivity to reduce the impact of rising energy prices and associated costs transitioning to a net-zero emissions economy
- Minimise environmental impacts to capture co-benefits of making NSW more resilient to climate change
- Increase opportunities and awareness across various sectors and communities associated with solar farm construction and operation
- Improve electrical connectivity for the existing network by working with grid suppliers to maximise energy efficiency.

NSW 2021: A Plan to Make NSW Number One

This plan was released in 2011, replacing the State Plan as the NSW Government's strategic business plan, setting priorities for action and guiding resource allocation. Goal 22 of this Plan seeks to protect our natural environment and includes a specific target to increase renewable energy.

A commitment is made to contribute to the national renewable energy target [i.e. 20% renewable energy supply] by promoting energy security through a more diverse energy mix, reducing coal dependence, increasing energy efficiency, and moving to lower emission energy sources (NSW Government 2011).

The Proposal would directly contribute to the plan's target through solar farm operation. Specific initiatives under this target that directly support building solar farms included the Solar Flagships

Program, in partnership with the Commonwealth Government, established in 2009 (now closed). Additionally, a strategic move towards renewable energy generation is supported through the establishment of a Joint Industry Government Taskforce to develop a Renewable Energy Action Plan for NSW, which would identify opportunities for investment in renewable energy sources, as is evident in the allocation of the Central-West REZ in which the Proposal is located.

Warrumbungle Shire Economic Development & Tourism Strategy 2019 – 2023

The purpose of the Economic Development Strategy is to provide the direction and framework to encourage, support and facilitate economic development within Warrumbungle Shire.

It aims to:

- Ensure the foundations are in place to take the local economy forward and realise emerging opportunities.
- Guide Council's actions, policies, regulations and resource and funding allocations to 'deliver' a positive investment environment.
- Inform Government agencies and service providers of the potential and needs of Warrumbungle Shire, including its infrastructure needs.
- Encourage development and investment, including expansion, diversification and retention of existing businesses, attraction of new businesses, residents and investment into the Shire and creation of employment and wealth.

The Proposal will be sited within the Warrumbungle Shire LGA to take advantage of the irradiance formed by a combination of low pollution, very low humidity and limited cloud coverage; some of the ideal qualities of an area to place a solar farm. In addition, Dunedoo Solar Farm has the potential to provide electricity to the township of Dunedoo, which has encountered power supply issues and blackouts within the Warrumbungle Shire. The Proposal would generate demand for accommodation during the construction period, providing rental opportunities for the local property owners in Dunedoo and Coolah and possibly Binnaway and Mendooran.

The strategy identifies Eco Efficiency and Sustainability as a macro trend and driver that have the potential to influence the following economic growth in the region:

- Economic growth through the transition to a more sustainable and resource efficient economy
- the provision of opportunities for new industries and businesses in energy and water efficient technologies and alternative energy; and
- Shift towards investment in renewable energy and higher demand for land and/or materials for alternative energy production (e.g. Solar and wind farms, bio-fuel production etc.).

The Proposal would directly contribute to the growth of Warrumbungle Shire in this manner. Additionally, a significant portion of the strategy's overall monitoring progress can be readily quantified as the solar farm is anticipated to contribute to productivity growth such as job creation, value, and business and investor confidence. Refer to Section 9.5 of the EIS for details.

5.2 STATE LEGISLATION

5.2.1 *Environmental Planning and Assessment Act 1979*

The *Environmental Planning and Assessment Act 1979* (EP&A Act) and its associated regulations and instruments set the framework for development assessment in NSW. The Proposal would be assessed under Part 4 of the EP&A Act. The relevant objects of the Act are to encourage:

- The proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment

- The promotion and co-ordination of the orderly and economic use and development of land
- The protection, provision and co-ordination of communication and utility services
- The protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats
- Ecologically sustainable development
- Increased opportunity for public involvement and participation in environmental planning and assessment.

Development assessment provisions are contained in Part 4 and Part 5 of the Act. Developments requiring consent under a planning instrument (such as State Environmental Planning Policies and Local Environmental Plans) are assessed under Part 4, applicable to this Proposal.

Section 4.15 identifies matters to be considered in determining a Development Application (DA), including:

(a) the provisions of any relevant environmental planning instrument, development control plan, planning agreement, regulation, coastal zone management plan

(b) the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality

(c) the suitability of the site for the development

(d) any submissions made in accordance with this Act or the regulations

(e) the public interest.

These matters are considered in relevant sections of this EIS and specifically in Section 11.

Section 5.5 of the Act requires a determining authority, when considering an activity, to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment. The BC Act specifies five factors which must be considered when assessing impacts on threatened species, populations or ecological communities, or their habitats. The BC Act contains provisions to prepare a Biodiversity Development Assessment Report (BDAR) to determine whether Serious and Irreversible Impacts (SAII) are likely. The Biodiversity Offsets Scheme would still apply regardless if SAII are determined or not.

Section 4.36 of the EP&A Act provides that a development would be State Significant Development (SSD) if it is declared to be SSD by a State Environmental Planning Policy (SEPP). Section 4.12 (8) of the Act requires an SSD DA to be accompanied by an EIS prepared in accordance with the EP&A Regulation. This EIS is intended to meet the objects and assessment requirements of the EP&A Act, and the Regulation and *State Environmental Planning Policy (State and Regional Development) 2011*.

5.2.2 *Environmental Planning and Assessment Regulation 2000*

Schedule 2 of the EP&A Regulation specifies the form and content of Environmental Impact Statements, which provide the basis for the Secretary's Environmental Assessment Requirements (SEARs) issued for proposals. The relevant sections in the EIS are referenced against each of the SEARs in Section 1.4 of this EIS.

Clause 82 of the EP&A Regulation addresses public participation in SSD Proposals. The Dunedoo solar farm DA and accompanying information (including this EIS) would be placed on public exhibition by DPIE for a period not less than 30 days.

5.2.3 *State Environmental Planning Policy (State and Regional Development) 2011*

SSDs are major projects, which require approval from the Minister for Planning and Public Spaces or delegate (Planning Assessment Commission, Secretary, or other public authority). An EIS must be prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) issued by DPIE.

Under section 4.41 of the EP&A Act, SSD developments do not require the following authorisations:

(a) (Repealed)

(b) a permit under section 201, 205 or 219 of the Fisheries Management Act 1994,

(c) an approval under Part 4, or an excavation permit under section 139, of the Heritage Act 1977,

(d) an Aboriginal heritage impact permit under section 90 of the National Parks and Wildlife Act 1974,

(e) (Repealed)

(f) a bush fire safety authority under section 100B of the Rural Fires Act 1997,

(g) a water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the Water Management Act 2000.

Under section 4.42 of the EP&A Act, several other authorisations cannot be refused if they are necessary for and consistent with an approved SSD, including a consent under section 138 of the *Roads Act 1993* (refer to Section 5.3 of this EIS).

State Significant Development status

Clause 20 of Schedule 1 of *State Environmental Planning Policy (State and Regional Development) 2011* defines SSD as including:

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

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

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

The Proposal would have an estimated capital investment cost greater than $30 million and is therefore considered SSD under Part 4 of the EP&A Act.

The DA and Scoping Report for the Proposal were submitted to DPIE on 26 October 2017. SEARs for the assessment were issued by DPIE on 27 November 2017 whereupon updated SEARs were issued on 9 April 2020 (refer to Appendix A). A summary of the SEARs and corresponding sections in the EIS are provided in Table 1.1.

5.2.4 *State Environmental Planning Policy (Infrastructure) 2007*

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) was introduced to facilitate the effective delivery of infrastructure across the State by improving regulatory efficiency through a consistent planning regime for infrastructure and services across NSW.

Part 3 Division 4 of ISEPP relates to electricity generating works. The Proposal falls under a development for the purpose of 'electricity generating works' - as defined in the Standard Instrument, for making or generating electricity, or electricity storage - in any land in a prescribed rural zone.

Traffic Generating Development

Clause 104 of the ISEPP requires certain developments (identified in Column 1 of the Table in Schedule 3 and known as 'traffic generating development') to be referred to TfNSW. The consent authority would then be required to take into account any submission made by TfNSW in relation to the development.

Although 'power generation' is not defined as 'traffic generating development'. Intersection upgrades to that of Castlereagh Highway and All Weather Road would be part of the Proposal. Castlereagh Highway is a classified road where intersection upgrade works would facilitate construction vehicle access to the Development Site, approximately 750 metres northeast of the intersection along the connecting road alignment (All Weather Road). As the site accesses a classified road, the vehicle movement threshold is 50 or more vehicles per hour.

The Proposal would result in the generation of fewer than 50 vehicles per hour during peak construction or operation, thus the requirements under clause 104 of the ISEPP do not apply. Section 9.6 of the EIS assesses the impact of the Proposal on traffic and transport.

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

The new *State Environmental Planning Policy (*Primary Production and Rural Development), known as the PPRD SEPP, is a new framework that commenced on 28 February 2019. The new framework simplifies the NSW planning system by consolidating, updating, and repealing provisions in five former agriculture-themed SEPPs, including the Rural Lands SEPP. The intention is to provide for better outcomes in balancing rural needs, including farming, and development, and to reduce the risk of land use conflict and rural land fragmentation. Many of the provisions in the repealed SEPPs were local-level land use planning matters, which have now been transferred to local LEPs. This aim is to ensure local industry and community have greater access to and awareness of the agricultural land use planning provisions that apply. The intent of the new SEPP is to deal with agricultural land use matters of State or regional significance only.

The aims of the *State Environmental Planning Policy (Primary Production and Rural Development) 2019* (Primary Production SEPP) are:

(a) to facilitate the orderly 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.*

The objectives of Part 2 (State Significant Agricultural Land) of Primary Production SEPP are as follows:

(a) to identify State significant agricultural land and to provide for the carrying out of development on that land,

(b) to provide for the protection of agricultural land:

- *i. that is of State or regional agricultural significance, and*
- *ii. that may be subject to demand for uses that are not compatible with agriculture, and*
- *iii. if the protection will result in a public benefit.*

Land that is considered State Significant Agricultural Land is listed in Schedule 1 of the Primary Production SEPP. Schedule 1 of the SEPP is currently incomplete/blank, with mapping yet to be completed or publicly available (DPE pers. comm., 12/06/19).

The proposal is compatible with the aims of the Primary Production SEPP, as it would not entirely remove the development site from agricultural land use, with sheep grazing persisting under the solar panels during operation, nor does the proposal permanently divert the land from future cropping, as the development site would eventually be returned to the landowner following decommissioning.

5.2.6 Other State Environmental Planning Policies

State Environmental Planning Policy No 33—Hazardous and Offensive Development

This SEPP defines and regulates the assessment and approval of potentially hazardous or offensive development. The SEPP defines ‘potentially hazardous industry’ as:

> *…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.*

‘Potentially offensive industry’ defined 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.*

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

A checklist and a risk screening procedure developed by DPIE is used to help determine whether a development is considered potentially hazardous industry (DOP 2011). Appendix 3 of the *Applying SEPP 33* guidelines list industries that may fall within SEPP 33; the lists do not include solar farms and energy storage facilities. The applicability of SEPP 33 is not immediately apparent for solar farms and as a result, a risk assessment against Appendix 2 of the SEPP 33 guidelines was undertaken. The hazardous development status of the Proposal is assessed in Section 9.7 of this EIS.

State Environmental Planning Policy No 55 - Remediation of Land

SEPP No 55 aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment. Clause 7 of the SEPP requires the remediation of land to be considered by a consent authority, when determining a DA.

A search of the NSW EPA contaminated land public record (NSW EPA, 2017) was undertaken for contaminated sites within the Warrumbungle Shire LGA on 6 November 2018. No contamination records were identified for the LGA in the EPA contaminated land register. Contamination associated with agricultural activities (e.g. pesticides, petrochemicals) maybe present on the site, but it is unlikely as the landowners have mainly used the area for grazing and cropping. In terms of the proposed solar farm, the risk from contamination and the need for remediation prior to the works is considered to be low.

State Environmental Planning Policy (Koala Habitat Protection) 2019

This SEPP encourages the conservation and management of natural vegetation that provides habitat for Koalas. The SEPP applies to each LGA listed in Schedule 1 of the BC Act, where Warrumbungle Shire LGA is listed. Although this SEPP applies to this LGA, with Council as the determining authority, the BDAR for this Proposal has considered the potential impacts of the Proposal to the Koala.

No evidence of Koalas were identified as part of the BDAR survey effort. Refer to Section 8.1 and Appendix D of this EIS for details.

5.3 NSW LEGISLATION

5.3.1 *Roads Act 1993*

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

The Roads Act provides for the declaration of TfNSW and other public authorities as roads authorities for both classified and unclassified roads. Freeways, state highways and main roads ('State Roads') are generally the responsibility of TfNSW. For State Roads other than Freeways, the local council generally has responsibility for footpaths and road reserves. Councils are roads authorities for less important classified roads and for roads not classified under the Act. Regional road may be classified, or unclassified, and local road are unclassified under the Act. The Lands Minister is the authority for Crown roads, including 'paper roads' (refer below).

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

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

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

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

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

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

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

Construction traffic would use the Castlereagh Highway and Golden Highway (State Road) and the sealed local road Digilah Road and the unsealed local All Weather Road. The need for upgrade works on the access roads has been considered as part of the traffic assessment conducted for the Proposal (refer to Section 9.6). If works are required, approval from the relevant roads authority (TfNSW and Council) would be sought under section 138 of the Roads Act. Under section 89K of the EP&A Act; a consent under section 138 of the Roads Act cannot be refused if is necessary for and consistent with an approved SSD.

5.3.2 *Water Act 1912*

Part 8 of the *Water Act 1912* (WA 1912), manages developments on floodplains, known as ‘controlled works’, which are likely to affect floodplain functions. Controlled works are generally earthworks, embankments or levees or other works that are likely to affect the flow of water. In 1999 the Act was amended to facilitate the development of rural Floodplain Management Plans (FMP) which would enable strategic control of works in floodplains (referred to as flood control works).

The State Government passed the Water Management Act 2000 (WMA), which consolidated most of the previous acts covering water management. The floodplain management provisions of that WMA would eventually replace Part 8 of the WA 1912; however, the 21 existing FMPs remain valid under current transitional arrangements of the WMA.

The Talbragar River is part of the Macquarie Catchment within the Murray-Darling basin. Currently, a Flood Management Plan (FMP) has been prepared for the Macquarie River floodplain, from Narromine to Oxley Station, as such the FMP does not cover the Development Site. However, it includes sections of the Talbragar River that is prone to flooding during 1% AEP (refer to Section 8.4 of this EIS).

5.3.3 *Water Management Act 2000*

The *Water Management Act 2000* (WMA), currently administered by the Department of Industry (Water), is progressively being implemented throughout NSW to manage water resources, superseding the *Water Act 1912*.

The aim of the WMA is to ensure that water resources are conserved and properly managed for sustainable use benefiting both present and future generations. It is also intended to provide formal means for the protection and enhancement of the environmental qualities of waterways and in-stream uses, as well as to provide for the protection of catchments. Freshwater sources throughout NSW are managed via Water Sharing Plans (WSPs) under the WMA. Key rules within the WSPs specify when licence holders can access water and how water can be traded.

Under section 89J of the EP&A Act, SSD developments do not require a water use approval under section 89, a water management work approval under section 90 nor an activity approval (other than an aquifer interference approval) under section 91 of the WMA.

The Development Site is located in an area subject to the following water sharing plan:

- Water Sharing Plan for the Macquarie Bogan Unregulated and Alluvial Source.

Water management work includes 'water supply work' which is defined as *"a work (such as a water pump or water bore) for the purpose of taking water from a water source"*. Thus, the Proposal does not require approval to construct and use a bore within the Development Site. However, a permit for aquifer interference as per section 4.41(g) of the EP&A Act would be required, post approval, to penetrate the aquifer. The bore would be located away from the existing irrigation bores at Lot 80 DP754309. Refer to Section 9.3.2 for details.

5.3.4 *Fisheries Management Act 1994*

The *Fisheries Management Act 1994* (FM Act) sets out to conserve fish stocks and key fish habitats, threatened species, populations and ecological communities of fish and marine vegetation and biological diversity. The FM Act aims to promote viable commercial fishing, aquaculture industries and recreational fishing opportunities. Threatened species, populations and ecological communities and key threatening process are listed in the Schedules of the FM Act.

As the Proposal does not include any dredging activities, no marine vegetation has been identified, and no passage of fish would be blocked, a permit under sections 201, 205 or 219 of the Act is not required under the provisions of section 89J of the EP&A Act.

5.3.5 *Crown Lands Act 1989*

Crown land includes leased Crown lands, Crown roads, Crown reserves managed by local councils and community trusts. It also includes Crown land retained for environmental purposes, many non-tidal waterways and most tidal waterways, and unallocated Crown land (NSW Trade and Investment 2014). Approval from the Lands Minister is required to:

- Reside, erect a structure or graze or drive stock on Crown land,
- Clear, dig up or cultivate or enclose Crown land.

Under Part 3 of the Act, land must be assessed prior to any allocation action (reservation, dedication, sale, lease, licence or permit), considering capabilities and suitable uses.

Consultation with Crown Lands has revealed that the parcels of land that will hold part of the TL easement north of the Talbragar River to the existing Dunedoo substation, are part of the Dunedoo Riverside Park Reserve Trust, managed by Warrumbungle Shire Council. The area is for public recreation and according to the Property Manager at Warrumbungle Shire Council, holds a temporary grazing licence on this land for cattle.

The Proponent is currently awaiting response from Crown Land regarding a submitted land owner's consent for the Talbragar River Reserve (reference 56146) and Lot 7012 DP93290. This EIS will be provided to Crown Lands to inform their decision.

5.3.6 *Aboriginal Land Rights Act 1983*

The *Aboriginal Land Rights Act 1983* provides a mechanism for compensating Aboriginal people of NSW for loss of their land. The role of the Department of Aboriginal Affairs is to administer the Act on behalf of the Minister for Aboriginal Affairs.

The proposed works include an easement through Crown land, as such an Aboriginal Lands Claims search has been undertaken, the results are discussed in Section 8.2.

5.3.7 *Biodiversity Conservation Act 2016*

The BC Act provides a regulatory framework for assessing and offsetting the biodiversity impacts of proposed developments and activities. The Act contains provisions relating to flora and fauna protection, threatened species and ecological communities listing and assessment a Biodiversity Offsets Scheme (BOS), a single Biodiversity Assessment Method (BAM), calculation and retirement of biodiversity credits and biodiversity assessment and planning approvals.

The BOS applies to the following development and clearing proposals:

- Local development that would have impacts above the ‘BOS Threshold’ or is likely to significantly affect threatened species or ecological communities based on the assessment of significance in s7.3 of the *Biodiversity Conservation Act 2016*. (“Local development” is development approved under Part 4 of the *Environmental Planning and Assessment Act 1979 (EP&A Act)* other than State Significant Development and Complying Development)
- SSD and State Significant Infrastructure (SSI), unless it is not likely to have any significant impact on biodiversity values (as determined by the Secretary of the Department of Planning and Environment and the Chief Executive of the Office of Environment and Heritage)
- Clearing above the BOS Threshold regulated through the Vegetation State Environmental Planning Policy. This covers clearing that does not require development consent in urban areas and environmental conservation zones (E2-E4 zones)
- Agricultural clearing Proposals that require approval by the Native Vegetation Panel under the *Local Land Services Amendment Act 2016*
- Biodiversity certification Proposals
- Activities assessed under Part 5 of the *EP&A Act*, if the proponent chooses to opt-in to the BOS.

Given this Proposal is assessed as SSD, and may have impacts on biodiversity values, a Biodiversity Development Assessment Report (BDAR) has been prepared (refer to Section 8.1 and Appendix D).

5.3.8 *Local Land Services Amendment Act 2016*

The *Local Land Services Amendment Act 2016* (LLSA Act) provides a three-tier system for native vegetation clearing approval based on a Native Vegetation Regulatory Map, and a Land Management (Native Vegetation) Code 2017. Under the Act, clearing is permitted if it is authorised under other legislation, including development consent under Part 4 of the EP&A Act. Although the Proposal is not being assessed under the LLSA Act, it is still consistent with its objectives, and its vegetation clearing would be assessed under Part 4 of the EP&A Act.

5.3.9 *National Parks and Wildlife Act 1974*

Under the *National Parks and Wildlife Act 1974*, the Director-General of the National Parks and Wildlife Service is responsible for the care, control and management of all national parks, historic sites, nature reserves, Aboriginal areas and state game reserves. The Director-General is also responsible under this legislation for the protection and care of native fauna and flora, and Aboriginal places and objects throughout NSW. Under section 4.41 of the EP&A Act, an Aboriginal Heritage Impact Permit under section 90 of the *National Parks and Wildlife Act 1974* would not be required for an SSD. The potential impacts to Aboriginal heritage and native fauna and flora are discussed in Sections 8.1 and 8.2 of this report.

5.3.10 *Biosecurity Act 2015*

The *Biosecurity Act 2015* repealed the *Noxious Weeds Act 1993* and provides a framework for the prevention, elimination and minimisation of biosecurity risks. The Act and supporting Biosecurity Regulation 2017 provide for the establishment and functions of Local Control Authorities for weeds (LGA or County Councils), and weed control obligations on public and private land. The EIS provides for the control of noxious weeds occurring at the Development Site as part of the proposed works (refer to Section 8.1).

5.3.11 *Heritage Act 1977*

The *Heritage Act 1977* defines 'environmental heritage' as those places, buildings, works, relics, moveable objects, and precincts, of State or local heritage significance, and aims to conserve these values. A property is a heritage item if it is listed in the heritage schedule of the local council's LEP or listed on the State Heritage Register; a register of places and items of particular importance to the people of NSW. Under section 4.41 of the EP&A Act, an approval under Part 4 or a permit under section 139 of the *Heritage Act 1977* would not be required for an SSD. The Proposal is unlikely to directly or indirectly affect any items of heritage significance (refer to Section 9.9 of this EIS).

5.3.12 *Conveyancing Act 1919*

The purpose of the *Conveyancing Act 1919* is to amend and consolidate the law of property and to simplify and improve the practice of conveyancing, and for such purposes to amend certain Acts relating thereto.

When land is leased from a landowner and the lease affects part of a lot or lots in a current plan, a subdivision under section 7A of the *Conveyancing Act 1919* is required when the total of the original term of the lease, together with any option of renewal, is more than five (5) years.

The Proposal would require subdivision and consolidation of the existing lots, as described in Section4.2.

5.3.13 *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 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."*

Presently, there are few facilities to recycle lithium-ion batteries in Australia. Therefore, spent batteries are likely to be exported and would require an export permit under section 40 of the Hazardous Waste Act. The Proponent would coordinate this activity and the associated commercial arrangements with the selected battery supplier.

5.3.14 *Mining Act 1992*

The main objective of the *Mining Act 1992* is to encourage and facilitate the discovery and development of mineral resources in New South Wales, having regard to the need to encourage ecologically sustainable development. There is currently one (1) exploration license EL 6093 registered to the Development Site, which recently expired in June 2018. A renewal application is pending and held by the Secretary of DPIE. Consultation with the titleholder clarified that the Geological Survey of New South Wales (GSNSW) has no concerns to raise regarding interactions between EL6093 and the Proposal.

5.3.15 *Protection of the Environment Operations Act 1997*

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

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

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

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

Legal requirements for the management of waste are also established under the POEO Act and the *Protection of the Environment Operations (Waste) Regulation 2005*. Unlawful transportation and deposition of waste is an offence under section 143 of the POEO Act. Waste minimisation and management is addressed in Section 9.11 of this EIS.

5.3.16 *Waste Avoidance and Resource Recovery Act 2001*

The *Waste Avoidance and Resource Recovery Act 2001* includes resource management hierarchy principles to encourage the most efficient use of resources and to reduce environmental harm. The proposal’s resource management options would be considered against a hierarchy of 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 ecologically sustainable development (refer to Section 9.11).

5.3.17 Policies and guidelines

Non-statutory State policies and guidelines used in the environmental assessment, and relevant sections in the EIS, are identified in Table 5-1.

Table 5-1 State policies and guidelines relevant to the assessment of the Proposal

Guideline	EIS section
Biodiversity	
Framework for Biodiversity Assessment (BCD)	Section 8.1
Threatened Species Assessment Guidelines Assessment of Significance (BCD)	
NSW Biodiversity Offsets Policy for Major Projects (BCD)	
Why Do Fish Need to Cross the Road? Fish Passage Requirement for Waterways Crossings (DPI)	
Policy and Guidelines for Fish Habitat Conservation and Management (DPI)	
Heritage	
Aboriginal Cultural Heritage Consultation Requirements for Proponents (BCD)	Section 6.2
Code of Practice for Archaeological Investigations of Objects in NSW (BCD)	Section 8.2
Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (BCD).	Section 8.2
NSW Heritage Manual (BCD)	Section 9.5
Land	
Primefact 1063: Infrastructure Proposals on rural land (DPI)	Section 9.2
Establishing the social licence to operate large scale solar facilities in Australia: insights from social research for industry (ARENA)	Sections 6.3, 8.3 and 9.2
The land and soil capability assessment scheme: second approximation (BCD)	Section 9.1
Noise	
NSW Noise Policy for Industry (EPA)	Section 9.4
Interim Construction Noise Guideline (EPA)	
NSW Road Noise Policy (EPA)	
Transport	
Guide to Traffic Generating Development (RTA)	Section 9.6
Road Design Guide (RMS) & relevant Austroads Standards	
Hazards and Risks	
Hazardous Industry Planning Advisory Paper No.6 – Guidelines for Hazard Analysis (DPIE)	Section 9.7
Multi-Level Risk Assessment (DPIE)	
Water	
Managing Urban Stormwater: Soils & Construction (Landcom)	Sections 9.1 and 8.4

Guideline	EIS section
Floodplain Development Manual (NCD)	Section 8.4
Guidelines for Controlled Activities on Waterfront Land (DPI Water)	
Water Sharing Plans (DPI Water)	
Floodplain Management Plan (DPI Water)	
Guidelines for Watercourse crossings on waterfront Land (DPI Water)	
Waste	
Waste Classification Guidelines (EPA)	Section 9.11
Light	
Dark Sky Planning Guideline: Protecting the observing conditions at Siding Spring (DPIE)	Section 8.3

5.4 LOCAL GOVERNMENT

5.4.1 *Warrumbungle Local Environmental Plan 2013*

The Development Site is located within the Warrumbungle LGA and is subject to the *Warrumbungle Local Environmental Plan 2013* (Warrumbungle LEP). The aims of the LEP are:

(a) to encourage sustainable economic growth and development in Warrumbungle,

(b) to encourage and provide opportunities for local employment growth and the retention of the population in Warrumbungle,

I to encourage the retention of productive rural land for agriculture,

(d) to identify, protect, conserve and enhance Warrumbungle's natural asset (e) to identify and protect Warrumbungle's built and cultural heritage assets for future generations,

(f) to facilitate the equitable provision of social services and facilities for the community,

(g) to provide for future tourist and visitor accommodation in a sustainable manner that is compatible with and will not compromise the natural resource and heritage values of the surrounding area.

The proposed solar farm site is located on land zone– RU1 - Primary Production under the Warrumbungle LEP. Electrical generation is not listed among developments, which are permitted with consent for the zone, however, the ISEPP takes precedence over the LEP and permits solar developments with consent in the RU1 zone.

Siding Spring Observatory – Dark Sky Region

Clause 5.14 of the Warrumbungle LEP outlines conditions regarding the Dark Sky Region for developments on land within the Warrumbungle Shire LGA.

The Proposal is on land 18 km or more from the Siding Spring Observatory, and would not emit light of one (1) million lumens or more during construction and/or operation of the solar farm. Measures would be in place to minimise light emission to maintain Warrumbungle LEP conditions. Refer to Section 8.3.3 for details.

Land zoning

The LEP states that the consent authority must have regard to the development objectives of planning zones identified in the LEP when determining DA. Although for SSD developments this does not act as a prohibition, the consent authority should still have regard to these objectives. The Development Site is located on land zone– RU1 - Primary Production under the Warrumbungle LEP.

The objectives of this zone are:

a) to encourage sustainable primary industry production by maintaining and enhancing the natural resource base

b) to encourage diversity in primary industry enterprises and systems appropriate for the area

c) to minimise the fragmentation and alienation of resource lands

d) to minimise conflict between land uses within this zone and land uses within adjoining zones

For the life of the Proposal, the solar farm would harness a natural resource (solar energy). While the activity would impact on land availability for primary production, the proposal would meet the second and third objects as identified above; allowing diversity in land use appropriate to the area, and it would not fragment resource lands. The proposed solar farm use is fully reversible, and the construction involves limited ground disturbance and therefore can be rehabilitated back to its original potential as land for primary production.

Permissibility of the Proposal is discussed in Section 5.6 below.

5.4.2 Subdivision

The purpose of the *Conveyancing Act 1919* is to amend and consolidate the law of property and to simplify and improve the practice of conveyancing; and for such purposes to amend certain Acts relating thereto.

As discussed previously, subdivision is required for the substation infrastructure and the separation of solar farm land use from agricultural activities. When land is leased from a landowner and the lease affects part of a lot, a subdivision under s.7A *Conveyancing Act 1919* (formerly s.327AA *Local Government Act 1919* now repealed) must occur if the total of the original term of the lease, together with any option of renewal, is more than five years.

A subdivision is not required when the lease affects the whole lot in a current plan. The area leased is identified by lot and DP number.

As indicated above, the proposed solar farm development includes the subdivision of lots, indicated in Figure 4-2, where a purchase or lease of part of these lots is required. The proposed subdivision would satisfy leasing requirements, facilitate the proposed solar farm and allow agricultural activities to continue on a portion of the land. There are no other opportunities for consolidation as the subject lots are held in separate ownership.

Support has been sought from Warrumbungle Shire Council who have stated they would be supportive of the solar farm development, although the Council have not supported the proposed subdivision.

Continued consultation with Council is being undertaken in order to obtain their support in the proposed subdivision and consolidation of lots. Further discussion regarding the permissibility of subdivision in accordance with section 89E(3) of the EP&A Act is addressed in further detail in Section 5.2.1 of this EIS.

Council's letter regarding the subdivision is provided in Appendix C.

5.5 COMMONWEALTH LEGISLATION

5.5.1 *Environmental Protection and Biodiversity Conservation Act 1999*

The EPBC Act provides an assessment and approval process for actions likely to cause a significant impact on Matters of National Environmental Significance (MNES). The nine (9) MNES are:

- World Heritage properties
- National Heritage places
- Wetlands of international importance (listed under the Ramsar Convention)
- Listed threatened species and ecological communities
- Migratory species protected under international agreements
- Nuclear actions (including uranium mines)
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- A water resource, in relation to coal seam gas development and large coal mining development.

Approval by the Commonwealth Environment Minister is required if an action is likely to have a significant impact on a MNES. Assessments of significance based on criteria listed in Significant Impact Guidelines 1.1 issued by the Commonwealth (Commonwealth of Australia 2013) are used to determine whether the proposed action is likely to have a significant impact (i.e. is likely to be considered a ‘controlled action’).

A search of the Commonwealth Protected Matters Search Tool was undertaken – see Section 8.1 of this EIS.

5.5.2 *Native Title Act 1993*

The *Native Title Act 1993* provides a legislative framework for the recognition and protection of common law native title rights. Native title is the recognition by Australian law that Indigenous people had a system of law and ownership of their lands before European settlement. Where that the law recognises the persistence of native title when the traditional connection to land and waters has been maintained in a social and legislative context.

People who hold native title have a right to continue to practise their law and customs over traditional lands and waters while respecting other Australian laws. This could include the protection of important places, making decisions about the future use of the land or waters, and hunting, gathering and collecting bush medicines. When the National Native Title Tribunal registers a native title claimant application, the Aboriginal group seeking native title recognition gain a right to consult or negotiate with anyone who wants to undertake a Proposal on the area claimed.

Native title may exist in areas such as:

- Vacant Crown land
- Some national parks, forests and public reserves
- Some types of pastoral leases
- Some land held for Aboriginal communities
- Beaches, oceans, seas, reefs, lakes, rivers, creeks, swamps and other waters that are not privately owned.

A search of the National Native Title Tribunal Registers on 9 March 2020 found two (2) Native Title Claims or active applications over the Development Site:

- Warrabinga-Wiradjuri #7 (NSD857/2017)
- Gomeroi People (NSD37/2019).

An Aboriginal Cultural Heritage Assessment (ACHA) was undertaken for the Proposal in consultation with interested parties. Refer to Sections 6.2, 8.2 and Appendix E for details.

5.5.3 *Renewable Energy (Electricity) Act 2000*

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

- Encourage the additional generation of electricity from renewable sources
- Reduce emissions of greenhouse gases in the electricity sector
- Ensure that renewable energy sources are ecologically sustainable.

Section 17 of the RE Act defines renewable energy sources eligible under the Commonwealth Government’s RET; this includes solar energy.

Certificates for the generation of electricity are issued using eligible renewable energy sources. This requires purchasers (called liable entities) to surrender a specified number of certificates for the electricity that they acquire. In January 2011, renewable energy certificates were reclassified as either large-scale generation certificates or a small-scale technology certificates following changes to the RET scheme.

The Proposal would need to be accredited as a Renewable Energy Generator to create Renewable Energy Certificates.

5.5.4 Policies and Guidelines

Non-statutory Commonwealth, national and international policies guidelines used in the environmental assessment, and relevant sections in the EIS, are identified in Table 5-2.

Table 5-2 Commonwealth, national and international policies and guidelines relevant to the assessment

Guideline	EIS section
Biodiversity	
Significant Impact Guidelines 1.1 (Commonwealth of Australia 2013) *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy. October 2012. Policy statement: Advanced environmental offsets under the *Environment Protection and Biodiversity Conservation Act 1999*. February 2016. Outcomes-based conditions policy. *Environment Protection and Biodiversity Conservation Act 1999*. March 2016.	Section 8.1, Appendix D
Heritage	
Engage early – guidance for proponents on best practice Indigenous engagement for environmental assessments under the *Environment Protection and Biodiversity Conservation Act 1999* (DoE 2016)	Sections 6.2 and 8.2
Social	
Establishing the social licence to operate large scale solar facilities in Australia: insights from social research for industry (ARENA)	Sections 6.3 and 9.2
Land	
Australian Soil and Land Survey Handbook (CSIRO) Guidelines for Surveying Soil and Land Resources (CSIRO)	Section 9.1
Transport	
Austroads Guide to Traffic Management Part 12: Traffic Impacts of Development (2016)	Section 9.3
Electromagnetic interference	
ICNIRP Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields	Section 9.7

5.6 PERMISSIBILITY AND APPROVALS SUMMARY

5.6.1 Permissibility

The proposed development is defined as a **solar energy system** and is permissible with consent under clause 34(7) of the *State Environmental Planning Policy (Infrastructure) 2007*. Consent may be granted under Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The proposed solar farm would be located within a rural zone (RU1 Primary Production) and the construction, operation, upgrade and decommissioning of the solar farm may be carried out with development consent.

State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP) declares the Proposal to be State Significant Development (SSD) as it is development for the purpose of electricity generating works with a capital cost of greater than $30 million (clause 20, Schedule 1).

Section 4.12(8) of the EP&A Act requires a development application for SSD to be accompanied by an EIS prepared in accordance with the EP&A Regulation. This EIS has been prepared in accordance with Part 4 of the EP&A Act and Schedule 2 of the EP&A Regulation.

5.6.2 Approvals and Licences

The approvals and licence requirements for the proposed solar farm are summarised in Table 5-3. Any additional licences or approvals that may be required would be obtained prior to the commencement of relevant activities.

Table 5-3 Summary of licences and approvals required for the Proposal

Legal instrument	Approving authority	Approval or licence
Environmental Planning and Assessment Act 1979	DPIE	Development approval Subdivision approval
Roads Act 1993	TfNSW, Warrumbungle Shire Council	Castlereagh Highway – TfNSW consent All Weather Road – Warrumbungle Shire Council consent for parts of the road under Warrumbungle Shire Council ownership. In the case of the junction upgrade, TfNSW makes the final decision in consultation with Council.
Electricity Supply Act 1995	Essential Energy	Connection to transmission network
Local Government Act 1993, section 68	Warrumbungle Shire Council	Operate an onsite sewage management system and to draw water from a council standpipe.
Workcover Notification		Exceedance of 10,000 kg of lithium-ion batteries requires Workcover notification.

Note, if it is determined that additional licenses or approvals are required, the Proponent would obtain these prior to commencement of relevant activities.

6 CONSULTATION

6.1 AGENCY CONSULTATION

The SEARs for the Proposal issued by DPIE were prepared in consultation with Warrumbungle Shire Council and relevant State Government agencies. Input from these agencies is provided in Appendix A. The issues raised by the agencies and corresponding sections in the EIS are summarised in Table 6-1.

In preparing the EIS, relevant local, State or Commonwealth Government authorities and infrastructure and service providers were consulted, in line with the SEARs. Emails inviting further input to assessment and approval requirements was sent to agencies which supplied responses attached to the SEARs.

The Proponent has also had direct discussions with agencies, including DPIE, Warrumbungle Shire Council, and Essential Energy. The outcome of this additional consultation with agencies is included in Table 6-1. A complete record of direct consultations with agencies and organisations is provided in Appendix L.

Table 6-1 Agency consultation summary

Issue raised	EIS section
Warrumbungle Shire Council	
Provided the following comments for consideration in the EIS: **Infrastructure** 1. Likely and potential impacts on Council infrastructure, in particular Council's road network and any consequent need for upgrades of increased maintenance. How would this be managed and funded. 2. It would be necessary to eliminate dust that would be generated by sealing the All Weather Road.	9.6 Traffic, Transport and Road Safety
Environmental Management Plan An Environmental Management Plan would be required to be submitted with the Development Application addressing: 1. Traffic and road issues. A traffic impact study would need to be undertaken for all operations. 2. Flora and fauna - if the land is to be cleared or vegetation or fauna habitats are likely to be disturbed	9.6 Traffic, Transport and Road Safety 8.1 Biodiversity The TMP and Fauna Flora Management Plans would be prepared for the CEMP. Mitigation measures in the respective sections would address the need and content of the management plans.
Water resource Use It is unclear if the development requires access to water during either construction or operation. The water supply for Dunedoo is drawn from a well on the southern end of the proposed development area. Due to this, Council has significant concerns if the developer intends on accessing groundwater aquifers in the area.	9.3 Water Use and Water Quality
Landscape 1. The applicant needs to demonstrate to Council that the site will not become a moonscape. The site should be strategically cleared with remnant areas left. 2. The applicant should engage an ecological consultant to look at how the site can be cleared having regard to its environmental sensitivity. 3. An ecological management plan should be prepared with the Development Application.	8.1 Biodiversity 8.3 Visual Amenity and Landscape Character

Issue raised	EIS section
Social and Economic Likely and potential economic and social impacts within the locality and the wider Warrumbungle Local Government Area specifically. To help ensure the future economic stability of the Warrumbungle Local Government Area and better social outcomes through greater solar farm related employment opportunities, Warrumbungle Shire Council would like to see commitment to the community.	9.5 Social and Economic Impacts
Visual Impact Likely and potential impacts of the proposed solar farm on neighbouring properties and the wider Local Government Area as a result of the visual impact and related activities.	8.3 Visual Amenity and Landscape Character
Glare Likely and potential impacts of the proposed solar farm on flight paths of aeroplanes resulting from glare and reflection from the solar panels.	9.7 Hazards The risk of glare is significantly reduced with PV panels, as the surface is designed to absorb light, compared to heliostats which reflect light, given that they are a mirrored surface.
Heritage Council requests that the proponent ensures that cultural heritage is assessed and reported on with appropriate sensitivity and regard for the private nature of traditional and cultural sites. The proponent should not only consider the impact of the development on artefacts and specific sites but also on the wider landscape context of those sites.	8.2 Aboriginal Heritage 9.9 Historic Heritage
Decommissioning Council request that the Environmental Assessment provides a clear and thorough outline of proposed rehabilitation techniques that will be implemented in order that disturbed lands are returned to a state that is equal to that identified prior to commencement of the solar farm activities, at the completion of the solar farm life.	Mitigation measures for decommissioning are provided in all environmental sections, where relevant.
Subdivision Council provided a letter on 15 May 2020 outlining the reasons for not supporting the subdivision of land below the minimum lot size because the proposal fails to meet the Rural Subdivision Principles with regard to the minimisation of rural land fragmentation and likely rural land use conflicts as well as being contrary to rural land subdivision, in that all lots are proposed to	4.2 Subdivision

Issue raised	EIS section
be less than the minimum size permitted for the land, upon which an existing dwelling would also be situated on one of these lots.	
Department of Industry (Crown Lands & Water, and Department of Primary Industries)	
Land An assessment of any impacts to Crown lands and any consent requirements arising from such impacts.	9.2 Land Use
DPIE - Division of Resources and Geoscience (the Division)	
Land Identify the current and in force Exploration Licence 6093 (Act 1992) (EL 6093) held by the Secretary of the Department of Planning and Environment (Figure 1), on a LAND USE/CONSTRAINT map in relation to the proposed Proposal boundary, including electricity transmission infrastructure and biodiversity offset areas. The date of the title search should be referenced. Current mining and exploration titles and applications can be viewed at: http://www.resourcesandenergy.nsw.gov.au/miners-and-explorers/geoscience information/services/online-services/minview. **Consultation** Consult with the titleholder to establish if the Proposal is likely to have a significant impact on current or future extraction of coal resources (including by limiting access to, or impeding assessment of, those resources), and any way the Proposal may be incompatible with current or future exploration. For consultation please contact: +61 (02) 4931 6697 or landuse.minerals@industry.nsw.gov.au. The Division will review the Environmental Impact Statement (EIS) on behalf of the titleholder of EL 6093, the Secretary of the Department of Planning and Environment. In this regard the Division considers the titleholder has been informed of the Project and will provide consultation during the public exhibition of the EIS.	9.2 Land Use
NSW Environment Protection Agency	
The EPA notes that the Proposal is not deemed a scheduled activity in accordance with Schedule 1 of the ***Protection of the Environment Operations Act 1997***. Therefore, the proponent will not be required to apply for an Environment Protection Licence for the Project should planning consent be granted.	

Issue raised	EIS section
Waste management The EIS must incorporate options and strategies for waste minimisation, reuse and recycling. Waste management should be a high priority given the issues that other similar developments in the region have experienced in managing the large volume of waste that is generated during construction. Examples of problematic wastes include large quantities of packing materials such as wooden pallets, metals and plastics.	9.11 Waste
Dust Impacts from dust generated during the construction phase must be identified and appropriate mitigation measures be defined and implemented.	9.10 Air Quality and Climate
Storage of chemicals and fuels The EIS must describe the control measures that are to be implemented to ensure the risk of spills to the environment are minimised. Further information is available at: http://www.environment.nsw.gov.au/water/bundingspill.htm.	9.1 Soils and Landforms 9.3 Water Use and Water Quality
Office of Environment and Heritage (OEH)	
The EIS should assess biodiversity and offsetting, Aboriginal cultural heritage, Historic heritage, Water and Soils, and Flooding. **Biodiversity and offsetting** 1. Biodiversity impacts related to the proposed solar farm are to be assessed in accordance with the BAM and documented in a Biodiversity Development Assessment Report (BDAR). in accordance with the BC Act 2. The BDAR must include information in the form detailed in the BC Act (s 6.12), Biodiversity Conservation Regulation 2017 (s 6.8) and Biodiversity Assessment Method including 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 and 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 (Fund). 3. If requesting the application of the variation rules, the BDAR must contain details of what reasonable steps have been taken to attempt to obtain the required like-for-like biodiversity credits.	8.1 Biodiversity

Issue raised	EIS section
4. 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 BC Act	
Aboriginal cultural heritage The EIS must identify and describe the Aboriginal cultural heritage values that exist across the whole area that will be affected by the proposed solar farm and document these in the EIS. This may include the need for surface survey and test excavation. The identification of cultural heritage values should be guided by the Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW (DECCW, 2011) and consultation with OEH regional officers Where Aboriginal cultural heritage values are identified, 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 EIS. Impacts on Aboriginal cultural heritage values are to be assessed and documented in the EIS. The EIS 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.	8.2 Aboriginal Heritage
Historic heritage 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 • be undertaken by a suitably qualified heritage consultant(s) • include a statement of heritage impact for all heritage items (including significance assessment), • 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), and • where potential impacts have been identified develop an assessment methodology, including research design and results.	9.9 Historic Heritage
Water and Soils The EIS must map the following features relevant to water and soils including: 1. Acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Planning Map).	8.4 Hydrology and Flooding 9.1 Soils and Landforms 9.3 Water Use and Water Quality

Issue raised	EIS section
2. Rivers, streams, wetlands, estuaries (as described in s4.1 of the Biodiversity Assessment Method). 3. Wetlands as described in s4.1 of the Biodiversity Assessment Method 4. Groundwater. 5. Groundwater dependent ecosystems. 6. Proposed intake and discharge locations.	
The EIS must describe background conditions for any water resource likely to be affected by the proposed solar farm, including: 1. Existing surface and groundwater. 2. Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations. 3. Water Quality Objectives (as endorsed by the NSW Government http://www.environment.nsw.gov.au/ieo/index.htm) including groundwater as appropriate that represent the community's uses and values for the receiving waters. 4. Indicators and trigger values/criteria for the environmental values identified at (3) 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.	9.3 Water Use and Water Quality The EIS would include a discussion of potential impacts to surface and groundwater water sources, in Section 9.3. Note that the Proposal would not involve any discharge of water from industrial processes. • No discharges from construction. Water would be used for dust control and concrete curing. Residual water would be lost to evaporation and shallow surface absorption. • No discharge from operation. The main use of water would be for panel cleaning. Residual water would be lost to evaporation, or absorption in surface soils. • No chemicals would be added to water used for construction and operation. The volume of run-off to soils would be minor, as such the risk of soil/groundwater contamination is negligible.
The EIS must assess the impacts of the project on water quality, including: 1. 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	9.1 Soils and Landforms 9.3 Water Use and Water Quality

Issue raised	EIS section
achievement of the Water Quality Objectives over time where they are currently not being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction. 2. Identification of proposed monitoring of water quality.	The mitigation measures would highlight any need for monitoring, although this is anticipated to be unlikely, as there are no discharges to surface water, and volume of water use would be minimal during the operation phase. Any impacts from construction water use would be short term and temporary. Equally volumes use would be minimised and managed through mitigation measures.
The EIS must assess the impact of the project on hydrology, including: 1. Water balance including quantity, quality and source. 2. Effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas. 3. Effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems. 4. Impacts to natural processes and functions within rivers, wetlands, estuaries and floodplains 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). 5. Changes to environmental water availability, both regulated/licensed and unregulated/rules- based sources of such water. 6. 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. 7. Identification of proposed monitoring of hydrological attributes.	9.3 Water Use and Water Quality The mitigation measures would highlight any need for monitoring, although this is anticipated to be unlikely, as the volume of water use during construction would be minimised through implementation of mitigation measures for reduction and re-use. Operational water use would be dedicated to panel cleaning. Volumes would be minimal, in comparison to irrigation, agriculture and town water demand.
Flooding and Coastal Erosion The EIS must map the following features relevant to flooding as described in the Floodplain Development Manual 2005 (NSW Government 2005) including: 1. Flood prone land 2. Flood planning area, the area below the flood planning level. 3. Hydraulic categorisation (floodways and flood storage areas). The EIS must describe flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 1 in 10 year, 1 in 100-year flood levels and the probable maximum flood, or an equivalent extreme event.	8.4 Hydrology and Flooding

Issue raised	EIS section
The EIS must model the effect of the proposed project (including fill) on the flood behaviour under the following scenarios: 1. Current flood behaviour for a range of design events as identified above. This includes the 1 in 200 and 1 in 500-year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change. Modelling in the EIS must consider and document: 1. The impact on existing flood behaviour for a full range of flood events including up to the probable maximum flood. 2. 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. 3. Relevant provisions of the NSW Floodplain Development Manual 2005. The EIS must assess the impacts on the proposed project on flood behaviour, including: 1. Whether there will be detrimental increases in the potential flood affectation of other properties, assets and infrastructure. 2. Consistency with Council floodplain risk management plans. 3. Compatibility with the flood hazard of the land. 4. Compatibility with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land. 5. Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site. 6. 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. 7. 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. 8. Whether the Proposal incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the SES and Council. 9. 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 the SES.	

Issue raised	EIS section
10. Any impacts the development may have on the social and economic costs to the community as consequence of flooding.	
Fire and Rescue NSW (FRNSW)	
FRNSW notes that the Proposal's location is within FRNSW Fire District. In the event of a significant fire event (either on or off-site in close proximity to the development) or hazardous material incident FRNSW is the designated combat agency. Due to the electrical hazards associated with large scale photovoltaic installations and the potential risk to the health and safety of firefighters, both FRNSW and the NSW Rural Fire Service must be able to implement effective and appropriate risk control measures when managing an emergency incident at the proposed site. Recommendations Should a fire or hazardous material incident occur, it is important that first responders have ready access to information which enables effective control measures to be quickly 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 in order 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 system (either in its entirety or partially, as determined by risk assessment) 4. Other risk control measures that may need to be implemented in a fire emergency due to any 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' which is 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 Proposal make contact with the relevant local emergency management committee (LEMC). The LEMC is a committee established by virtue of 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	9.8 Fire and Bushfire

Issue raised	EIS section
emergency procedures for significant hazardous sites within their particular Local Government Area. The contact details of members of the LEMC can be obtained from the relevant local council.	
NSW Rural and Fire Service	
The Development Site is mapped bush fire prone by Warrumbungle Shire Council. NSW RFS is the primary response agency for fighting fires within the site. The NSW RFS shall require the proponent to address how they will manage grass fire impacting on and structural fire emanating from, their proposed solar farm. The EIS shall identify: • potential bush fire threats to the Proposal ; • potential hazards to fire fighters ; • firefighting water supplies; • vehicle access and defendable space around the solar array; • land and vegetation management opportunities; and • proposed emergency management procedures. Ultimately, as part of any consent issued, the NSW RFS will require the proponent to develop a Bush Fire Management Plan, in consultation with the local NSW RFS District Fire Control Centre.	9.8 Fire and Bushfire
Roads and Maritime Services (now Transport for NSW)	
TfNSW notes the Proposal is for the construction and operation of a 55 MW AC solar farm on land north of Dunedoo with frontage to All Weather and Digilah Roads. All Weather Road intersects the Castlereagh Highway (HW18) north of Dunedoo, whilst Digilah Road intersects with the Golden Highway north east of Dunedoo. Vehicular access to the site is proposed via the intersection of All Weather Road and the Castlereagh Highway. TfNSW requests the following issues be addressed in the EIS: 1) A traffic impact study prepared in accordance with the methodology set out in section 2 of the ***RTA's Guide to Traffic Generating Developments 2002*** and including: • hours and days of construction. • schedule for phasing/staging of the project. • traffic volumes:	9.6 Traffic, Transport and Road Safety

Issue raised	EIS section
○ existing background traffic. ○ project-related for each stage of the project including construction, operation and decommissioning. ○ projected cumulative traffic volumes. • traffic volumes are to also include a description of: ○ ratio of light vehicles to heavy vehicles. ○ origin and destination. ○ peak times for existing traffic. ○ peak times for project-related traffic. ○ transportation hours. ○ project related traffic interaction with existing and projected background traffic. • the origin, destination and routes for: ○ employee and contractor light traffic. ○ heavy traffic. ○ over size and over mass traffic. 2) A description of all oversize and over mass vehicles and the materials to be transported. 3) The impact of traffic generation on the public road network and measures employed to ensure traffic efficiency and road safety during construction, operation and decommissioning of the project. 4) The need for improvements to the road network, and the improvements proposed such as road widening and intersection treatments, to cater for and to mitigate the impact of project-related traffic. with regard to possible upgrades to the intersection of All Weather Road and Castlereagh highway, particular attention is to be made to its proximity to the Talbragar river bridge structure and road approaches. 5) Local climate conditions that may affect road safety for vehicles used during construction, operation and decommissioning of the project (e.g. fog, wet and dry weather). 6) Proposed road facilities, access and intersection treatments are to be identified and be in accordance with Austroads guide to road design including safe intersection sight distance (SISD). 7) The layout of the internal road network, parking facilities and infrastructure within the project boundary. 8) Location of proposed Transmission Lines and any required Transmission Line crossings of public roads.	

Issue raised	EIS section
9) A Traffic Management Plan (TMP) developed in consultation with Warrumbungle shire council and roads and maritime. the TMP is to identify and provide management strategies to manage the impacts of projected related traffic including: • haulage of materials to site. • the safe transportation of construction workers from accommodation facilities to site and return.	
SafeWork NSW	
"at this stage of the development, the majority of the scoping work and report do not identify any issues with which SafeWork NSW requires any direct input in terms of the planning process. It is noted however, that potential contaminants are mentioned in the Preliminary Environmental Assessment dated October 2017 (page 24). One of those potential contaminants is specified as asbestos. Our only point to make here is that any Asbestos Containing Material or Naturally Occurring Asbestos needs to be treated in accordance with legislative requirements pursuant to the WHS Act 2011 and WHS Regulation 2017 – once a workplace is established, which would include any construction/demolition phase of the project."	9.1 Soils and Landforms

6.2 ABORIGINAL COMMUNITY CONSULTATION

The consultation with Aboriginal stakeholders including Local Aboriginal Land Councils (LALCs) was undertaken in accordance with clause 80C of the National Parks and Wildlife Amendment (Aboriginal Objects and Aboriginal Places) Regulation 2010 following the consultation steps outlined in the (ACHCRP) guide provided by OEH.

The full list of consultation steps, including those groups and individuals that were contacted and a consultation log is provided in Aboriginal Cultural Heritage Assessment in Appendix E.

As a result of this process, seven (7) Aboriginal parties contacted the consultant to register their interest in the Proposal. The groups who registered interest were the Binjang Wellington Wiradjuri Heritage Survey, Dubbo LALC, Wellington Valley Wiradjuri Aboriginal Corporation, Gallangabang Aboriginal Corporation, Buudang, Muronggialinga and Diram Ngurumbang Consulting (Paul Barton). No other party registered their interest.

After circulation of the assessment methodology to all seven (7) parties listed above. Wellington Valley Wiradjuri Aboriginal Corporation and Gallangabang provided comments. These comments were incorporated into the methodology and other registered parties provided comments.

Initial fieldwork associated with the assessment was undertaken in January 2018. NGH archaeologists and Registered Aboriginal Parties present included Binjang Wellington Wiradjuri Heritage Survey, Diram Ngurumbang Consulting, Buudang, Muronggialinga, Wellington Valley Wiradjuri Aboriginal Corporation and Gallangabang Aboriginal Corporation and several areas for potential in situ subsurface deposits were identified.

In March 2018, an updated assessment methodology was agreed between relevant parties to account for subsurface potential.

A number of further site inspections were carried out as follows, led by NGH archaeologists:

1. May 2018 subsurface testing was undertaken with Binjang Wellington Wiradjuri Heritage Survey, Diram Ngurumbang Consulting, Buudang, Muronggialinga, Wellington Valley Wiradjuri Aboriginal Corporation and Gallangabang Aboriginal Corporation
2. November 2018 intersection upgrade survey – attended by Binjang Wellington Wiradjuri Heritage Survey, Buudang and Muronggialinga.
3. May 2020 TL and Dunedoo Substation was attended by Binjang Wellington Wiradjuri Heritage Survey, Diram Ngurumbang Consulting, Buudang, Muronggialinga, Wellington Valley Wiradjuri Aboriginal Corporation and Gallangabang Aboriginal Corporation

The draft Aboriginal Cultural Heritage Assessment Report was shared with registered parties on 24/7/2020.

6.3 COMMUNITY CONSULTATION

6.3.1 Consultation Requirements

The SEARs issued by DPIE for the Proposal require the Proponent to 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 during the preparation of the EIS. In particular, detailed consultation with affected landowners surrounding the development and Warrumbungle Shire Council is required. The EIS is required to describe the consultation, identify the issues raised, and explain how the issues have been addressed in the EIS.

The Proponent has undertaken consultation with the local community during the planning of the Proposal, in line with the Australian Renewable Energy Agency's (ARENA's) *Establishing the social licence to operate large scale solar facilities in Australia: insights from social research for industry* (ARENA n.d.). Consultation activities were also informed by *Beyond Public Meetings: Connecting community engagement with decision making* (Twyford Consulting 2007). The consultation process was coordinated using a Community Consultation Plan (refer to Appendix L) and is discussed below.

6.3.2 Community Consultation Plan

A Community Consultation Plan (CCP) has been prepared to provide a framework to engage with the community and stakeholders about the Proposal and ensure opportunities to provide input into the assessment and development process are understood. The plan is provided in Appendix L.

The aim of the plan is to:

1. Identify effective methods to inform the community about the Proposal
2. Facilitate engagement with the community, including input into the environmental assessment and development.

The plan identifies:

- Community stakeholders for the Proposal
- Issues/risks related to the engagement of each stakeholder group
- A consultation strategy for each stakeholder group
- A set of activities against the Proposal development timeline to facilitate consultation.

Stakeholders were identified as those potentially being impacted by the solar farm or having an interest in the Proposal. The CCP sets out consultation requirements with interested parties including adjacent neighbours, near neighbours, local businesses, any special interest groups and representative bodies. The CCP also includes strategies for consultation for the local community and the broader community within the region.

The Proposal has been developed iteratively in response to agency and community input. Measures to reduce adverse impacts and promote positive impacts have been incorporated in the EIS. The CCP further aims to ensure that there is ongoing effective liaison with the community.

6.3.3 Community Consultation Activities to Date

The following community consultation activities have been undertaken for the Proposal, consistent with the CCP:

- Development of a website for the Proposal (https://dunedoosolarfarm.com.au/) to provide information and updates. The website went live in November 2017 and has been updated as the Proposal has progressed. An online feedback form can be filled in to submit feedback.
- Establishment of a dedicated email address for feedback to: info@dunedoosolarfarm.com.au
- Direct engagement with neighbours through phone calls, letters, emails, face to face meetings and community open day events:
- The Proponent staff made contact with neighbours to the Development Site during October 2017 to advise of the Proposal and provide staff contact details should people have any further queries. Contact was made via phone calls and door knocking.
- A newsletter was issued in early November 2017 to all addresses in the Dunedoo postcode. The newsletter provided information about the solar farm proposal, a link to the community feedback form on the project website, staff contact details and advised that a

Community Open Day would be held in December 2017, to be advertised in the local press beforehand. The newsletter was made available on the Proposal website.

- A Community Open Day was held in Dunedoo on 12 December 2017 to provide proposal information including maps and photomontages, to gain feedback from the local community regarding the proposal and for the Proponent staff to answer questions. The Open Day was advertised in the Mudgee Guardian newspaper and the Dunedoo Diary newsletter. 50 people dropped in to view plans of the Proposal and provided feedback, including members of Dunedoo Landcare. Community feedback forms were completed by 16 attendees.
- In February 2018, a 2nd newsletter was mailed out to all residences in the Dunedoo post code. This newsletter included an update on the progress of the proposal (reduction in Development Footprint so that the area south of All Weather Road would not be developed), responses to some of the concerns raised and details of the 2nd Community Open Day to be held on 13th March 2018. The newsletter was made available on the Proposal website.
- A 2nd Community Open Day was held in Dunedoo on 13th March 2018 where the Proponent staff provided an updated on the proposal with maps and photomontages and results of the environmental investigations so far. The Open Day was advertised in the Dunedoo Diary newsletter. 28 people attended the Open Day, including members of Dunedoo Landcare. Community feedback forms were completed by six (6) attendees.
- Specific concerns raised by residents were followed up individually by the proponent via face-to-face meetings, phone calls, letters and/or emails.
- In May 2018, the Proponent issued a notice in the Dunedoo Diary newsletter stating that additional field work would be required during May 2018 for the Aboriginal heritage assessment and that the Proponent was looking at minor adjustments to the solar farm layout to minimise impacts to native flora and fauna. The notice stated that Development Application and Environmental Impact Statement was expected to be submitted during July 2018.
- In August 2019, the Proponent issued a notice in the Dunedoo Diary newsletter that the solar farm design now has a smaller footprint than the one presented in the February 2018 Newsletter and at the March 2018 Open Day (to be set back further from Digilah Road, reducing the visual impact) and that the submission date was delayed to October 2018.
- In December 2018, the Proponent issued a notice in the Dunedoo Diary newsletter that the project had been further delayed due to complications around the proposed grid connection. The notice advised that the submission of the Development Application had been delayed until early 2019.
- In February 2020, the Proponent issued a notice in the Dunedoo Diary newsletter which advised that the plans for the Dunedoo solar farm proposal were on hold for most of 2019 due to uncertainties around connection to the electricity grid. The notice stated that the issues had been resolved and the Proponent was progressing the Proposal again with the Development Application for the solar farm expected to be submitted during March 2020.
- Andrew's Direct contact with immediate neighbours to the project in February 2020 – door knocking and letter to provide a verbal update on the project. Refer to Appendix C.
- In March 2020, a 3rd newsletter was mailed out to residences in the Dunedoo postcode. The newsletter included a map of the revised layout for the solar farm and noted that since 2018, the size of the solar farm footprint had been reduced so that there is now a setback between Digilah Road and the proposed solar panels. The map illustrated two (2) 66-kV overhead Transmission Line options being considered to connect to Essential Energy's network. The newsletter included details of the 3rd Community Open Day to be held on 26 March 2020. The newsletter was made available on the Proposal website.

- The 3rd Community Open Day planned for 26 March 2020 was postponed until further notice due to the COVID-19 government-imposed lockdown. the Proponent informed the community via the Proposal website that the project team is still conducting consultation through email, phone calls and tele-conferencing until the lodgement of the EIS.
- On July 22nd, 2020, the Proponent performed door knocking and letter drop on the ten (10) closest residences to the Dunedoo Substations. This was to update them on the project generally and provide some more specific information about the potential for construction noise impacts that may occur at the dwellings.
- Shortly after submission to the DPIE, a 4th newsletter will be mailed out to residences in the Dunedoo postcode. This newsletter will include an update on the proposal, information about the SSD process, timing for the public exhibition of the EIS and places where the EIS will be available for viewing during the public exhibition period. The newsletter will provide information about making a submission about the Proposal. The newsletter will be made available on the Proposal website.

The Proponent has also provided a sign-up form for contractors interested in working on the Proposal. This Contractor's Work Book has already received interest from local traders, such as electricians, construction managers, building/ maintenance contractors, and construction material suppliers.

Interested parties would be contacted by the Proponent in the construction and operation planning stages of the Proposal. The purpose of this form is to enable direct participation of local businesses in the construction and operation phases of the Proposal, thereby ensuring an economic uplift to the township and locality and maintaining community involvement in the lifecycle of the Proposal.

6.3.4 Results of Community Consultation

Community Open Days were held in the Jubilee Hall, Dunedoo on 12 December 2017 and 13 March 2018 covering the Proposal. A 3rd event planned for 26 March 2020 was cancelled due to COVID-19 concerns where community feedback forms were made available online.

Representatives from the Proponent, Andrew Wilkinson, Jenny Walsh were present to provide information and answer questions for the events held in Dunedoo. The following summarises the results of community consultation:

- 50 people attended the 1st Open Day. 47 were supportive of the Proposal while 1 undecided and 2 objected; one of them also being an online objector.
- 28 people attended the 2nd Open Day. The majority of attendees were supportive of the Proposal.
- 23 comment forms (16 from the Open Day and 7 from online) have been received to date. All Open Day comments were supportive. 6 of the 7 online comments were supportive (1 objector, also attended the 1st Open Day).

A letter of objection to the Proposal was also published in the Dunedoo Diary (29 November 2017) and Mudgee Guardian (5 December 2017). The details of this letter are provided in Table 6-2.

Copies of advertisements, letters, and community feedback forms are all provided in Appendix L.

Community and resident concerns have been specifically addressed in the Proposal design and the environmental assessment, and mitigation measures have been identified where appropriate. Feedback obtained from these consultations has also been incorporated in relevant sections of the assessment.

The questions and concerns raised at the Open Days, via the community feedback forms, and during other consultations are summarised in Table 6-3, which also shows the relevant sections of the EIS where concerns are addressed.

Table 6-4 provides a summary of recommendations and suggestions from the stakeholders, which would help the Proposal contribute to the community's values.

The main concerns raised in the Open Days are echoed in the comment forms. A review of the community feedback forms reveals that the important values are community/family ties, history and economy. There is a great deal of appreciation for the natural values, habitats and landscape of the area. The greatest benefit the community hopes to achieve from the Proposal is economic uplift in the form of jobs and commerce. The main concerns are impact on land value/land use and views. Generally, the community is favourable to renewable and clean energy production and is keen for the Proponent to develop mechanisms that would encourage community involvement by way of education, training and site visits/viewing.

Table 6-2 Concerns raised in letter to the press

Concern	Response	EIS reference
Use of word Farm. The Proposal is an industrial complex, not a rural industry	There is no defined nomenclature for the word Farm. It is not exclusive to agricultural production and is applicable to any processing of a material to produce an economic good. Equally, industrial complexes and rural industries have no strict definitions. Agricultural practices are becoming more and more industrialised, in order to meet growing population demands. Mechanisation, automation, specialisation of equipment, chemical and pharmaceutical inputs, genetically modified foods and intensive animal farming (chicken battery farms, cattle feedlots) are common practices in commercial scale farms. Such production facilities can be described as industrial complexes.	2.1 Proposal Objectives
Views: Maintenance of rural outlook is an important amenity of the district. The area proposed is 200ha in full view of the township and surrounding residences. Would dominate views of the countryside and destroy rural outlook.	Visual impact of the proposed solar farm would be limited to specific viewpoints and any potential impact to the landscape character would be low.	8.3 Visual Amenity and Landscape Character
Proposal fails to meet the following Warrumbungle DCP objectives: • **Protect the amenity of the locality**	The Proposal has been designed to comply with Warrumbungle DCP and LEP objectives throughout its iterations.	2.2.2 Alternative Locations and Layouts 5.4.1 Warrumbungle LEP 8.1 Biodiversity

Concern	Response	EIS reference
• **Ensure the development complements the natural characteristics of the area** • **Achieve design that complements the landscape and does not cause adverse visual impact** • **Ensure the development does not adversely impact on the existing and future agricultural and rural industry potential of the land** • **Minimise possible impacts on threatened species and their habitat**		8.3 Visual Amenity and Landscape Character 9.2 Land Use
The Proposal is on Prime agricultural land, on the river flats of Talbragar River. Prime land should be reserved for agricultural purposes, and not coal seam gas and also not solar. The solar farm can be located anywhere else.	The Proposal would be located on land north of said river flats. Approximately 0.01% of the Proposal is classified as Prime agricultural land, where this area largely refers to the land surrounding the proposed TL easement. Operation of the main solar array area would still be compatible with grazing activities as opposed to activities such as coal seam gas extraction.	2.2.2 Alternative Locations and Layouts 9.2 Land Use 11.11 Site Suitability
Reflection and glare. Drivers travelling east on Mendooran Rd towards Dunedoo, would have a direct view of the solar farm for several kms. This is a road hazard.	PV solar panels are designed to be light-absorbent and low-lying, and would not result in hazardous glare for nearby motorists. Comparative reflection analysis has shown that solar panels have a lower reflective index than crops/grassland and forest.	8.3 Visual Amenity and Landscape Character 9.7 Hazards

Concern	Response	EIS reference
Residents of dwellings on the Corumbene farm would be affected by glare as they have direct views onto the field.	PV solar panels are designed to be light-absorbent and low-lying, and would not result in intrusive glare for nearby residents. Modern solar panel construction has shown to result in negligible reflection differences between existing roofs and building surfaces.	8.3 Visual Amenity and Landscape Character 9.7 Hazards
The endangered black swan, nest in a low-lying part of the Corumbene property, adjacent to the solar farm site. The glare would impact on the birds	The Black Swan is not an endangered species under the BC Act nor EPBC Act. Any nesting communities would unlikely be impacted by glare as the Proposal would be sited on higher ground than the river flats of the Talbragar River.	8.3 Visual Amenity and Landscape Character 9.7 Hazards
The Proposal is contrary to the proper planning and sustainable development of the area.	The Proposal has been designed to comply with the relevant planning framework throughout its iterations, including the Warrumbungle Shire Economic Development & Tourism Strategy 2019-2023.	2.3 Proposal Benefits 5 Planning Context
Feb 13th meeting with the Proponent, to go over the issues raised in the letter.	The EIS is being prepared in accordance with the EP&A act, SEARs and Warrumbungle Shire LGA requirements.	1.4 The State Significant Development Process 5 Planning Context

Table 6-3 Questions and concerns raised by residents and the community

Question or concern	EIS reference
Community Impacts I would like to see the workers live in Dunedoo and support Dunedoo and not just use the community and bleed it dry. I would like to see the company be supportive of the local community and not just bleed it dry.	9.5 Social and Economic Impacts
Effects on Land Use or land values	8.3 Visual Amenity and Landscape Character 9.2 Land Use
Effects on natural areas and habitats	8.1 Biodiversity 8.3 Visual Amenity and Landscape Character 9.2 Land Use
Visual Impacts	8.3 Visual Amenity and Landscape Character
Noise during construction or operation Noise from inverters	9.4 Noise and Vibration Impacts
Biodiversity offsets. Especially riparian/wetland areas	8.1 Biodiversity
What happens after decommissioning?	4.6 Decommissioning and Rehabilitation
Traffic during construction or operation	9.6 Traffic, Transport and Road Safety
Effects on Recreation opportunities	9.5 Social and Economic Impacts
Effective vegetation screening	8.1 Biodiversity 8.3 Visual Amenity and Landscape Character
Effect on power bills	2.3.1 Electricity Reliability and Security
Should not be sited on good agricultural land	2.2.2 Alternative Locations and Layouts 9.2 Land Use 11.11 Site Suitability

Table 6-4 Stakeholders recommendations and suggestions for the Proposal

Recommendations	EIS reference
Consider a tourism aspect to this project- a viewing platform with interpreting signage. **Public education and access to wetland/river** **Support local school in possibly science/engineering field through a partnership.**	9.5 Social and Economic Impacts Recommendation is included as a mitigation option to assess the feasibility to implement a program to open the solar farm for visits and education events.
If there is no livestock between panels, please consider bee friendly species of flowering plants to help the bee populations, which are so important for pollination and a water source for them.	8.1 Biodiversity Recommendation is included as a mitigation option.
Please engage local businesses in construction phase and train up locals for the ongoing maintenance phase.	Contractor's Work Book has been set up for interested businesses and members to sign up
Sponsor local groups. e.g. Landcare educational/restoration projects.	9.5 Social and Economic Impacts Recommendation is included as a mitigation option. The Proponent is consultation with Warrumbungle Shire LGA to provide a fund to support local community programs
Supporting the local shops and trades	9.5 Social and Economic Impacts Contractor's Work Book Direct employment and indirect employment throughout the Proposal Lifecycle, would help contribute to the local economy.
Include the local people in decision making, so they know and understand what is happening	Community Consultation, notification and feedback would be implemented throughout the Proposal Lifecycle.
Maybe a project where locals can access cheap panels through mass purchase and financial support for installation for clubs and sporting venues	The Proponent would consider providing information to private individuals that could help with their decision making.

Recommendations	EIS reference
	Consideration to assist/support with commercial scale installations would be considered on a case by case basis.

6.3.5 Continued Engagement

Engagement activities would continue throughout the determination period, as set out in the CCP (refer to Appendix L).

The CCP would be reviewed regularly, as well as during key transitions between different phases of the proposed development (e.g. prior to construction or operation). The CCP would continue to guide engagement activities at all phases of the Proposal, ensuring that engagement is appropriate and in line with good practice, and maintains community support for the Proposal.

7 IMPACT ASSESSMENT

7.1 IMPACT ASSESSMENT APPROACH

The environmental issues relevant to the Proposal were reviewed in light of potential impacts, site values and planning requirements. Key issues were identified based on potential impact and risk, considering the nature of potential impact, the likelihood of impact and the sensitivity of the local environment. The risk assessment approach is consistent with AS/NZ ISO 14004:2004 (Environmental Management Systems) and AS/NZ ISO 13000:2009 (Risk Management).

The risk rating is a factor of the *likelihood* of the impact occurring and the *consequence* of the impact. Depending on the combination of consequence and likelihood values, potential overall risk ratings range from low to extreme (refer Table 7-1). High to extreme risks (termed 'key risks') warrant a higher level of investigation in the EIS. Low to medium risks are addressed in less detail. Where uncertainty exists, a higher rating has been applied.

Table 7-1 Risk assessment rating matrix

Likelihood	Consequence				
	Negligible	**Minor**	**Moderate**	**Major**	**Catastrophic**
Remote	Low	Low	Low	Medium	Medium
Unlikely	Low	Low	Medium	High	High
Possible	Low	Medium	High	Very High	Very High
Likely	Medium	High	Very High	Very High	Extreme
Almost certain/ inevitable	Medium	High	Very High	Extreme	Extreme

Table 7-2 summarises the results of the risk assessment applied to the Proposal. 16 environmental issues were investigated. The risk rating is unmitigated, based on a 'worst case scenario' prior to assessment and development of avoidance or mitigation measures. A mitigated risk assessment has been discussed in each environmental issue which takes into account the solar farm's proposed avoidance or mitigation measures.

Table 7-2 Risk assessment of environmental issues

Environmental risk	Likelihood	Consequence	Unmitigated risk rating	Mitigated risk rating
Biodiversity	Likely	Moderate	Very High	Low
Aboriginal heritage	Possible	Moderate	Very High	Low
Visual and landscape	Possible	Moderate	Very High	Low
Hydrology and Flooding	Possible	Moderate	High	Low
Soils and landforms	Possible	Moderate	Medium	Low
Land use and resources	Likely	Minor	Medium	Low

Environmental risk	Likelihood	Consequence	Unmitigated risk rating	Mitigated risk rating
Water use and water quality	Unlikely	Moderate	Medium	Low
Noise and vibration	Possible	Minor	Medium	Low
Social and economic impacts	Possible	Minor	Medium	Low
Traffic, transport and road safety	Unlikely	Moderate	Medium	Low
Hazards	Unlikely	Moderate	Medium	Low
Fire and Bush fire	Unlikely	Moderate	Medium	Low
Historic heritage	Unlikely	Moderate	Medium	Low
Air quality and climate	Unlikely	Minor	Low	Low
Waste	Unlikely	Minor	Low	Low
Cumulative impacts	Possible	Minor	Medium	Low

7.2 KEY ISSUES

The risk assessment indicates four (4) key environmental issues for the purposes of the impact assessment:

- Biodiversity
- Aboriginal heritage
- Visual amenity and landscape character
- Hydrology and flooding.

Refer to Section 8 below for a discussion of the key above issues.

8 ASSESSMENT OF KEY ISSUES

8.1 BIODIVERSITY

8.1.1 Approach and Methods

A specialist Biodiversity Development Assessment Report (BDAR) was prepared by NGH to investigate and assess the potential impacts of the Proposal on biodiversity according to the NSW Biodiversity Assessment Methodology (BAM).

The Proposal conforms to the definition of a *site-based development* under the BAM. The site-based development assessment methodology has therefore been used in this BAM assessment.

The BAM assessment ID is 00009114/BAAS17051/18/00009115 and the assessment type selected was 'Major Project'. This section summarises the values entered into the Landscape values section of the BAM calculator.

The aim of this BDAR is to address the requirements of the BAM, as required in the SEARs and summarised below.

Secretary's Environmental Assessment Requirement	Where addressed
• **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);** • **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;**	Whole Report.

No specific considerations for any threatened species, populations or communities were specified in the SEARs or by the NSW BCD.

Refer to Appendix D for the full methodology including survey efforts.

8.1.2 Existing Environment

The Subject Land is within the Interim Biogeographical Regionalisation of Australia (IBRA) subregion *Inland Slopes* within the broader IBRA region *South Western Slopes,* and comprises of several large flat paddocks, which have been largely cleared for cropping and mixed farming purposes. Cleared areas are commonly cropped with improved pasture species such as Lucerne, Forage Oats and sub-tropical grasses and legumes that have been fertilised accordingly. Remnant vegetation is heavily modified throughout the Subject Land and generally derived from a community of Yellow box alluvial woodland and Fuzzy box Woodland. The remnant areas have been highly disturbed and lack native understory due to grazing and pasture improvement practices. The Talbragar River is a perennial stream that runs to the South of the Subject Land, just to the North of the Dunedoo township.

The land immediately surrounding the Development Site includes cropping and grazing land, crown land, Essential Energy substation and Dunedoo township, south of the Talbragar River.

Talbragar River (7th order stream) occurs to the south of the Development Site. The Talbragar River flows generally west-southwest and into the Macquarie River, reaching the confluence with the Macquarie River near Dubbo.

No wetlands occur within or adjacent to the Subject Land. The closest Nationally Important Wetland downstream from the Subject Land is the Macquarie Marshes located over 200 km northwest.

Two (2) man-made dams occur within the Development Site for stock. Habitat at these dams is limited and lack fringing vegetation and/or aquatic vegetation.

The landscape within the Development Site has been heavily cleared and lacks significant connectivity. However, remnant vegetation does occur in small isolated patches within the farmed landscape. The main source of connectivity throughout the broader region surrounding the Proposal occurs along the watercourse to the South of the Development Site, Talbragar River, which supplies permanent to semi-permanent water, contains a predominately native understorey and lined with sparsely distributed *Eucalyptus* and *Casuarina* species.

One (1) Mitchell Landscape occurs within the Development Site, *Talbragar - Upper Macquarie Terrace Sands and Gravels*. This Mitchell landscape has a total of approximately 87,270 ha within NSW and has a percentage cleared estimate of 93%. A description of the general characteristics of this landscape are provided below.

'Sandy Quaternary alluvial sediments on the floodplains and terraces of the Talbragar River, general elevation 350 to 500m, local relief 30 to 40m. Red-brown and red-yellow earthy sands with some yellow texture-contrast soils on the valley margins. River red gum (Eucalyptus camaldulensis) along the channels, Yellow box (Eucalyptus melliodora) and Rough-barked apple (Angophora floribunda) with White cypress pine (Callitris glaucophylla) on the plain'.

This Mitchell Landscape was selected within the BAM Calculator for the Proposal.

Percent Native Vegetation Cover

The Percent Native Vegetation Cover within the 1,500-metre buffer comprising the Development Site was calculated to be 8%. This number was entered into the BAM calculator for the Proposal. A summary of the calculations is as follows

- The total area of the buffer, including the Development Footprint, is 2,040 ha.
- The total area of native vegetation mapped within the buffer, including the Development Site, is 158.23 ha.
- Current native vegetation cover is therefore 7.75% (rounded to 8%).

Refer to Figure 8-1 for biodiversity elements in the vicinity of the site.

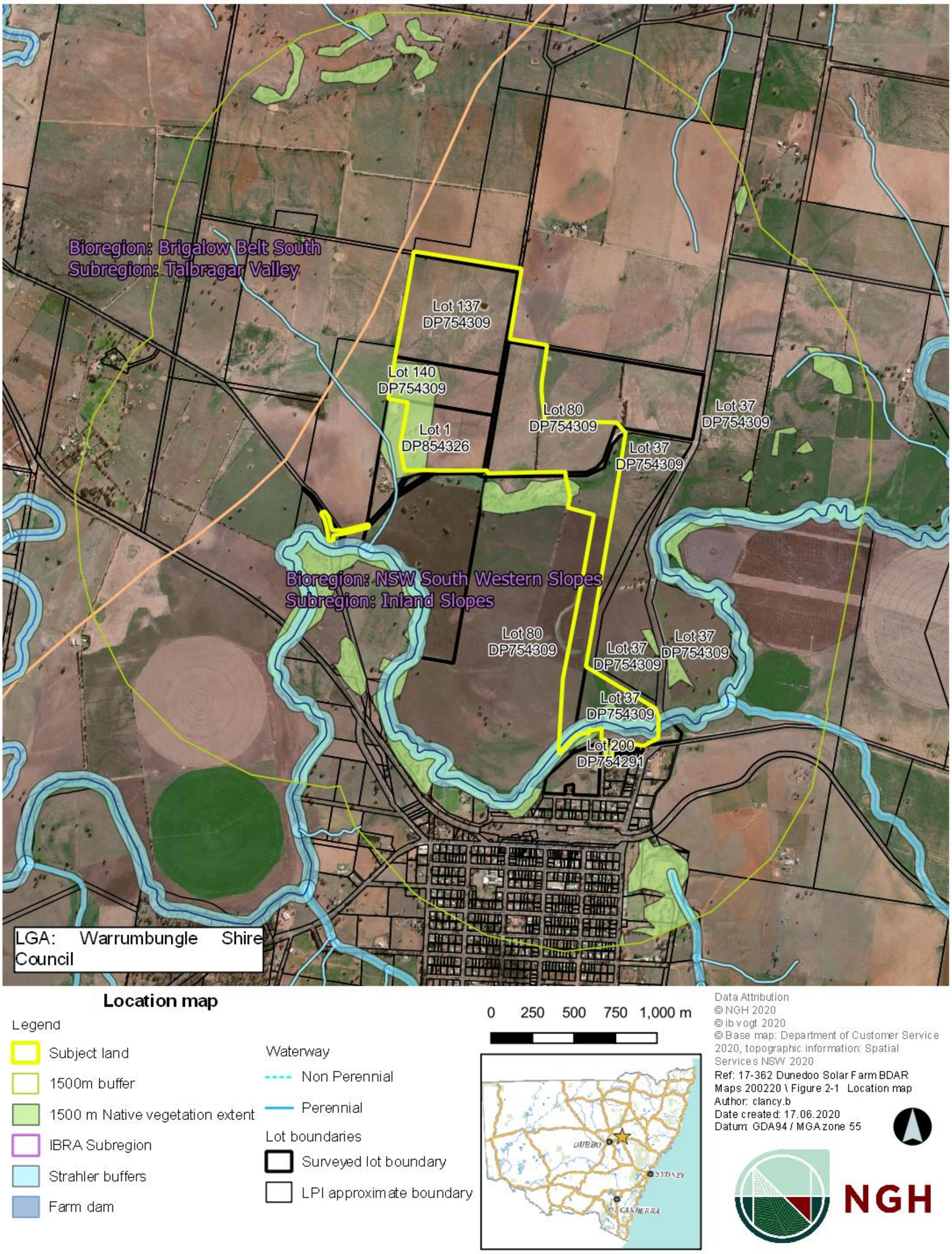

Figure 8-1 Subject Land biodiversity elements

Native Vegetation

A search was undertaken of BCD Vegetation Information System (VIS) database and NSW SEED mapping to access existing vegetation mapping information within the Development Site. Two (2) relevant existing vegetation maps were assessed:

- Central West and Lachlan Catchments Vegetation Mapping by the Department of Environment and Conservation (2017).
- SEED Mapping – Sharing and Enabling Environmental Data (2017) for the Central West and Lachlan Region.

Flora surveys were undertaken in December 2017. The entire Development Site was surveyed by car and foot on the 5th – 7th December 2017 by one (1) Senior Ecologist and one (1) Fauna Ecologist from NGH to determine the Plant Community Types (PCTs) and habitat on the Development Site.

PCTs were identified using native species present, landforms and physiography and its location in the IBRA subregion. The Subject Land was then stratified into areas of similar condition class to determine vegetation zones for each PCT. Vegetation integrity plots (20 x 50 metres) were established in each vegetation zone. In total, 19 plots were undertaken throughout the Development Site. Data was collected on the composition, structure and function of the vegetation and collected utilising the methodology outlined within the BAM.

Approximately 8.4 ha of native vegetation occur within the Development Site:

- 2.18 ha PCT 281 Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion
- 1.86 ha PCT 201 Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion
- 4.36 ha PCT 78 River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion

Eight (8) paddock trees occur within the Development Site, derived from PCT 78 - River Red Gum riparian tall woodland / open forest. Paddock trees are defined as:

- A tree or a group of up to three trees less than 50 metres apart from each other, and
- Over an exotic groundcover, and
- More than 50 metres away from any other living tree greater than 20 cm DBH, and
- On Category 2 land surrounded by Category 1 land (as defined by the BAM, 2017).*

*The regulatory land mapping has not yet been published under the new LLSA Act. During the transitional period, land categories are to be determined in accordance with the definitions of regulated land in the LLSA Act. In this case, the paddock trees are surrounded by land that has been cleared of native vegetation since January 1990.

Paddock trees throughout the Development Site were assessed under the streamlined assessment module- clearing paddock trees (Appendix 1 of the BAM). They are considered both in terms of ecosystem credits and as habitat for threatened species and any credits generated are additional to those created by applying the full BAM.

Exotic Vegetation

Approximately 105 ha of the Subject Land, or approximately 66%, occurs as cleared agricultural land used for rotational cropping and grazing. Evidence of cropped areas occurs and is dominated by Consol love grass, Bambasti panic, Premier digit, Biserrula as well as areas of Lucerne. Additionally, areas of improved pasture contain species such as *Digitaria eriantha, Panicum coloratum* and *Biserrulla pelecinus* as well as *Medicago sativa*.

The BC Act determines that the BAM is to exclude the assessment of the impacts of clearing native vegetation on Category 1 - exempt land. As Category 1 Land regulatory maps are not yet publicly available, an assessment of whether the cleared areas meet the definition of the Category 1 - exempt land was undertaken (Appendix A of the BDAR). Based on 2017 Landuse Dataset (OEH, 2017), NSW Woody Vegetation extent dataset (OEH, 2015), Native Vegetation Regulatory Mapping and historical aerial Imagery, 105 ha was considered to be classed as Category 1 Land (refer to Figure 8-2). These areas are exempt from further assessment in the BAM with exception to prescribed impacts as stated in section 6.3 of the BC Act.

Refer to Figure 8-3 and Figure 8-4 for the extent of native and exotic vegetation within the Development Site.

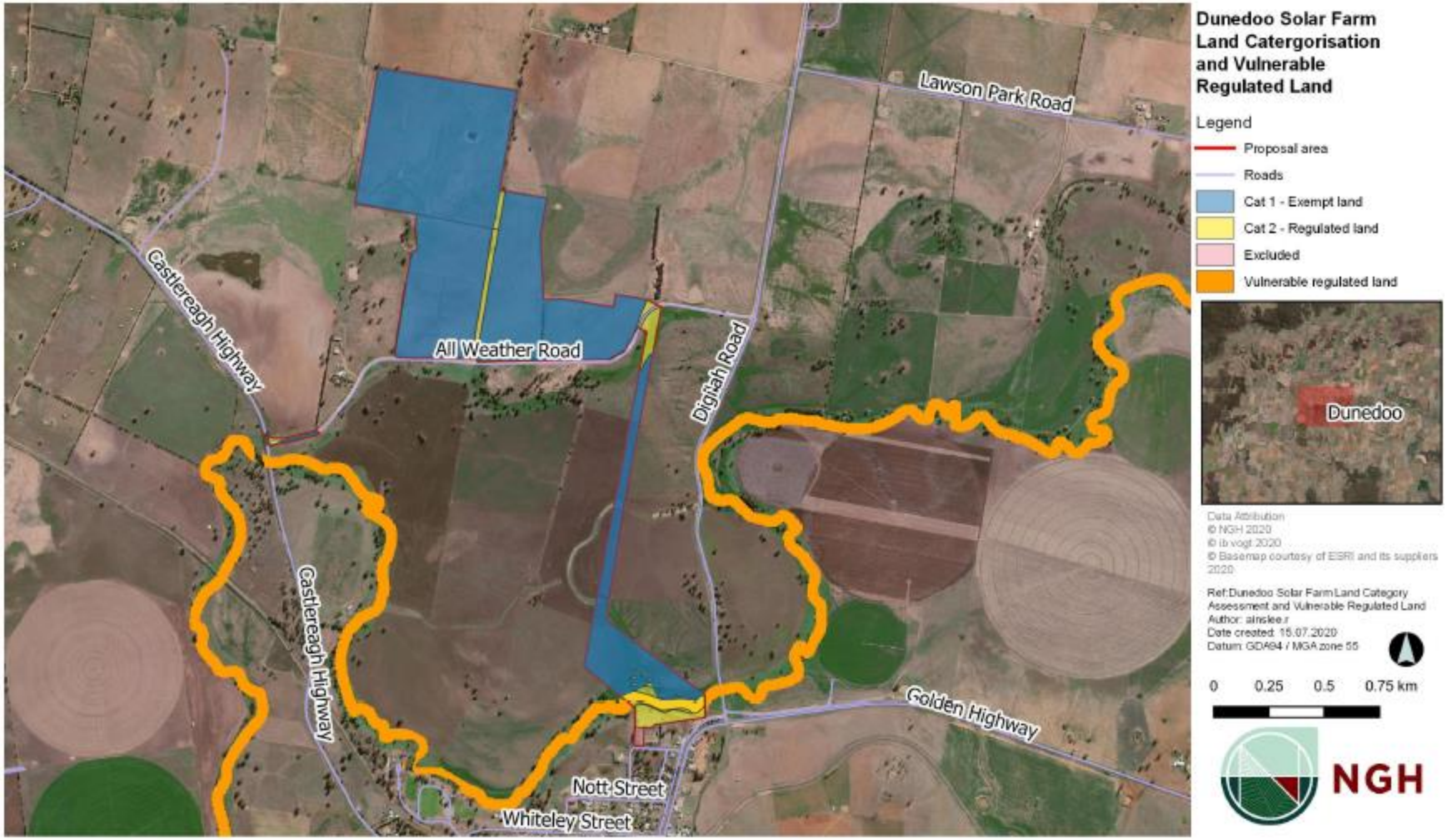

Figure 8-2 Proposal land categorisation

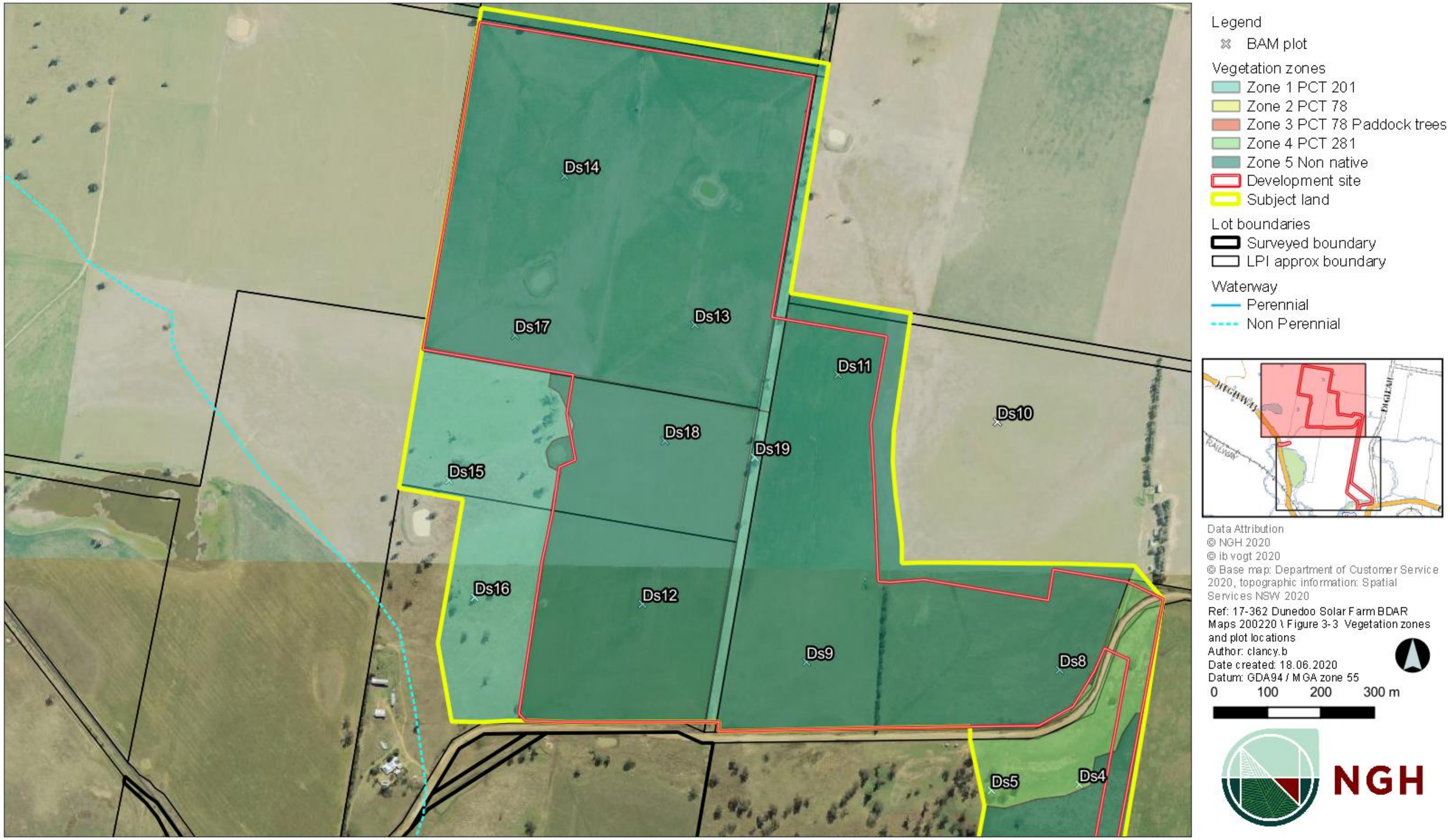

Figure 8-3 Native vegetation extent within the Development Site (north)

Figure 8-4 Native vegetation extent within the Development Site (south)

Threatened Ecological Communities

PCTs associated with two (2) TECs listed under the BC Act and one (1) under the EPBC Act occur within the Development Site.

- *White Box, Yellow Box, Blakely's Red Gum Grassy Woodland* (BC Act-Endangered and EPBC Act-Critically Endangered)
- *Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions* (BC Act-Endangered).

Small areas of moderate-condition PCT 281 (2.18 ha) is considered to form part of the *White Box Yellow Box Blakely's Red Gum Woodland* occur within the Development Site. Additionally, a small area of PCT 201 (1.86 ha) is considered to be consistent with Fuzzy Box Woodland TEC occurs within the Development Site. All vegetation zones associated with PCTs 201 and 281 within the Development Site are considered to constitute TECs within the BAM Calculator.

Vegetation Integrity Assessment

The vegetation zones that would be impacted by the Proposal, as entered into the BAM calculator, their condition class, number of plots undertaken within them and their current integrity score, as determined by the BAM calculator, are provided in Table 8-1.

Table 8-1 Table of current vegetation integrity scores for each vegetation zone within the Development Site.

Zone ID	Composition score	Structure score	Function score	Vegetation Integrity Score
1	65.7	60.6	25.6	46.7
2	57.9	54.8	32.6	46.9
3				Paddock Tree
4	67.1	78.6	20.1	47.3
5				Non-native

Threatened Species

The BAM Calculator returned the following credit species types as being associated with PCTs present on the Development Site:

- Ecosystem credit species
- Species credit species
- Candidate species.

Refer to Appendix D for the full species lists.

Ecosystem Credit Species

One (1) species, Barking Owl *Ninox connivens*, has a patch size limitation which requires patches of 25 - 100 ha, which are larger than those within the Subject Lands and locality. However, a precautionary approach has been taken, and the species has been retained within the list of species requiring assessment as a result of proximate records to the Development Site.

The BAM calculator states that geographic restrictions exist for Rosenberg's Goanna *Varanus rosenbergi*. The site does not occur within the area identified within the geographic restriction for the species, thus the species has been excluded from further assessment. No other ecosystem species have been excluded from assessment.

Species Credit Species

The following species credit species have been excluded from further assessment based on the habitat features present at the Development Site. Table 8-2 below details habitat features required.

Table 8-2 Species credit species excluded based on habitat features

Species Credit Species	Habitat components and abundance on site	Reason for exclusion
Spear-grass ***Austrostipa wakoolica***	Occurs west of Cowra	Site is approximately 250 km north-northeast of Cowra.
Brush-tailed Rock-wallaby ***Petrogale penicillata***	Habitat constraint is listed as land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliff lines.	None of these features occur within 1 km of site.
Eastern Bentwing-bat ***Miniopterus schreibersii oceanensis***	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding	None of these features occur within site.
Grey-headed Flying-fox ***Pteropus poliocephalus***	Breeding camps	No breeding camps occur within site.
Large-eared Pied Bat ***Chalinolobus dwyeri***	Cliffs - Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.	None of these features occur within 2 km site.
Pink-tailed Legless Lizard ***Aprasia parapulchella***	Rocky Areas - Or within 50m of rocky areas	No rocky areas within site.
Regent Honeyeater ***Anthochaera phrygia***	Mapped Important Areas	Site does not occur within mapped important area.
Swift Parrot ***Lathamus discolor***	Mapped Important Areas	Site does not occur within mapped important area.
Tarengo Leek Orchid ***Prasophyllum petilum***	Known in subregion east of Binalong, south and east of Boorowa.	Site does not occur east of Binalong, south and east of Booroowa.

Furthermore, under section 6.4.1.17 of the BAM, a species credit species can be considered unlikely to occur on a Development Site (or within specific vegetation zones) if, following field assessment, it is determined that the habitat is substantially degraded such that the species is unlikely to utilise the Development Site (or specific vegetation zones).

No species credit species have been excluded from assessment based on habitat quality. Non-native vegetation has been excluded from assessment under the BAM, and all remaining vegetation is considered to constitute potential habitat for species credit species.

Candidate Species

The species listed in Table 8-3 are those that are considered to have habitats present at the Development Site. All species have been surveyed for within the correct survey window, utilising appropriate methodologies. Details of the survey methodologies and results are provided for each surveyed species are provided below.

Targeted survey locations are mapped on Figure 8-3 and Figure 8-4. Species polygons have been defined as well for the species present on the site as mapped on Figure 8-3 and Figure 8-4.

Table 8-3 Summary of species credit species surveyed at the Development Site

Candidate Species	Biodiversity risk weighting	Survey Period	Assumed to occur/survey/ expert report	Present on site?	Species polygon area or count
FAUNA					
Bush Stone-curlew ***Burhinus grallarius***	2	Any	Surveyed Dec 2017 Surveyed September 2018	No	0
Gang-gang Cockatoo ***Callocephalon fimbriatum***	2	Oct - Jan	Surveyed Dec 2017 Surveyed September 2018	No	0
Glossy Black Cockatoo ***Calyptorhynchus lathami***	2	Mar - Aug	Surveyed August 2018	No	0
Eastern Pygmy-possum ***Cercartetus nanus***	2	Any	Surveyed Dec 2017 Surveyed September 2018	No	0
White-bellied Sea Eagle ***Haliaeetus leucogaster***	2	Jul - Dec	Surveyed Dec 2017	No	0
Black-breasted Buzzard ***Hamirostra melanosternon***	1.5	Sep - Jan	Surveyed Dec 2017	No	0
Little Eagle ***Hieraaetus morphnoides***	1.5	Aug - Oct	Surveyed August 2018	No	0
Pale-headed Snake	2	Nov - Mar	Surveyed Dec 2017	No	0

Candidate Species	Biodiversity risk weighting	Survey Period	Assumed to occur/survey/ expert report	Present on site?	Species polygon area or count
Hoplocephalus bitorquatus					
Booroolong Frog ***Littoria booroolongensis***	2	Nov - Dec	Surveyed Dec 2017	No	0
Major Mitchell's Cockatoo ***Lophochroa leadbeateri***	2	Sep - Dec	Surveyed Dec 2017	No	0
Square-tailed Kite ***Lophoictinia isura***	1	Sept - Jan	Surveyed Dec 2017	No	0
Barking Owl ***Ninox connivens***	2	May - Dec	Surveyed Dec 2017	No	0
Powerful Owl ***Ninox strenua***	2	May - Aug	Surveyed August 2018	No	0
Squirrel Glider ***Petaurus norfolcensis***	2	Any	Surveyed Dec 2017	No	0
Brush Tailed Phascogale ***Phascogale tapoatafa***	2	Any	Surveyed Dec 2017	No	0
Koala ***Phascolarctos cinereus***	2	Any	Surveyed Dec 2017	No	0
Superb Parrot ***Polytelis swainsonii***	2	Sept - Nov	Surveyed September 2018	No	0
Masked Owl ***Tyto novaehollandiae*** **(Breeding)**	2	May - Aug	Detected on site Dec 2017 Not detected During August 2018 Survey	No	0
FLORA					
Ausfeld's Wattle ***Acacia ausfeldii***	2	Any	Surveyed December 2017 Surveyed September 2018	No	0
Bluegrass ***Dichanthium setosum***	2	Sep - May	Surveyed December 2017 Surveyed September 2018	No	0
Pine Donkey-orchid ***Diuris tricolor***	1.5	Sep - Oct	Surveyed September 2018	No	0

Candidate Species	Biodiversity risk weighting	Survey Period	Assumed to occur/survey/ expert report	Present on site?	Species polygon area or count
Euphrasia arguta	3	None listed, Plantnet lists flowering Oct - Jan	Surveyed December 2017 Surveyed September 2018	No	0
Scant Pomaderris ***Pomaderris queenslandica***		Any	Surveyed December 2017 Surveyed September 2018	No	0
Small Purple-pea ***Swainsona recta***	1	Sep - Oct	Surveyed December 2017 Surveyed September 2018	No	0
Silky Swainson-pea ***Swainsona sericea***	2	Sep - Feb	Surveyed December 2017 Surveyed September 2018	No	0

Additional Habitat Features Relevant to Prescribed Biodiversity Impacts

Terrestrial Habitat

No occurrences of karsts, caves, crevices, cliffs nor surface rock were within the Development Site.

There are several agricultural buildings on the Subject Land, including a large open shed on the southwest corner of the Subject Land. This shed could provide potential roosting habitat for Eastern Bent-wing Bat and other threatened bats that roost in buildings. These buildings do not occur within the Development Site.

Planted vegetation not representing a PCT was present in one (1) patch within the Subject Land, but not within the Development Site. The vegetation will not be removed or impacted as a result of the proposal. The 0.69-ha patch comprises planted *Eucalypt* species.

No hollows are yet present in any of these trees. These trees could provide foraging habitat for threatened bird and mammal species. Threatened species that may use this habitat for foraging include:

- Eastern Pygmy Possum
- Squirrel Glider
- Brush-tailed Phascogale
- Eastern Bent-wing Bat
- Barking Owl
- Masked Owl
- Little Eagle
- Gang-gang Cockatoo
- Glossy Black Cockatoo
- Major Mitchell’s Cockatoo

- Superb Parrot.

As this vegetation is not being impacted, it does not require further assessment within the BAM Calculator.

Aquatic Habitat

The Talbragar River intersects the proposed TL easement. The river is heavily eroded and has been subject to extensive previous clearing, however it contains occasional sedges and grasses. This creek and surrounding vegetation could provide habitat for:

- Boorolong Frog (*Litoria booroolongensis*)
- Pale-headed Snake (*Hoplocephalus bitorquatus*)

The Booroolong Frog and Pale-headed Snake were not detected during the site surveys.

Unnamed farm dams occur within the north-western portion of the Development Site. These dams would be filled by the Proposal. The impacts proposed to the two (2) dams are not anticipated to have any broader impacts for environments that sustain and interact with the rivers, streams nor wetlands either on or offsite.

An assessment of threatened species and ecological communities under the FM Act that may use the habitats of the Talbragar River was undertaken. No threatened species were considered to occur within the Development Site. Talbragar River, as a tributary of the Macquarie River has potential to fall within the Darling River Endangered Ecological Community, listed under the FM Act. However, as the site is upstream of Burrendong Dam, the portion of the river does not fall within the Endangered Ecological Community. No construction activities would occur within the creek. No impacts would occur to water flow paths or volumes within the creek.

Matters of National Environmental Significance

An EPBC Protected Matters Search Tool (PMST) report was undertaken on 9 March 2020 (10-km buffer of the Development Site) to identify Matters of National Environmental Significance (MNES) that have the potential to occur within the Development Site (refer to Appendix C of the BDAR). Relevant to biodiversity, these include:

- Wetlands of International Importance
- Threatened Ecological Communities
- Threatened species
- Migratory species

The potential for these MNES to occur at the site are discussed below.

Wetlands of International Importance

Five (5) wetlands of international importance were returned from the PMST report. The nearest of these (within 200 km of the Development Site) are the Macquarie Marshes and Hunter estuary wetlands. All other wetlands returned from the search are over 700 km away. The Macquarie Marshes occurs approximately 220 km north-west of the Development Site. It is fed by the Macquarie River. While the Talbragar River is a tributary of the Macquarie River, it is separated by Burrendock Dam, and impacts to Wetlands of International Importance are considered unlikely.

Threatened Ecological Communities

Five (5) TECs were returned from the PMST report. One of these, *White Box-Yellow Box-Blakely's Red Gum Grass Woodland and Derived Native Grassland*, listed as Critically Endangered, has been assessed within the Development Site which corresponds to PCT 281. An assessment of whether the vegetation community within the Development Site met the condition threshold for each of the EPBC Act-listed communities was undertaken.

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived native grassland

2.18 ha of remnant *Blakely's Red Gum and Yellow Bow Woodland* occurs within the Subject Land. This woodland was considered to form part of the EPBC Act-listed TEC due to the presence of mature trees and naturally regenerating Blakley's Red Gum. An assessment of condition threshold is shown in Figure 8-3 and Figure 8-4 as 'Zone 4'. It concludes that 0.58 ha occurs within the Development Footprint and would be impacted by the Proposal.

Threatened Species

39 threatened species were identified in the PMST report. Of these, 10 are considered likely to occur in the Development Site. Bold entries can be considered to have been targeted during onsite surveys:

- Swift Parrot
- **Superb Parrot**
- Painted Honeyeater
- Regent Honeyeater
- **Koala**
- **Grey-headed Flying-fox**
- **Booroolong Frog**
- ***Dichanthium setosum***
- ***Swainsona recta.***

No EPBC Act-listed threatened species were identified within the Development Site during surveys. Based on the comprehensive mammal and bird surveys undertaken and evaluation of habitat, no other listed MNES are considered likely to occur in the Development Site regularly or rely on the habitats present.

Migratory Species

12 listed migratory species were identified in the PMST report. Of these, five (5) could potentially occur in the Development Site based on an assessment of habitat and distribution.

- Common Sandpiper
- Fork-tailed Swift
- White-throated Needletail
- Yellow Wagtail
- Satin Flycatcher.

One (1) EPBC Act-listed Marine species, Dollarbird *Eurystomus orientalis* was identified in proximity to the Development Site. The individuals were utilising hollows in trees outside of the Development Footprint. Based on the bird surveys undertaken and evaluation of habitat, none of these species are considered likely to occur in the Development Site regularly or rely on the habitats present.

8.1.3 Potential Impacts

Direct Impacts

The construction and operational phases of the Proposal has the potential to impact biodiversity values at the site that cannot be avoided. This would occur through direct impacts such as habitat clearance and installation and existence of infrastructure. Refer to Table 8-4 for a summary of these impacts.

Table 8-4 Potential impacts to biodiversity during the construction and operational phases

Nature of impact	Extent	Frequency	Duration and timing	Consequence
Direct impacts				
Habitat clearance for permanent and temporary construction facilities (e.g. solar infrastructure, Transmission Lines, compound sites, stockpile sites, access tracks)	Up to 0.91 ha	Regular	Construction	Direct loss of native flora and fauna habitat Potential over-clearing of habitat outside proposed Development Footprint Injury and mortality of fauna during clearing of fauna habitat and habitat trees Disturbance to stags, fallen timber, and bush rock
Displacement of resident fauna	Up to 0.91 ha	Regular	Construction, Operation	Direct loss of native fauna Decline in local fauna populations
Injury or death of fauna	Up to 0.91 ha	Regular	Construction	Direct loss of native fauna Decline in local fauna populations
Removal of habitat features e.g. HBTs	Up to 0.91 ha No HBTs impacted	Regular	Construction	Direct loss of native fauna habitat Injury and mortality of fauna during clearing of habitat features
Shading by solar infrastructure	Up to 0.91 ha	Regular	Operational Phase: Long-term	Modification of native fauna habitat Potential loss of ground cover resulting in unstable ground surfaces and sedimentation of adjacent waterways.
Existence of permanent solar infrastructure	Up to 0.91 ha	Regular	Operational Phase: long-term	Modification of habitat beneath array (entirely non-native) Reduced fauna movements across landscape due to fencing Collision risks to birds and microbats (fencing).

Changes in Vegetation Integrity

The changes in vegetation integrity scores as a result of clearing are documented for each vegetation zone in Table 8-5 below. Note that Zones 3 and 5 constitute Category 1 – exempt land (refer to Figure 8-2) and thus are excluded from vegetation integrity scores.

Table 8-5 Current and future vegetation integrity scores for each vegetation zone within the Development Site

Zone ID	PCT	EEC and/or threatened species habitat?	Area (ha)		Current vegetation Integrity Score	Future vegetation Integrity Score
			Option 1	Option 2		
1	201	EEC	0.06	0.06	46.7	0
2	78	No	0.26	0.21	46.9	0
4	281	EEC	0.58	0.58	47.3	0

The future vegetation integrity scores have been considered with precaution, and account for complete removal of the vegetation within the footprint.

Loss of Species Credit Species Habitat or Individuals

No species credit species are considered impacted by the Proposal, thus do not generate a credit requirement.

Loss of Hollow-bearing Trees

23 hollow-bearing trees (HBTs) were recorded within the Development Site. One (1) of these HBTs occur within the Development Footprint and would be removed by the Proposal. The tree, a River Red Gum *Eucalyptus camaldulensis* contains one (1) small and one (1) medium hollow.

8.1.4 Prescribed Impacts

The following prescribed biodiversity impacts are relevant to the Proposal:

- Impacts of the development on the connectivity of different areas of habitat of threatened species that facilitates the movement of these species across their range
- Impacts of the development on movement of threatened species that maintains their life cycle
- Impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation.
- Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities
- Impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC.

These are discussed in detail below and the necessary information required by section 9.2 of the BAM.

Impacts of Development on the Connectivity of Different Areas of Habitat or Threatened Species that Facilitate the Movement of these Species Across the Range

River Red Gum riparian vegetation along Talbragar River, Fuzzy Box woodland along the western side of the Development Site and Rough-Barked Apple - Red Gum - Yellow Box woodland to the south of the site provide corridors of habitat connectivity for mobile fauna species. The Development Footprint intersects with this habitat in the 6 m wide easement for the Transmission Line across the Talbragar River. There would also be some short-term, indirect disturbance associated with construction and long-term disturbance would occur as the permanent removal of one (1) HBT. Fauna utilising this corridor for movement such as the Masked Owl would be considered unlikely to be impacted as a result of the proposed clearing, due to the already fragmented and degraded nature of the vegetation. The Proposal is not considered likely to exacerbate this impact such that threatened species would not continue to utilise the habitat as a movement corridor.

Impacts of Development on Movement of Threatened Species that Maintains their Life Cycle

The Masked Owl is a highly mobile species with a large home range. Individuals were detected during the initial surveys in December, but not during the breeding period in August, indicating that the individuals on site breed in a location outside of the Development Site. The Proposal would remove one (1) HBT, which contains hollows large enough to support the species' breeding. These impacts would occur within the riparian corridor, where an approximate 6-metre corridor will be cleared in order to connect the Transmission Line to the substation. The species and others would continue to utilise the Development Site and surrounding habitats as movement corridors.

Impacts of Development on the Habitat of Threatened Species or Ecological Communities Associated with Human Made Structures or Non-native Vegetation

Impacts to all human made structures and non-native vegetation have been avoided, thus removing this impact.

Impacts of Development on Water Quality, Water Bodies and Hydrological Processes that Sustain Threatened Species and Threatened Ecological Communities (Including Subsistence or Upsidence Resulting from Underground Mining or Other Development)

No threatened flora or fauna dependent on water bodies were detected within the Development Site. The Talbragar River does not form part of any threatened ecological communities, and no threatened species listed under the fisheries management act are considered likely to occur

Construction of the Proposal would not directly affect surface water quality. Indirectly, the proposed works would involve a range of activities that would disturb soils and potentially lead to sediment laden runoff, affecting local water ways during rainfall events. These potential impacts are unlikely to significantly impact water quality. The use of fuels and other chemicals on site pose a risk of surface water contamination in the event of a spill. Chemicals used onsite would include fuels, lubricants and herbicides, none of which are considered difficult to manage.

Operation of the Proposal would have minimal potential for any impact to surface water quality. Appropriate drainage features would be constructed along internal access roads to minimise the risk of dirty water leaving the site or entering waterways. With the exception of internal roads, parking areas and areas around site offices, the site would be largely vegetated with grass cover (specifically, ground cover would be maintained beneath the solar array). There would be a low risk of contamination in the event of a chemical spill (fuels, lubricants, herbicides etc.) as storage and emergency handling protocols would be implemented.

The Proposal is not likely to impact the bioregional persistence of any threatened flora, fauna or ecological communities with the implementation of the recommended mitigation measures.

Impacts of Vehicle Strikes on Threatened Species or on Animals that are Part of a TEC

Impacts from vehicle strikes have largely been avoided by not proposing construction within the majority of vegetated areas. Where works do occur in or in proximity to vegetation, mitigation measures will be implemented to enforce a site speed. With the recommended mitigation measures, it is therefore not likely that vehicles associated with the proposal will have a substantive impact on this species.

8.1.5 Impacts to Matters of National Environmental Significance

One (1) EPBC Act-listed community was recorded during the surveys, that of *White Box, Yellow Box, Blakely's Red Gum Grassy Woodland* (Box-gum Woodland). 0.58 ha of this community would be impacted by the construction of the Transmission line, in proximity to the substation. An EPBC Assessment of significance was completed for *White Box, Yellow Box, Blakely's Red Gum Grassy Woodland* (Appendix C of the BDAR) and concluded that a significant impact was unlikely on the basis that:

1. The amount of habitat to be removed or disturbed by the Proposal is relatively small in the context of the greater area of habitat that would remain.
2. No fragmentation or isolation of habitat would occur.
3. The Proposal would not modify or destroy abiotic factors
4. The Proposal would not cause a substantial change in the species composition
5. The Proposal would not cause a substantial reduction in the quality of the ecological community

Therefore, no referral is considered necessary to the Federal DAWE.

One (1) EPBC Act-listed species was recorded during the surveys; Dollarbirds were recorded at four (4) separate locations within vegetation outside the Development Footprint. It is considered unlikely that the species would utilise any habitats within the Development Footprint.

An assessment of significant impact was completed for the Dollarbird (Appendix C of the BDAR) and concluded that a significant impact was unlikely on the basis that the proposal would not:

- Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

An EPBC referral is not considered necessary.

No other EPBC Act-listed species were detected or considered likely to occur within the Development Site.

8.1.6 Serious and Irreversible Impacts (SAII)

The principles used to determine if a development will have serious and irreversible impacts, include impacts that:

- Will cause a further decline of the species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to be in a rapid rate of decline, or
- Will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to have a very small population size, or
- Impact on the habitat of a species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to have a very limited geographic distribution, or
- Impact on a species or ecological community that is unlikely to respond to measures to improve habitat and vegetation integrity and is therefore irreplaceable.

Potential Entities

Two (2) threatened ecological communities will be impacted on by the Proposal that is listed as a potential SAII entity in the *Guidance to assist a decision-maker to determine a serious and irreversible impact*. These entities are:

- White Box, Yellow Box, Blakely’s Red Gum Grassy Woodland, and
- Fuzzy Box Woodland TEC.

There are no SAII candidate species recorded at the Development Site.

No further species were considered to be potential SAII entities.

Assessment of Serious and Irreversible Impacts

White Box – Yellow Box – Blakely’s Red Gum Woodland (Box-gum Woodland)

An assessment of the impacts to Box Gum Woodland was undertaken. Figure 8-5 shows the location of the Box Gum Woodland in context to the Development Site.

a) the action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII

The Development Site contains approximately 2.18 ha of vegetation which conforms to the listing of Box Gum Woodland. The Proposal avoids the highest quality areas of this community in the southern part of the Development Site where large patches of good condition vegetation are present. Avoiding the 0.58 ha patch of Box Gum Woodland to be impacted would require moving the Proposal into larger more intact patches of remnant vegetation.

b) the area (ha) and condition of the TEC to be impacted directly and indirectly by the proposed development. The condition of the TEC is to be represented by the vegetation integrity score for each vegetation zone

Approximately, 0.58 ha of Box Gum Woodland would be directly impacted by the Proposal. Indirect impacts are listed in Table 8-6. This vegetation is highly modified and generally lacks native understory due to grazing and pasture improvement practices. The vegetation integrity score for this patch is 47.3.

Table 8-6 Vegetation attributes of Box Gum Woodland patch

Zone ID	Zone Description	Patch size	Composition score	Structure score	Function score	Vegetation Integrity Score
4	PCT 281	0.58	67.1	78.6	20.1	47.3

c) a description of the extent to which the impact exceeds the threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact

No threshold has yet been defined by OEH for the extent of Box Gum Woodland to be removed that constitutes a serious and irreversible impact.

d) the extent and overall condition of the potential TEC within an area of 1000ha, and then 10,000ha, surrounding the proposed Development Footprint

Using GIS and State Vegetation Mapping (VIS_4468 & 4469), it is estimated that 55 ha of Box Gum Woodland occurs within an area of 1,000 ha surrounding the proposed Development Footprint, and 1627 ha of Box Gum Woodland occurs within an area of 10,000 ha surrounding the proposed Development Footprint.

e) an estimate of the extant area and overall condition of the potential TEC remaining in the IBRA subregion before and after the impact of the proposed development has been taken into consideration

Using GIS and State Vegetation Mapping (VIS 4468 & 4469), it is estimated that 32,801 ha of Box Gum Woodland occurs within the Lower Slopes IBRA Subregion. Vegetation mapped from aerial imagery is assumed to be in moderate to good condition. Up to 0.58 ha is proposed to be removed by the development, which is less than 0.002% of the estimated extent remaining.

f) an estimate of the area of the potential TEC that is in the reserve system within the IBRA region and the IBRA subregion

In NSW, Box Gum Woodland is known to occur within at least 42 reserve systems. Around 8,000 ha of Box Gum Woodland is estimated to occur in national parks and nature reserves within the NSW South Western Slopes IBRA Region (Benson 2008). Using GIS Vegetation Mapping, it is estimated that 481 ha of Box Gum Woodland occurs in four (4) reserves in the Lower Slopes Subregion.

g) the development, clearing or biodiversity certification proposal's impact on:

i. abiotic factors critical to the long-term survival of the potential TEC; for example, how much the impact will lead to a reduction of groundwater levels or the substantial alteration of surface water patterns

It is predicted that the Proposal could have impacts on,

- Surface water flows across the ground due to the presence of solar panels,
- Change in light levels reaching the ground due to shading of panels,

- Modification to ground moisture levels where solar panels may block or concentrate rain over certain areas.

The Proposal could potentially benefit the Box Gum Woodland by removing disturbances caused by farming activities such as application of fertilisers and exclusion of stock.

There is little scientific information on the effects of solar farms on these factors. Until sufficient monitoring of Solar farms is carried out, it is largely unknown whether solar farms are likely to have a detrimental impact on abiotic factors. A 'worst case' assumption would be that alterations to sunlight reaching the ground and changes to surface water flows due to the large surface area of solar panels over the ground, could modify abiotic factors necessary for survival of the community.

A review of the National Recovery Plan for Box Gum Woodland indicates that:

- Altered hydrological regimes may lead to impacts,
- Prolonged shading may lead to impacts and
- Mowing and slashing associated with managing grasslands may lead to impacts

It therefore has to be assumed (without scientific evidence suggesting otherwise) that this Proposal may lead to modification and destruction of important abiotic factors for preserving the integrity of Box Gum Woodland onsite.

ii. characteristic and functionally important species through impacts such as, but not limited to, inappropriate fire/flooding regimes, removal of understorey species or harvesting of plants

The Proposal would remove 0.58 ha of Box Gum Woodland including moderate condition native canopy and native groundcovers. No introduced fire or flooding regimes would occur and no increase of natural occurrences of these events is anticipated from the development. The harvesting of plants will not occur within the remaining Box-gum woodland.

iii. the quality and integrity of an occurrence of the potential TEC through threats and indirect impacts

Up to 0.58 ha of Box Gum Woodland would be removed reducing the vegetation quality and integrity of this patch. No further impacts would occur to remaining Box Gum Woodland in the locality.

h) direct or indirect fragmentation and isolation of an important area of the potential TEC

The small fragmented patches of Box Gum Woodland in the Development Site are already isolated within the agricultural landscapes. The small isolated patch to be removed would not cause further fragmentation to areas of Box Gum Woodland in the locality.

i) the measures proposed to contribute to the recovery of the potential TEC in the IBRA subregion.

The 0.58 ha of Box-gum woodland to be removed will be offset by 14 Ecosystem Credits that will be used for management of another area of Box Gum Woodland in the same IBRA region.

Conclusion:

The Proposal avoids the highest quality areas of this community in the southern part of the

Development Site where large patches of good condition vegetation are present. Extensive areas of Box Gum Woodland occur within 1,000 ha and 10,000 ha of the Development Site.

Fuzzy Box Woodland TEC

An assessment of the impacts to the Fuzzy Box Woodland TEC was undertaken. Figure 8-5 shows the location of the Fuzzy Box Woodland TEC within the Development Site.

a) *the action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII*

The Fuzzy Box Woodland within the Development Site (1.86) occurs in a range of conditions, with moderate condition patches containing both native canopy and native groundcovers and low condition patches lacking native overstorey and having exotic groundcovers. The Proposal avoids the highest quality areas of this community in the north-western part of the Development Site where large patches of moderate condition vegetation are present. Avoiding the 0.06 ha patch of Fuzzy Box Woodland to be impacted would require moving the Proposal into larger more intact patches of remnant vegetation.

b) *the area (ha) and condition of the TEC to be impacted directly and indirectly by the proposed development. The condition of the TEC is to be represented by the vegetation integrity score for each vegetation zone*

0.06 ha of Fuzzy Box Woodland would be directly impacted by the Proposal. Indirect impacts are listed in Table 8-7. This vegetation is highly modified and generally lacks native understory due to grazing and pasture improvement practices. The vegetation integrity score for this patch is 46.7.

Table 8-7 Vegetation attributes of Fuzzy Box Woodland patch

Zone ID	Zone Description	Patch size	Compositio n score	Structure score	Function score	Vegetation Integrity Score
1	PCT 201	0.06	65.7	60.6	25.6	46.7

c) *a description of the extent to which the impact exceeds the threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact*

No threshold has yet been defined by DPIE for the extent of Fuzzy Box Woodland to be removed that constitutes a serious and irreversible impact.

d) *the extent and overall condition of the potential TEC within an area of 1000 ha, and then 10,000 ha, surrounding the proposed Development Footprint*

Using GIS and State Vegetation Mapping (VIS 4468 & 4469), it is estimated that 0 ha of Fuzzy Box Woodland occurs within an area of 1,000 ha surrounding the proposed Development Footprint, and 92 ha of Fuzzy Box Woodland occurs within an area of 10,000 ha surrounding the proposed Development Footprint.

e) an estimate of the extant area and overall condition of the potential TEC remaining in the IBRA subregion before and after the impact of the proposed development has been taken into consideration

Using GIS and State Vegetation Mapping (VIS_4468 & 4469), it is estimated that 3,447 ha of Fuzzy Box Woodland occurs within the Lower Slopes IBRA Subregion. Vegetation mapped from aerial imagery is assumed to be in moderate to good condition. Up to 0.06 ha is proposed to be removed by the development, which is less than 0.001% of the estimated extent remaining.

f) an estimate of the area of the potential TEC that is in the reserve system within the IBRA region and the IBRA subregion

Using GIS Vegetation Mapping, it is estimated that 41 ha of Fuzzy Box Woodland occurs in two (2) reserves in the Lower Slopes Subregion, and that 595 ha occurs in four (4) reserves in the NSW South Western Slopes Bioregion.

g) the development, clearing or biodiversity certification proposal's impact on:

i. abiotic factors critical to the long-term survival of the potential TEC; for example, how much the impact will lead to a reduction of groundwater levels or the substantial alteration of surface water patterns

It is predicted that the proposal could have impacts on,

- Surface water flows across the ground due to the presence of solar panels,
- Change in light levels reaching the ground due to shading of panels,
- Modification to ground moisture levels where solar panels may block or concentrate rain over certain areas.

The Proposal could potentially benefit the Fuzzy Box Woodland by removing disturbances caused by farming activities such as application of fertilisers and exclusion of stock.

There is little scientific information on the effects of solar farms on these factors. Until sufficient monitoring of Solar farms is carried out, it is largely unknown whether solar farms are likely to have a detrimental impact on abiotic factors. A 'worst case' assumption would be that alterations to sunlight reaching the ground and changes to surface water flows due to the large surface area of solar panels over the ground, could modify abiotic factors necessary for survival of the community.

ii. characteristic and functionally important species through impacts such as but not limited to, inappropriate fire/flooding regimes, removal of understorey species or harvesting of plants

The Proposal would remove 0.06 ha of Fuzzy Box Woodland which would permanently remove the characteristic overstory species of *Eucalyptus microcarpa* and *E. conica* in these areas. These areas have an exotic understory and few native groundcover species would be likely to remain. No introduced fire or flooding regimes would occur and no increase of natural occurrences of these events is anticipated from the development. The harvesting of plants will not occur within the remaining Fuzzy Box Woodland.

iii. the quality and integrity of an occurrence of the potential TEC through threats and indirect impacts

Up to 0.06 ha of Fuzzy Box Woodland would be removed reducing the vegetation quality and integrity of this patch. No further impacts would occur to remaining Fuzzy Box Woodland in the locality.

h) direct or indirect fragmentation and isolation of an important area of the potential TEC

The small fragmented patches of Fuzzy Box Woodland in the Development Site are already isolated within the agricultural landscapes. The small isolated patch to be removed would not cause further fragmentation to areas of Fuzzy Box Woodland in the locality.

i) the measures proposed to contribute to the recovery of the potential TEC in the IBRA subregion.

The Proposal will generate 1 Ecosystem Credit impacts to Fuzzy Box Woodland which will contribute to the conservation of higher quality patches of the community in the same IBRA region.

Conclusion:
The Proposal would remove 0.06 ha of Fuzzy Box Woodland. The Proposal avoids the highest quality areas of this community in the north western part of the Development Site where large patches of good condition vegetation are present. Extensive areas of Fuzzy Box Woodland occur within 10,000 ha of the Development Site.

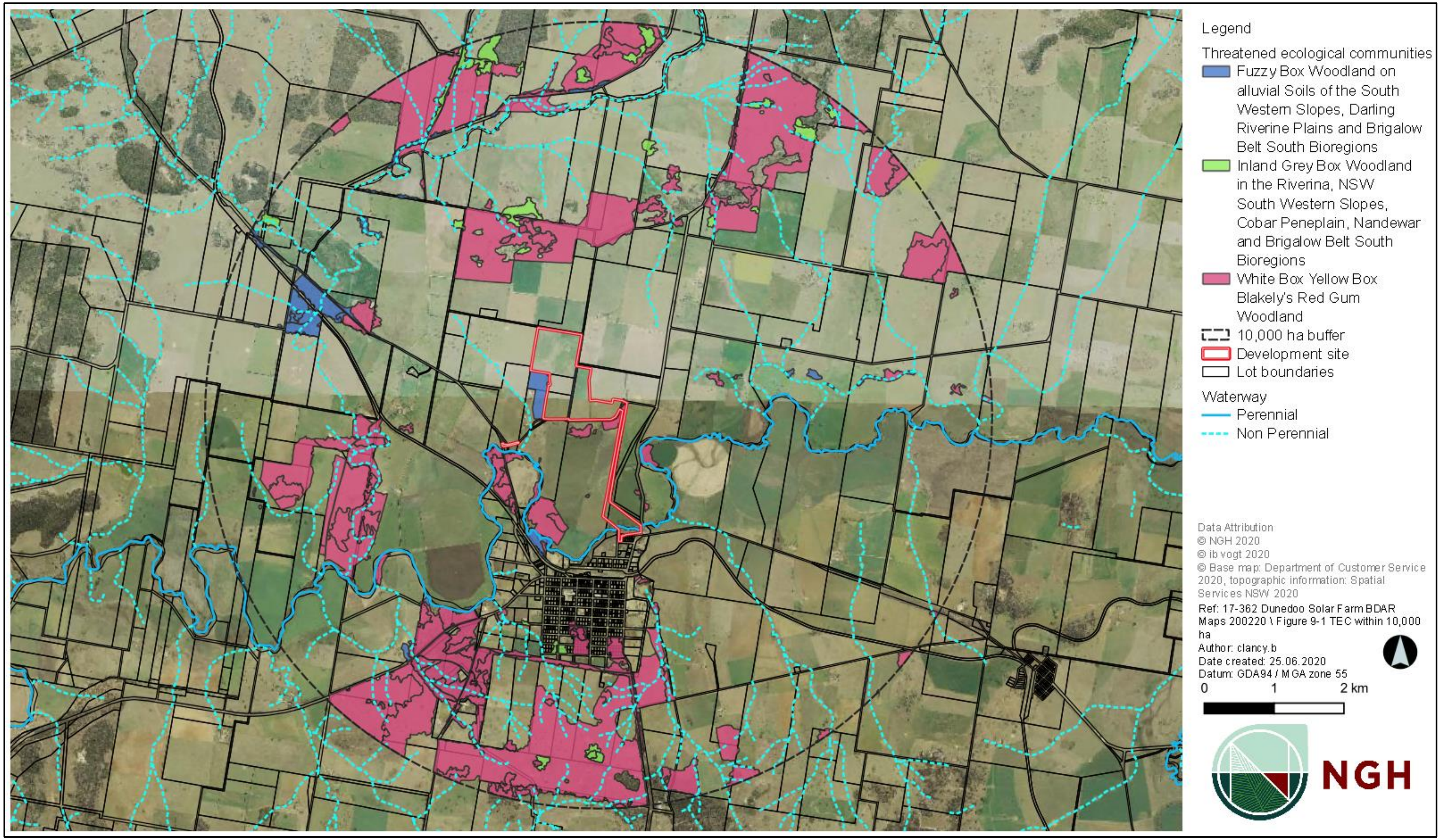

Figure 8-5 Location of serious and irreversible impacts

8.1.7 Offset Requirements

Ecosystem Credits

An offset is required for all impacts of development on PCTs that are associated with:

a) a vegetation zone that has a vegetation integrity score ≥15 where the PCT is representative of an endangered or critically endangered ecological community, or
b) a vegetation zone that has a vegetation integrity score of ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community, or
c) a vegetation zone that has a vegetation integrity score ≥20 where the PCT is not representative of a TEC or associated with threatened species habitat.

The PCTs and vegetation zones requiring offset and the ecosystem credits required are documented in Table 8-8 and mapped on Figure 8-6 to Figure 8-9.

Table 8-8 PCTs and vegetation zones that require offsets

Zone ID	PCT ID	PCT name	Zone area (ha)		Vegetation integrity score	Ecosystem credits required	
			Option 1	Option 2		Option 1	Option 2
1	201	Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion	0.06	0.06	46.7	1	1
2	78	River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	0.26	0.21	46.9	5	4
4	281	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	0.58	0.58	47.3	14	14
		Total	**0.9**	**0.85**	N/A	**20**	**19**

The full Biodiversity Credit Report generated by the BAM Calculator is provided in Appendix D of the BDAR.

Species Credits

An offset is required for the threatened species impacted by the development that require species credits. As no species credit species were present on site, the proposal does not generate a species credit offset requirement.

Offsets Required under the EPBC Act

No species listed on the EPBC Act have been identified as having the potential to be significantly impacted by the Proposal. As such, the Proposal is not considered to require offsets in accordance with the EPBC Offsets Policy.

Ecosystem Credits

Impacts to PCTs that do not meet the thresholds identified in Table 8-8. These PCTs and vegetation zones are identified in Table 8-9 below and mapped in Figure 8-3 and Figure 8-4.

Table 8-9 PCTs and vegetation zones that do not require offsets

Zone ID	PCT ID	PCT name	Zone area (ha)	Vegetation integrity score
3	78	River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	0	-

Areas Not Requiring Offsets

Identification of areas not requiring assessment in accordance with BAM section 10.4 i.e. land without native vegetation.

These areas are mapped in Figure 8-6 to Figure 8-9.

Figure 8-6 Impacts requiring offset, not requiring offset and not requiring assessment (Option 1; north)

Figure 8-7 Impacts requiring offset, not requiring offset and not requiring assessment (Option 1; south)

Figure 8-8 Impacts requiring offset, not requiring offset and not requiring assessment (Option 2; north)

Figure 8-9 Impacts requiring offset, not requiring offset and not requiring assessment (Option 2; south)

8.1.8 Mitigation Measures

Mitigation measures proposed to manage impacts, including proposed techniques, timing, frequency, responsibility for implementing each measure, risk of failure and an analysis of the consequences of any residual impacts are provided in Table 8-10.

Table 8-10 Mitigation measures proposed to avoid and minimise impacts on native vegetation and habitat

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
Displacement of resident fauna through vegetation clearing and habitat removal						
Time works to avoid critical life cycle events	• Hollow-bearing trees would not be removed during spring to summer • If clearing outside of this period cannot be achieved, pre-clearing surveys would be undertaken to ensure no impacts to fauna would occur	Construction	Regular	Contractor	Moderate	Species not detected during pre-clearing surveys may be impacted.
Implement clearing protocols during tree clearing works, including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological or wildlife handler	• Pre-clearing checklist • Tree clearing procedure	Construction	Regular	Contractor	Moderate	Species not detected during pre-clearing surveys may be impacted.
Relocate habitat features (fallen timber,	• Tree-clearing procedure including relocation of habitat	Construction	Regular	Contractor	Low	None

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
hollow logs) from within the development site	features to adjacent area for habitat enhancement					
Indirect impacts on native vegetation and habitat						
Clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance; for example, removal of native vegetation by chainsaw, rather than heavy machinery, is preferable in situations where partial clearing is proposed	• Approved clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing. • No stockpiling or storage within dripline of any mature trees • In areas to clear adjacent to areas to be retained, chainsaws would be used rather than heavy machinery to minimise risk of unauthorised disturbance	Construction	Regular	Contractor	Low	None
Noise barriers or daily/seasonal timing of construction and operational activities to reduce impacts of noise	• Construction Environmental Management Plan will include measures to avoid noise encroachment on adjacent habitats such as avoiding	Construction	Regular	Contractor	Low	None

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
	night works as much as possible.					
Light shields or daily/seasonal timing of construction and operational activities to reduce impacts of light spill	• Avoid Night Works • Direct lights away from vegetation	Construction/ Operation	Regular	Contractor	Low	None
Adaptive dust monitoring programs to control air quality	• Daily monitoring of dust generated by construction activities • Construction would cease if dust observed being blown from site until control measures were implemented • All activities relating to the proposal would be undertaken with the objective of preventing visible dust emissions from the development site	Construction	Regularly	Contractor	Moderate	Sedimentation in ephemeral waterways and dams.
Temporary fencing to protect significant	• Prior to construction commencing, exclusion	Construction	Regularly	Contractor	Low	None

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
environmental features such as riparian zones	fencing, and signage would be installed around habitat to be retained					
Hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas	• A Weed Management procedure would be developed for the proposal to prevent and minimise the spread of weeds. This would include: • Management protocol for declared priority weeds under the *Biosecurity Act 2015* during and after construction • Weed hygiene protocol in relation to plant, machinery, and fill • Any occurrences of pathogens such as Myrtle Rust and Phytophthora would be monitored, treated, and reported. • The weed management procedure would be incorporated into the	Construction, Operation	Regular	Contractor	Moderate	Weed encroachment

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
	Biodiversity Management Plan.					
Staff training and site briefing to communicate environmental features to be protected and measures to be implemented	• Site induction • Toolbox talks	Construction	Regular	Contractor	Moderate	Impacts to native vegetation or threatened species for Staff training not being followed
Preparation of a vegetation management plan to regulate activity in vegetation and habitat adjacent to the proposed development	• Preparation of a Biodiversity management plan that would include protocols for: • Protection of native vegetation to be retained • Best practice removal and disposal of vegetation • Staged removal of hollow-bearing trees and other habitat features such as fallen logs with attendance by an ecologist • Weed management	Construction	One-off	Contractor	Moderate	Impacts to native vegetation or threatened species for Biodiversity Management Plan not being followed.

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
	• Unexpected threatened species finds • Rehabilitation of disturbed areas					
Erosion and sediment controls	• An erosion and sediment control plan would be prepared in conjunction with the final design and implemented	Construction	Regular	Contractor	Moderate	Impacts may occur if erosion and sedimentation control plan not implemented.
Making provision for the ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on or adjacent to the development site.	• Retained native vegetation would be considered as an offset site	Operation	Regular	Client	Low	None
Prescribed biodiversity impacts						
Sediment barriers and spill management procedures to control the quality of water	• An erosion and sediment control plan would be prepared in conjunction with	Construction	Regular	Contractor	Moderate	Impacts may occur to waterway if erosion and

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
runoff released from the site into the receiving environment	the final design and implemented • Spill management procedures would be implemented.					sedimentation control plan not implemented.
Appropriate landscape plantings of local indigenous species to replace loss of planted vegetation	• Landscape plantings will be comprised of local indigenous species.	Operation	Regular	Client	Moderate	Plants not surviving
Staff training and site briefing to communicate impacts of traffic strikes on native fauna.	• Awareness training during site inductions regarding enforcing site speed limits. • Site speed limits to be enforced to minimise fauna strike.	Construction and Operation	Regular	Contractor	Moderate	Fauna strikes from vehicles

8.2 ABORIGINAL HERITAGE

8.2.1 Approach and Methods

The Aboriginal Cultural Heritage Assessment (ACHA) sought to identify and record Aboriginal cultural areas, objects or places, to assess the archaeological potential of the Subject Land, and to formulate management recommendations based on the results of Aboriginal community consultation, background research, field survey and significance assessment. Refer to Appendix E for the full ACHA report.

The ACHA was conducted in accordance with the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC 2005), the OEH Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011) and the Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW 2010b). The general approach of the ACHA included the following steps:

- Description of the land and history of peoples living on the land.
- A review of previous archaeological work and heritage listings on the NSW OEH Aboriginal Heritage Information Management System (AHIMS).
- A predictive model of aboriginal site distribution relevant to the Development Site.
- A field inspection.
- Aboriginal community consultation.
- An analysis of background information.
- An assessment of the impact of the proposal on aboriginal objects and places.
- Consideration of management and mitigation measures.

8.2.2 Aboriginal Consultation

Aboriginal community consultation undertaken as part of the ACHA has been conducted in accordance with the guidelines set in the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC 2005) and OEH's Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (DECCW 2010a).

The consultation with Aboriginal stakeholders was undertaken in accordance with section 60 of the *National Parks and Wildlife Amendment (Aboriginal Objects and Aboriginal Places) Regulation 2019* following the consultation steps outlined in the guidelines.

The full list of consultation steps, including those groups and individuals that were contacted and a consultation log is provided in Aboriginal Cultural Heritage Assessment Appendix E of the ACHA.

As a result of this process, seven (7) Aboriginal groups registered their interest in the project. No other party registered their interest, including the entities and individuals recommended by statutory bodies and government heritage departments. The fieldwork components of this assessment included the participation of Aboriginal community representatives.

A copy of the draft report was provided to all the registered parties for comment.

8.2.3 Existing Environment

The Subject land is located across a relatively flat alluvial plain and therefore the only area noted to have higher sensitivity are the elevated southern banks of the Talbragar River near the Essential Energy Dunedoo Substation. The areas surrounding the Talbragar River are likely to have been a major focus for Aboriginal people in the area. Given the proximity of the Subject land to the Talbragar

River it is considered that prior to European land modifications, this area as a whole may have provided resources, shelter, water, and food for Aboriginal people.

AHIMS Search

A search of the Aboriginal Heritage Information Management System (AHIMS) database was conducted over an area approximately 8 km east-west x 8 km north-south centred on the Subject land on 25 June 2020 (AHIMS Client Service Number 515668). There were 95 Aboriginal sites and no declared Aboriginal Places recorded in the search area. Refer to Table 8-11 and Figure 8-10 for details of these sites and their locations relative to the Proposal.

One (1) AHIMS site # 36-2-0049 was found to be within the Subject land. This open artefact site was initially recorded during an assessment for the Tamworth to Dubbo Gas Pipeline in 1998. While this site is listed on AHIMS as valid, a recent survey by OzArk in 2012 for the proposed Beryl to Dunedoo 66kV TL noted that the site has been previously legally impacted under two (2) permits issued under the NPW Act and that their field survey confirmed that this site no longer exists. Another open artefact site (AHIMS site # 36-2-0048) was also recorded approximately 350 metres east of the Essential Energy Dunedoo Substation near the intersection of the Golden Highway and Digilah Road. Refer to Figure 8-11 for the location of these sites nearest to the Proposal.

Table 8-11 Details of previously recorded Aboriginal sites within the region

Site Type	Number
Modified Tree (Carved or Scarred)	36
Artefact (1 or more)	31
Art (Pigment or Engraved)	6
Grinding Groove	6
Artefact (1 or more) and Potential Archaeological Deposit (PAD)	5
Hearth	3
Artefact, (1 or more) Hearth and Potential Archaeological Deposit (PAD)	2
Fish Trap	1
Stone arrangements	1
Artefact (1 or more) and Shell	1
Artefact (1 or more) and modified tree	1
Aboriginal Resource and Gathering and Grinding Groove	1
Grinding Groove and Potential Archaeological Deposit (PAD)	1
TOTAL	**95**

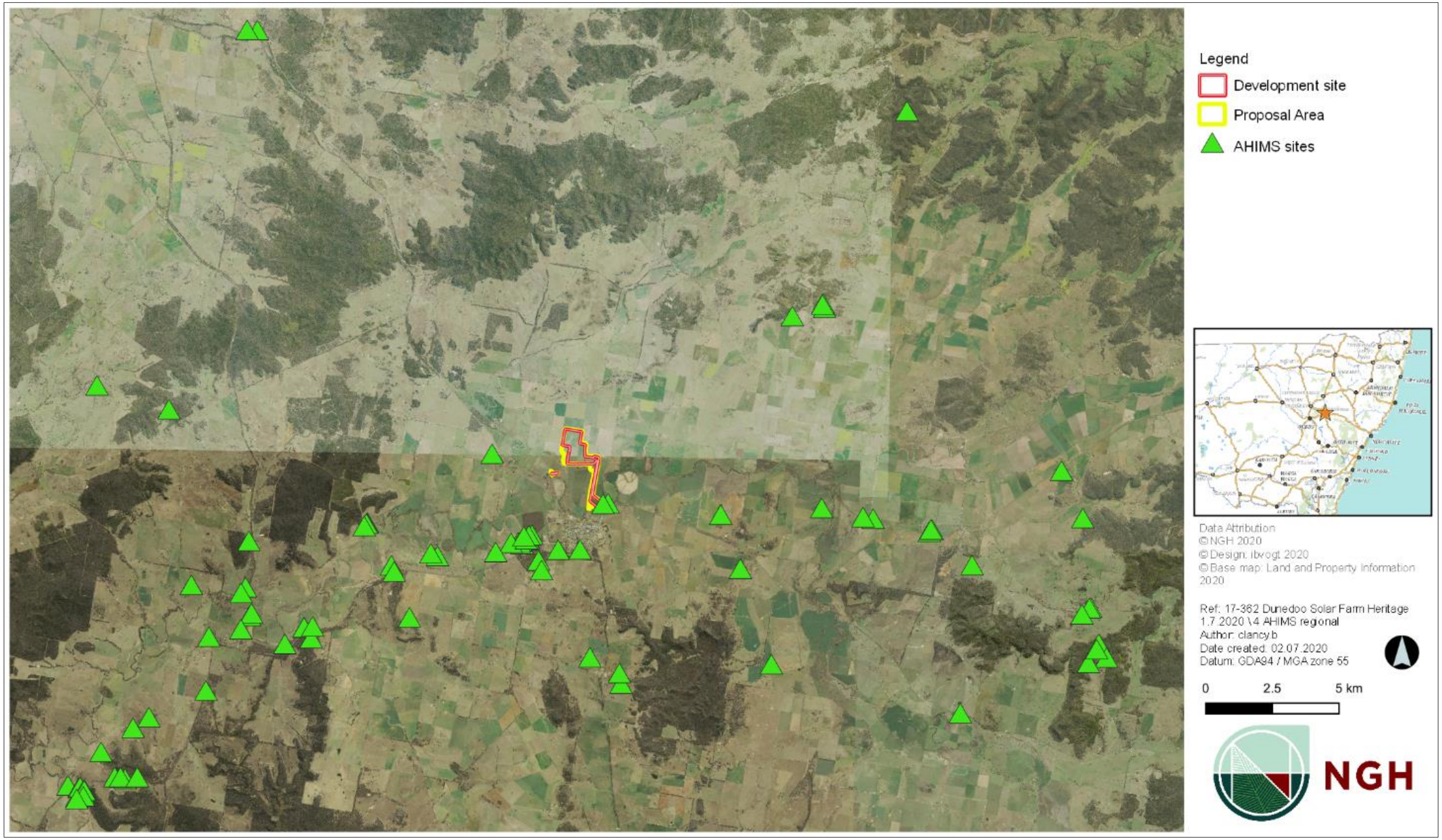

Figure 8-10 AHIMS sites in the Proposal's locality

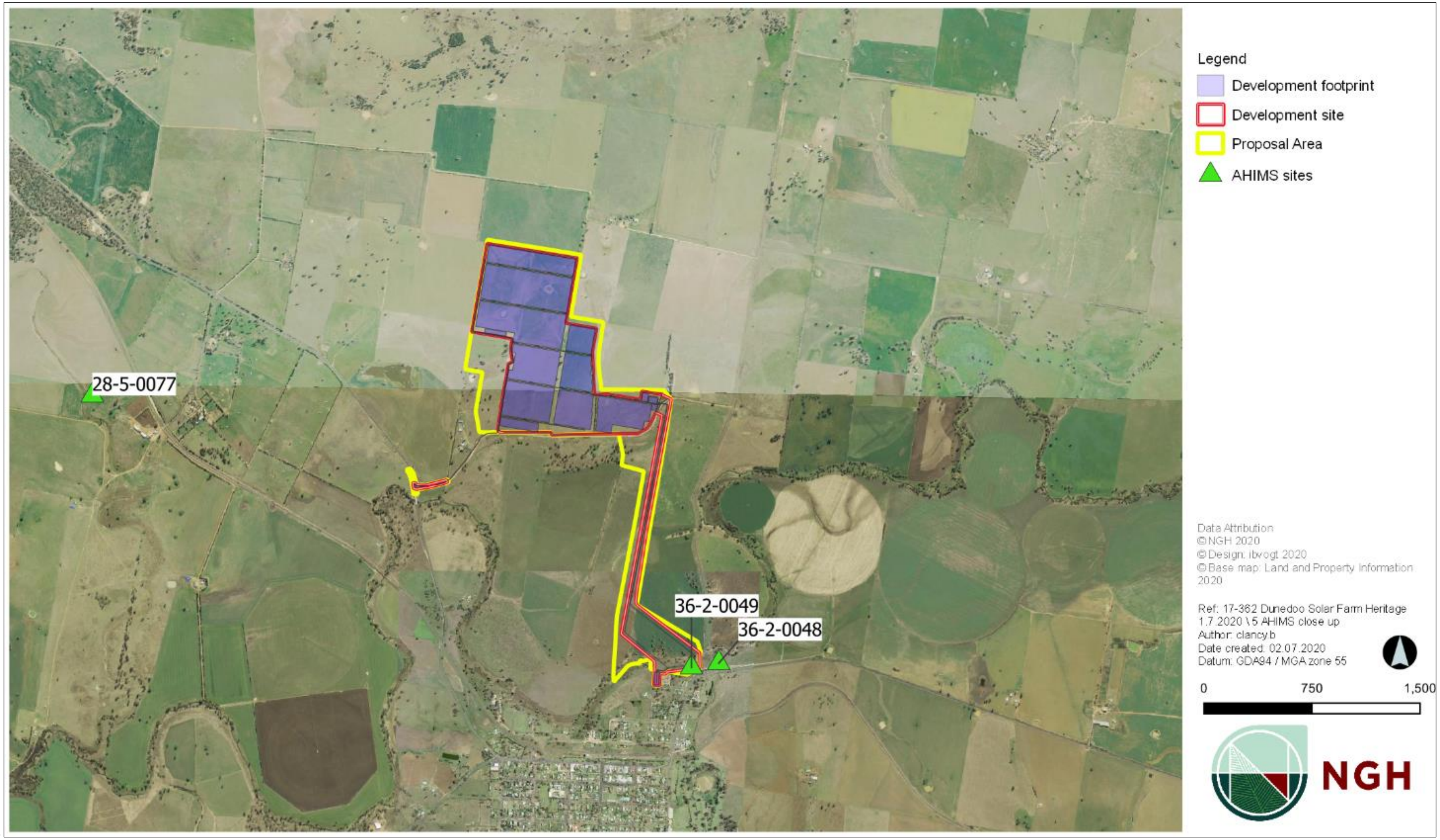

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Figure 8-11 AHIMS sites in the Proposal's vicinity

Previous Archaeological Studies

Several archaeological studies have traversed the Proposal's locality ranging from 1988 to 2019. Based on these studies, it is plausible to suggest that while Aboriginal sites may be expected through all landscapes, there does appear to be a pattern of sites that relate to the presence of potential resources for Aboriginal use. Refer to Figure 8-12 for the indicative survey areas of these previous studies.

In summary, in the local area the dominant raw material type is quartz, with variations of colour and quality. Sites tend to be concentrated on elevated level ground associated with a reliable water source. Additionally, the presence of scarred trees is relatively common and can occur across all landscapes. Based on site modelling and the prevalence of sites in the surrounding and immediate area, the site types most likely to be encountered within the Subject land are quartz lithic scatters, isolated artefacts and scarred trees in remnant old growth vegetation areas bordering the cleared proposed development area and/or as isolated paddock trees.

Refer to Appendix E for the full discussion of previous archaeological studies.

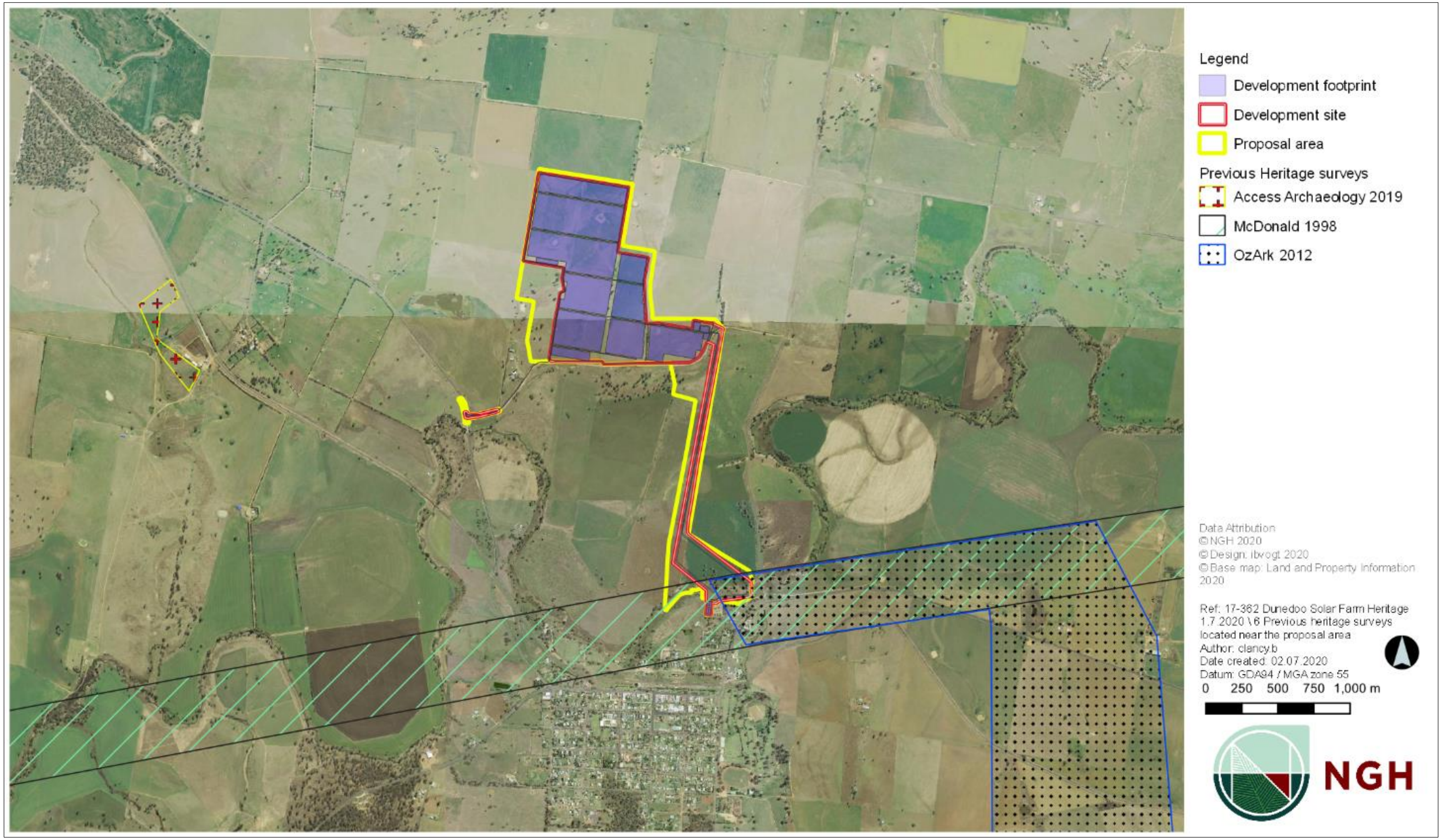


Figure 8-12 Previous heritage survey locations near the Proposal

8.2.4 Archaeological Investigation Results

Site Survey

The initial archaeological investigation area for this project was significantly larger than the Subject land assessed in this report. Consequently, a larger area then that proposed for development in this report was initially investigated for the presence of any Aboriginal sites. Following the initial survey undertaken for the Proposal in January 2018, additional areas were identified for possible impacts for the intersection upgrade and TL options which were also surveyed. The survey strategy objective during all survey works undertaken for this Proposal was to cover as much of the ground surface within the proposed development area as possible.

Despite the variable visibility encountered during the surveys undertaken for the Dunedoo Solar Farm a total of nine (9) isolated finds and 14 artefact scatters were recorded (Dunedoo Solar AFT1 to Dunedoo Solar AFT 23). Three (3) archaeologically sensitive areas were also identified. The GPS location of the previously recorded site AHIMS # 36-2-0049 (DTG/OC27 - Dunedoo 1) was also thoroughly inspected during the survey fieldwork however no artefacts were able to be identified and the RAPs commented that the site had previously been significantly impacted and destroyed.

Subsurface Testing

Based on the results of the survey undertaken for the Dunedoo Solar Farm it was determined that subsurface testing was required to investigate the presence and extent of archaeological material within the archaeologically sensitive areas which were considered to have potential for *in situ* subsurface deposits. Of the 75 test pits excavated across the archaeologically sensitive areas investigated, only 13 contained stone artefacts. In total, 85 artefacts were recorded from the subsurface testing program. The subsurface artefacts recovered were generally able to be incorporated into the assemblages of previously identified sites with surface artefacts. The material recovered adjacent to the existing Essential Energy Dunedoo Substation was however recorded as a new site, Dunedoo Solar AFT 24. The highest artefact density recovered during the subsurface testing programme was identified adjacent to the existing Essential Energy Dunedoo Substation. Following the completion of the subsurface testing program in May 2018, the Subject land was significantly reduced in size and redesigned.

The results of the survey and subsurface testing programme indicate that low- to moderate-density artefact scatters and isolated Aboriginal objects can occur throughout the landscape, even in areas of highly disturbed farming activities. The results of the survey and subsurface testing programme of works undertaken for the Dunedoo Solar Farm substantially increased the number of stone artefact sites recorded in the local area.

8.2.5 Potential Impacts

A total of nine (9) isolated finds and 15 artefact scatters (with surface and/or subsurface artefacts) were recorded during archaeological investigations undertaken for the Dunedoo Solar Farm. A single previously recorded AHIMS site is also located within the Subject land. Table 8-12 below provides a summary of site types that will be impacted and avoided by the proposed Dunedoo Solar Farm Development Footprint.

Table 8-12 Summary of sites observed

Site Type	Type of Harm	Degree of Harm	Consequence of harm	No. of Sites	% of site type identified in surveys for the project	% of site type within Subject land
Isolated Finds	Direct	Complete	Total loss of value	6	66.7	100
	Nil	Nil	N/A	3	33.3	N/A
Artefact Scatters	Direct	Complete	Total loss of value	10	62.5	100
	Nil	Nil	N/A	6	37.5	N/A
Previously recorded site	Direct	Complete	Total loss of value	1	N/A	100

A total of six (6) isolated finds, nine artefact scatters (with surface and/or subsurface artefacts) and the single previously recorded AHIMS site would be impacted by works proposed for the construction of the Dunedoo Solar Farm. The impact to these 16 sites with stone artefacts is likely to be most extensive where earthworks occur which is considered a direct impact on the Aboriginal sites. The Aboriginal sites recorded during archaeological investigations for the Dunedoo Solar Farm which will be impacted and avoided by the development are listed in Table 8-13 below.

Table 8-13 List of sites to be impacted and avoided by the Proposal

Sites impacted within Subject land	Sites avoided as outside Subject land
• DTG/OC27 - Dunedoo 1 (Artefact Scatter) • Dunedoo Solar AFT 1 (Artefact Scatter) • Dunedoo Solar AFT 2 (Artefact Scatter) • Dunedoo Solar AFT 3 (Artefact Scatter) • Dunedoo Solar AFT 4 (Artefact Scatter) • Dunedoo Solar AFT 5 (Artefact Scatter) • Dunedoo Solar AFT 6 (Artefact Scatter) • Dunedoo Solar AFT 7 (Artefact Scatter) • Dunedoo Solar AFT 8 (Artefact Scatter) • Dunedoo Solar AFT 9 (Isolated Find) • Dunedoo Solar AFT 10 (Isolated Find) • Dunedoo Solar AFT 11 (Isolated Find) • Dunedoo Solar AFT 12 (Isolated Find) • Dunedoo Solar AFT 13 (Isolated Find) • Dunedoo Solar AFT 14 (Isolated Find) • Dunedoo Solar AFT 24 (Artefact Scatter)	• Dunedoo Solar AFT 15 (Artefact Scatter) • Dunedoo Solar AFT 16 (Artefact Scatter) • Dunedoo Solar AFT 17 (Artefact Scatter) • Dunedoo Solar AFT 18 (Artefact Scatter) • Dunedoo Solar AFT 19 (Artefact Scatter) • Dunedoo Solar AFT 20 (Artefact Scatter) • Dunedoo Solar AFT 21 (Isolated Find) • Dunedoo Solar AFT 22 (Isolated Find) • Dunedoo Solar AFT 23 (Isolated Find)

While all the stone artefact sites within the Subject land are rated as having total loss of scientific value, it is argued that there are likely to be a number of similar sites in the local area and therefore the impact to the overall local archaeological record is considered to be low. Given that that the Development Footprint for the Dunedoo Solar Farm has been reduced, eight (9) sites with stone artefacts which were recorded during archaeological investigations for the Proposal would be avoided.

Given the low density of the subsurface material recovered from the testing program undertaken across the solar array area mitigation in the form of salvage excavation is deemed not be feasible or warranted in this instance. However, the high-density subsurface material recovered from the substation area suggests that further mitigation measures such as an excavation salvage programme is warranted. An excavation salvage programme at the substation works area was also requested by the Aboriginal representatives.

8.2.6 Mitigation Measures

The following management and mitigation strategy is recommended to manage potential impacts to Aboriginal heritage associated with the development.

Table 8-14 Mitigation measures for Aboriginal heritage values

Mitigation Measures	Phase
The sites Dunedoo Solar AFT 1 to Dunedoo Solar AFT 14 which are located within the Development Footprint for the Dunedoo Solar Farm must be salvaged via surface collection prior to construction works commencing for the Dunedoo Solar	Pre-construction

Mitigation Measures	Phase
Farm. Until surface collection salvage has occurred at the sites a minimum 5-metre buffer must be observed to ensure no inadvertent impacts occur.	
The collection and relocation of the surface artefacts within the Dunedoo Solar Farm Subject land should be undertaken by an archaeologist with representatives of the registered Aboriginal parties and be consistent with Requirement 26 of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales.* The salvage of Aboriginal objects can only occur following development consent that is issued for State Significant Developments and must occur prior to any construction works commencing.	Pre-construction
No mitigation is required prior to impacts to the previously recorded site AHIMS# 36-2-0049/ DTG/OC27 - Dunedoo 1. Following development consent that is issued for State Significant Development to allow impacts to the Aboriginal site AHIMS# 36-2-0049 an *Aboriginal Site Impact Recording Form* must be completed to list the site as destroyed.	Pre-construction
The sites Dunedoo Solar AFT 15 to Dunedoo Solar AFT 23 which are located outside the Dunedoo Solar Farm Subject land must not be impacted. Any future activities that may potentially pose a risk of impacts to these sites by this project would need to be assessed by an archaeologist and additional consultation with the registered Aboriginal parties would be required.	Pre-construction
Prior to works commencing adjacent to the existing Essential Energy Dunedoo Substation an excavation salvage programme must be undertaken for the site Dunedoo Solar AFT 24. The areas surrounding the locations of Pit 1 and Pit 3 which had high densities of subsurface artefacts recovered during the testing programme should be focus areas for the excavation salvage programme.	Pre-construction
All objects salvaged, following development consent that is issued for State Significant Developments, including those recovered from the subsurface testing and salvage excavation programmes, must be buried in line with Requirement 26 of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* and at an appropriate location within the Subject land that will not be subject to any ground disturbance. The burial location/s must be submitted to the AHIMS database.	Pre-construction
An *Aboriginal Site Impact Recording Form* must be completed and submitted to AHIMS following harm for each site collected or destroyed from salvage and/or construction works as approved for impacts in line the development consent for this State Significant Development.	Pre-construction
For any additional impacts to sites and areas outside the Subject land, as assessed in this report a modification application would need to be submitted to the to the Department of Planning, Industry and Environment (DPIE) for this State Significant Development which includes consideration of impacts on Aboriginal Heritage as determined by an archaeologist, additional Aboriginal consultation and survey may be required.	Pre-construction

Mitigation Measures	Phase
The Proponent should prepare a Cultural Heritage Management Plan (CHMP) to address the potential for finding additional Aboriginal artefacts during the construction of the Dunedoo Solar Farm and for the management of known sites and artefacts within the Subject land. The Plan should include the unexpected finds procedure to deal with construction activity. Preparation of the CHMP should be undertaken in consultation with the registered Aboriginal parties.	Pre-construction
In the unlikely event that human remains are discovered during the construction of the Dunedoo Solar Farm, all work must cease in the immediate vicinity. The appropriate heritage team within the Department of Planning, Industry and Environment (DPIE) and the local police should be notified. Further assessment would be undertaken to determine if the remains were Aboriginal or non-Aboriginal. If the remains are deemed to be Aboriginal in origin the Registered Aboriginal Parties should be advised of the find as directed by the appropriate heritage team within DPIE.	Construction
Further archaeological assessment would be required if the proposal activity extends beyond the area assessed in this report. This would include consultation with the registered Aboriginal parties and may include further field survey.	Pre-construction

8.3 VISUAL AMENITY AND LANDSCAPE CHARACTER

A visual impact assessment was undertaken by Moir Landscape Architecture Pty Ltd (Appendix F). The VIA provides a full assessment of the visual impacts associated with the Proposal, including:

- Landscape character and scenic vistas in the locality.
- Stakeholder values regarding visual amenity.
- Potential impacts on representative viewpoints, including residences and road corridors.

The purpose of the VIA was to identify the nature and degree of visual change that would be introduced into the landscape by the Proposal, assess whether it is an adverse or beneficial change, evaluate its significance and recommend mitigation measures where appropriate.

This report includes consideration of reflectivity and glare, an evaluation of potential visual impacts significant vistas in the locality, consideration of the *Dark Sky Planning Guideline: Protecting the observing conditions at Siding Spring*, and a draft landscaping plan.

8.3.1 Approach and Methods

The VIA identifies and determines the value, significance and sensitivity of a landscape. The assessment was undertaken as follows:

- Objective assessment of the relative aesthetic value of the landscape; defined as visual quality and expressed as high, medium or low. This assessment generally relates to variety, uniqueness, prominence and naturalness of the landform, vegetation and water forms within each character type.

- Determination of the landscape sensitivity and its ability to absorb different types of development on the basis of physical and environmental character.
- An assessment of viewer sensitivity to change. This includes how different groups of people view the landscape (for example, a resident as opposed to a tourist), and how many people are viewing the Proposal and from how far away.
- Viewpoint analysis to identify areas likely to be affected by development of the site and a photographic survey using a digital camera and a handheld GPS unit to record position and altitude.
- Preparation of photomontages depicting the Proposal.
- Assessment of visual impacts. Suggestions are made for suitable development patterns that would maintain the areas visual quality.

Assessment Method

Visual Sensitivity

Visual sensitivity is a measure of how critically a change to the existing landscape is viewed by people from different areas. The assessment is based on the number of people affected, land use, and the distance of the viewer from the Proposal (EDAW, 2000). Sensitivity ratings are defined as high, moderate or low and are shown in the table below.

Table 8-15 Visual sensitivity criteria

Land use	Distance zones				
	Foreground		Middle Ground		Background
	0 - 1 km	1 - 2 km	2 - 4.5 km	4.5 - 7 km	> 7 km
Tourist / recreation	High	High	High	Moderate	Low
Residential: rural or urban	High	High	High	Moderate	Low
Main travel corridor	Moderate	Moderate	Low	Low	Low
Minor / local roads	Moderate	Moderate	Low	Low	Low
Railway line (freight)	Low	Low	Low	Low	Low
Industrial areas	Low	Low	Low	Low	Low

Visual Effect

Visual effect is the interaction between a proposal and the existing visual environment. It is often expressed as the level of visual contrast of the Proposal against its setting or background in which it is viewed. The visual effects are assessed as:

- Low visual effect: occurs when a proposal blends in with its existing viewed landscape due to a high level of integration of one or several of the following: form, shape, pattern, line, texture or colour. It can also result from the use of effective screening often using a combination of landform and landscaping.
- Moderate visual effect: occurs where a proposal is visible and contrasts with its viewed landscape however, there has been some degree of integration (e.g. good siting principles employed, retention of significant existing vegetation, provision of screen landscaping, appropriate colour selection and/or suitably scaled development).
- High visual effect: results when a proposal has a high visual contrast to the surrounding landscape with little or no natural screening or integration created by vegetation or topography.

Visual Impact

Visual impact is the combined effect of visual sensitivity and visual effect. Various combinations of visual sensitivity and visual effect would result in high, moderate and low overall visual impacts as suggested in the below table (URBIS, 2009).

Table 8-16 Visual impact criteria

Visual sensitivity levels	**Visual effect zone**		
	High	**Moderate**	**Low**
High	High	High	Moderate
Moderate	High	Moderate	Low
Low	Moderate	Low	Low

8.3.2 Existing Environment

In terms of the visual landscape, the Proposal is located in the Orana Region of central NSW, within the rural area of Dunedoo, in the Warrumbungle LGA. Traditionally the area is rich farmland used for cattle, sheep and wheat-growing. The Talbragar River traverses the southern boundary of the Development Site. The site is located approximately 2 km north of the town of Dunedoo.

Land use at the Development Site includes improved pasture (lucerne) in the south-eastern corner, sown oats in the north-western paddock, and weedy pasture elsewhere. The land has mainly been used for sheep grazing (80%) and cattle grazing (20%) by the current landowners. On occasion, oats and winter grasses have been cultivated. The main production value from the lot is meat, and wool is secondary.

Similar agricultural land uses are undertaken on freehold properties surrounding the Development Site, which are also included in the RU1 LEP zone. The principal activities on surrounding properties are cattle grazing, sheep grazing, horse stud, and oat growing.

In reference to the Development Site, the Castlereagh Highway is located approximately 700 metres west, All Weather Road is on the southern boundary, and Digilah Road is approximately 500 metres east.

The Siding Spring Observatory is located approximately 85 km northwest of the Development Site. The Dark Sky Region is centred around this observatory which is considered Australia's most important visible-light observatory. The Dark Sky Region consists of land within a 200-km radius of the observatory, which therefore includes the development.

Landscape Character Units

The Development Site was divided into five (5) landscape character units (LCUs) as described below.

Table 8-17 Landscape character units

LCU	Visual amenity and quality
LCU1: Land Use	The development and surrounding sites are all zoned RU1 Primary Production.
LCU2: Roads	Major roads used to access the site include the Golden Highway and Castlereagh Highway. Local roads used to directly access the site are All Weather Road and Digilah Road.
LCU3: Topography	The topography of the area is fairly flat to a gently undulating land form consistent with central western NSW landscapes. Long range views from the site to the north provide the scenic back drop of rolling hills and a more densely vegetated landscape.
LCU4: Vegetation	The site has undergone significant modification of its land cover and has been predominantly cleared, in line with its history as a 'working rural' property. Retained vegetation is limited along water courses, roadsides and along the perimeters of paddocks and property boundaries.
LCU5: Cultural Heritage	The area is on the border of Wiradjuri and Kamilaroi country and there is evidence to suggest that there was Aboriginal habitation in the area. There are few Aboriginal people still residing in the area and it is suggested that there were past massacres due to conflict over land and water as farms and mines expanded. Dunedoo is known for its bush poetry.

Values of the local community

Community consultation undertaken to inform the assessment and design of the Proposal is summarised in Section 6 of this EIS.

8.3.3 Potential Impacts

Viewpoint Analysis

Viewpoints have been carefully selected to be representative of the range of views surrounding the Development Site. The selection of viewpoints is informed by topographical maps, field work observations, landscape character and the popularity of vantage points. A total of 15 viewpoints were taken from publicly accessible roads surrounding the site, refer to Figure 8-13. The viewpoints which have been included represent the areas from where the Development Site would appear most prominent, either based on the degree of exposure or the number of people likely to be affected.

Figure 8-13 Viewpoint assessment locations and photomontages locations

Table 8-18 below evaluates the representative viewpoints based on their land use, effect and impact. Four (4) montages were also produced as part of the assessment and provided in Figure 8-14 to Figure 8-17.

Of the 15 viewpoints from which the Proposal would be visible, five (5) received a Visual Impact Rating of 'low' and 10 received a Visual Impact Rating of 'moderate'. Assessed viewpoints were found to have a low potential for visual impact, although mitigation was considered appropriate from some vantages.

Primarily viewpoints that were rated as 'moderate' consisted of views into the site that were already screened or fragmented by topography or existing established vegetation. The addition of screen planting would further reduce the visual impact.

Table 8-18 Viewpoint analysis

Viewpoint	Distance to site	Viewpoint description	Land use	Visual effect	Visual sensitivity	Visual impact	Comment
1	1.25 km	This view is looking north west towards the site from Digilah Road. This is a minor road which connects to the Golden (Castlereagh) Highway and provides access to the eastern boundary of the proposed solar farm. The topography in this area is relatively flat and the landscape has been generally cleared of vegetation for farming, with the exception of roadside vegetation. A transmission line easement runs along the western edge of the roadside.	RU1	Low	Moderate	Low	From this viewpoint the proposed solar farm will be visible, appearing as a grey band in the distant ground. The solar farm will be partially screened due to a combination of the flat topography, existing vegetation both in the foreground and also along the southern boundary to the site and All Weather Road. The visual effect from this viewpoint is assessed as low resulting in an overall visual impact of low.
2	560 metres	View from the intersection of All Weather and Digilah Road, looking north west. All Weather Road, is a minor local road which runs east west connecting Digilah Road and the Golden (Castlereagh) Highway.	RU1	Moderate	Low	Low	From this viewpoint the solar farm will be visible, given the flat topography of the site and minimal vegetation screening. Due to proximity the visual effect from this location will be moderate. The Visual Impact is determined to be low. Refer to photomontage PM01. Mitigation measures from this viewpoint have been recommended. This will reduce the visual effect to being rated as low
3	1.38 km	This photo is taken from Digilah Road looking south west. Digilah Road is a minor road which provides access to the eastern boundary of the solar farm. The landscape has been substantially cleared for use as rural land. Native trees remaining are scattered through the landscape and	RU1	Moderate	Moderate	Moderate	From this viewpoint the proposed solar farm will be visible. Due to the distance to the proposal the visual effect is considered to be low. The overall visual impact form this viewpoint is considered to be low. Refer photomontage PM02

Viewpoint	Distance to site	Viewpoint description	Land use	Visual effect	Visual sensitivity	Visual impact	Comment
		compose stands along drainage lines and fenced boundaries. The topography is generally flat, inclining slightly to the south towards the town centre of Dunedoo.					Mitigation measures such as screen planting along the eastern boundary of the proposed site should greatly reduce any visual impact from this viewpoint. The visual effect from this viewpoint is rated as low
4	1.22 km	View from the corner of Digilah Road and Lawson Park Road. Both roads are local roads which provide access to rural properties. The landscape has been substantially cleared for use as rural land. Native trees remaining are scattered through the landscape and compose stands along drainage lines and fenced boundaries. The proposed site is generally of flat topography.	RU1	Moderate	Moderate	Moderate	From this viewpoint the solar farm would be visible, appearing as a grey band in the distant ground. Due to the distance from the proposal the Visual Effect is considered to be low. The overall visual impact is determined to be low. Refer to Photomontage PM03. Mitigation measures such as screen planting along the eastern boundary of the proposed site should greatly reduce any visual impact from this viewpoint. The Visual Effect is rated as moderate.
5	50 metres	View from All Weather Road, servicing rural properties, looking in a north easterly direction towards the proposal. Native trees remaining are scattered through the landscape and compose stands along drainage lines and fenced boundaries. The proposed site is generally of flat topography.	RU1	High	Moderate	High	From this viewpoint the solar farm would be visible, given the flat topography of the site and virtually no natural vegetation screening. Due to the close proximity and contrasting nature of the panels within the view the visual effect of the Study Site from this viewpoint is rated moderate.
6	650 metres	View from All Weather Road proximate to the intersection with the Castlereagh Highway. Views from this point are generally open across the flat landform of the rural landscape, however dense vegetation to the east, obscures views directly to the site. Multiple overhead transmission lines and	RU1	Low	Moderate	Low	From this location the proposed solar farm would be primarily screened by the existing vegetation. Based on distance to the site, topography falling away from this viewpoint and existing screen vegetation the Visual Effect is rated as low The Visual Impact is rated as low. Refer to photomontage PM06.

Viewpoint	Distance to site	Viewpoint description	Land use	Visual effect	Visual sensitivity	Visual impact	Comment
		associated easements are visible in the foreground.					
7	980 metres	View from the Castlereagh Highway adjacent to a private access road. The Castlereagh Highway is a main road, providing access into the town centre of Dunedoo. Views from this location are generally open across the flat rural landscape. Scattered trees can be seen in the foreground; however, the land has been generally cleared for farming purposes.	RU1	Low	Moderate	Low	From this viewpoint the proposed solar farm would be visible, due to the flat topography, appearing as a thin grey line on the horizon. The view would be partially obscured however, by a combination of the distance from the Study Site and existing vegetation. Mitigation measures from this viewpoint include screen planting along the boundary of the site. The visual effect from this viewpoint is assessed as low.
8	1.68 km	View from Digilah Road proximate to the intersection with the Castlereagh Highway. Digilah Road is a minor road which provides access to the eastern boundary of the proposed solar farm. Views from this point are generally open across the flat landform of the rural landscape, however existing vegetation obscures views directly to the site. Multiple overhead transmission lines and associated easements are visible in the foreground.	RU1	Low	Moderate	Low	From this location the proposed solar farm would be visible to the north west, appearing as a very thin grey line on the horizon. The solar farm would be slightly obscured by a combination of distance, flat topography and existing vegetation. Mitigation measures from this viewpoint could be greatly reduced through screen planting along the boundary of the site. The visual effect from this viewpoint is assessed as low.
9	2.9 km	The view from the residential area of Dunedoo, on the laneway behind the houses fronting Yarrow Street, looking north towards the site. The view is dominated by residential housing in the foreground and the rural landscape in the distance.	R1	Low	High	Moderate	From this location it is likely the proposed solar farm would be significantly screened by the residences, associated buildings and vegetation. The solar farm will be partially visible through the small gaps in these elements.

Viewpoint	Distance to site	Viewpoint description	Land use	Visual effect	Visual sensitivity	Visual impact	Comment
							The visual effect from this viewpoint is assessed as low.
10	3 km	View looking north along Tallawang Street, south of the intersection with Yarrow Street. Views from this location are generally concealed by residential housing and associated vegetation, roadside planting and overhead transmission lines.	R1	Low	High	Moderate	From this location it is likely the proposed solar farm will be partially visible through the gaps in the buildings and vegetation; however, it will be generally obscured by these elements. Given the distance from the site, it is likely the solar farm would appear as a thin grey line, which would not be sufficient to substantially alter the character of the view. The Visual Effect is rated as low.
11	2.9 km	View looking in a north to north east direction from the intersection of Tallawang and Yarrow Streets. Views to the site are generally concealed by residential housing and associated vegetation, roadside planting and overhead transmission lines.	R1	Low	High	Moderate	From this location it is likely the proposed solar farm will be visible through the gaps in the buildings and vegetation; however, it will be generally obscured by these elements. Given the distance from the site, it is likely the solar farm would appear as a thin grey line, which would not be sufficient to substantially alter the character of the view. The Visual Effect is rated as low.
12	3.8 km	View looking north towards the site from Tallawang Street. The view is dominated by residential housing, vegetation and overhead transmission lines.	R1	Low	High	Moderate	From this location it is likely the proposed solar farm will be partially visible through small gaps in the buildings and vegetation. Combined with the distance from the site, the solar farm will not be sufficient to alter the character of the view. The Visual Effect is rated as low.
13	2.84 km	View from the intersection of Merrygoen and Yarrow Streets. Views from this location are	RU1	Low	High	Moderate	From this location it is likely the proposed solar farm will be partially visible through small gaps in

Viewpoint	Distance to site	Viewpoint description	Land use	Visual effect	Visual sensitivity	Visual impact	Comment
		generally concealed by residential housing, vegetation, signage and overhead transmission lines.					the buildings and vegetation. Combined with the distance from the site, the solar farm will not be sufficient to alter the character of the view. The Visual Effect is rated as low.
14	2.7 km	View from the residential area of Dunedoo looking north from the intersection of Tucklan and Merrygoen Streets. The view is dominated by residential housing, vegetation and overhead transmission lines.	RU1	Low	High	Moderate	From this location it is likely there would be limited views of the proposed solar farm between the buildings and vegetation. Combined with the distance from the site, the solar farm will not be sufficient to alter the character of the view. The Visual Effect is rated as low.
15	2.75 km	This view is looking north from the residential area of Dunedoo, on the corner of Tallawang Street and Tucklan Street. Views towards the site are concealed by the residential housing, vegetation and overhead transmission lines in the foreground.	RU1	Low	High	Moderate	From this location it is likely there would be limited views of the proposed solar farm between the buildings and vegetation. Combined with the distance from the site, the solar farm will not be sufficient to alter the character of the view. The Visual Effect is rated as low.

PHOTOMONTAGE: PM01

EXISTING VIEWPOINT: VP02

SOLAR PANELS

SOLAR PANELS WITH PROPOSED MITIGATION (10 year projection)

Figure 8-14 Photomontage 1 VP02

Photomontage PM02

EXISTING VIEWPOINT: VP03

SOLAR PANELS

SOLAR PANELS WITH PROPOSED MITIGATION (10 year projection)

Figure 8-15 Photomontage 2 VP03

Photomontage PM03

EXISTING VIEWPOINT: VP04

SOLAR PANELS

SOLAR PANELS WITH PROPOSED MITIGATION (10 year projection)

Figure 8-16 Photomontage 3 VP04

Photomontage PM04

EXISTING VIEWPOINT: VP05

SOLAR PANELS

Figure 8-17 Photomontage 4 VP05

Photomontage PM05

EXISTING VIEWPOINT: VP06

SOLAR PANELS

SOLAR PANELS WITH PROPOSED MITIGATION (10 year projection)

Figure 8-18 Photomontage 5 VP06

Photomontage PM06

EXISTING VIEWPOINT: VP07

SOLAR PANELS

SOLAR PANELS WITH PROPOSED MITIGATION (10 year projection)

Figure 8-19 Photomontage 6 VP07

Visual Impact Assessment at Representative Viewpoints

The nature and scale of the Proposal would create a new landscape and visual environment. Overall, the Proposal would result in impacts on the existing landscape elements, character and quality in the context of the site and its environs. The visual impacts associated with the proposal will vary depending on the viewing location.

The Warrumbungle LEP does not include any specific landscape character values for the rural zone that applies to the Development Site. The Warrumbungle Development Control Plan 2015 section 5 (Warrumbungle Shire Council 2015), covering objectives of rural development controls to RU1 land zone, lists the fairly general objectives to achieve well designed and sited dwellings and outbuildings that complements the landscape, and, in the opinion of Council, do not cause adverse visual impacts.

The solar panel arrays are relatively low lying, reaching a maximum height of approximately 3 metres above the existing ground level. The solar plant would be constructed as an array of panels arranged in a north south direction, tracking east to west on a single axis. The highest visual effect of the PV panels is likely to be seen from the east and west, where the most surface area is visible. Visibility of the solar plant from the north and south would be significantly lower. The visual impact is likely to be greatest during the construction phase.

The Proposal is situated between Castlereagh Highway, All Weather Road and Digilah Road, which are unsealed roads. There are clear and close views to the Site from these local roads. Views from Digilah Road and All Weather Road have the most significant change in character from the public domain. However, visual impact in close proximity is generally brief and, due to the low nature of the development, easily mitigated with screen planting along the boundary line. It should also be noted that no uninvolved receivers are identified on All Weather Road.

The site is relatively close to the outskirts of Dunedoo town and could be considered a transition zone between the density of the town and the broader rural landscape beyond. The visual characteristics of this rich farming land are important to members of the local community. However, the residents of Dunedoo are over 2 km from the site, and views from these receivers would be screened by buildings and vegetation. Due to the undulating nature of the topography, and distant views to the site, it is likely the solar panels would appear as grey/black lines within open paddocks.

Dark Sky Region

Additional impacts are relevant to the Proposal, given its location within the Dark Sky Region for the Siding Spring Observatory. Construction has potential to increase the levels of dust in the locality temporarily. Excavation would be minimal; however, the traffic on unsealed internal access track and local roads is likely to increase local dust levels, particularly in dry conditions. Dust would be suppressed during construction through the use of appropriate machinery, surface watering applications and covering of loads. Minimal night lighting (limited security lighting) is proposed further reducing the night time impact of dust and light.

During operation, the dust generation would likely be less than for existing agricultural land uses. The arrays themselves as well as the ground cover retained beneath the array would limit dust generation and movement. The unsealed perimeter access track would have low traffic levels during operation and is unlikely to generate substantially more dust that existing farm access tracks onsite. Limited security lighting is proposed.

Given that the Development Site is approximately 85 km south of the Siding Spring Observatory, potential light pollution impacts would be negligible during construction and operation of the solar farm. General measures to minimise light pollution are detailed in the following section.

Reflectivity

The solar panels proposed for the installation are designed to absorb the suns energy and directly convert it to electricity. Modern PV modules absorb approximately 82-93% of the light received. The solar panels are designed using anti-reflective solar glass effectively reducing reflectivity. Thin slivers of metal stripping on the face of the panels further reduce any potential glare issues that may occur. The level of glare and reflectance from the solar panels are considerably lower than the level of glare and reflectance of common surfaces. The solar panels would reflect approximately 7-18% of energy which is less than typical rural environments which have a reflectivity of approximately 15-30%. Figure 8-20 compares the percentage of reflected energy from common reflective surfaces to that of a PV solar panel.

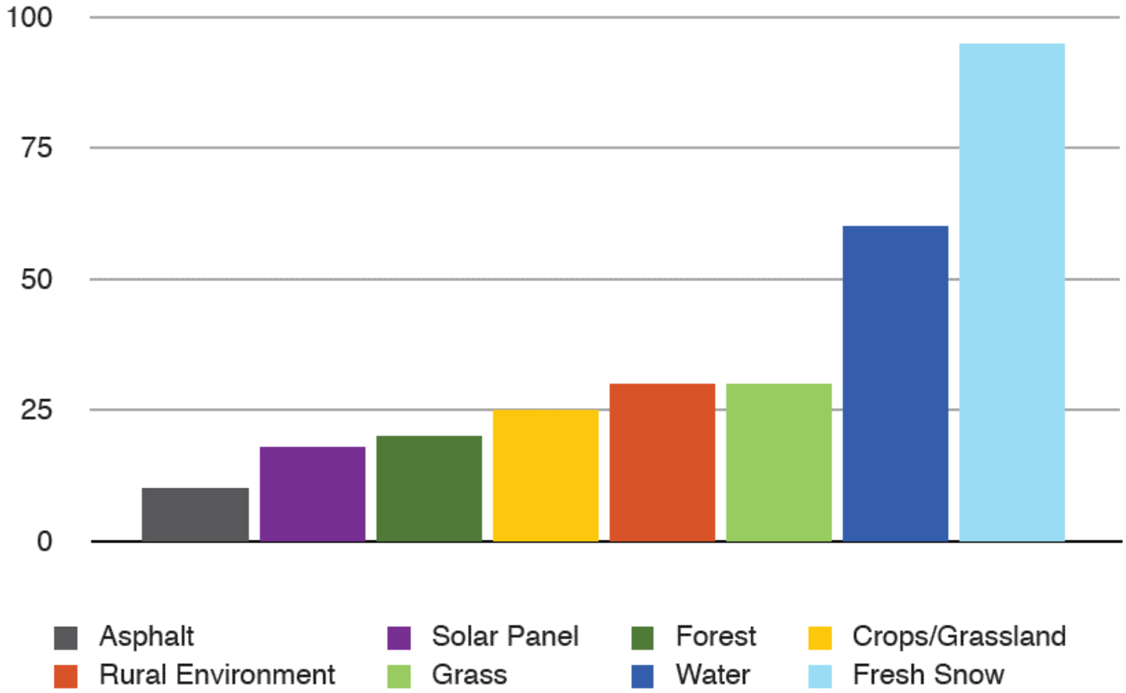


Figure 8-20 Comparative reflection analysis

8.3.4 Mitigation Measures

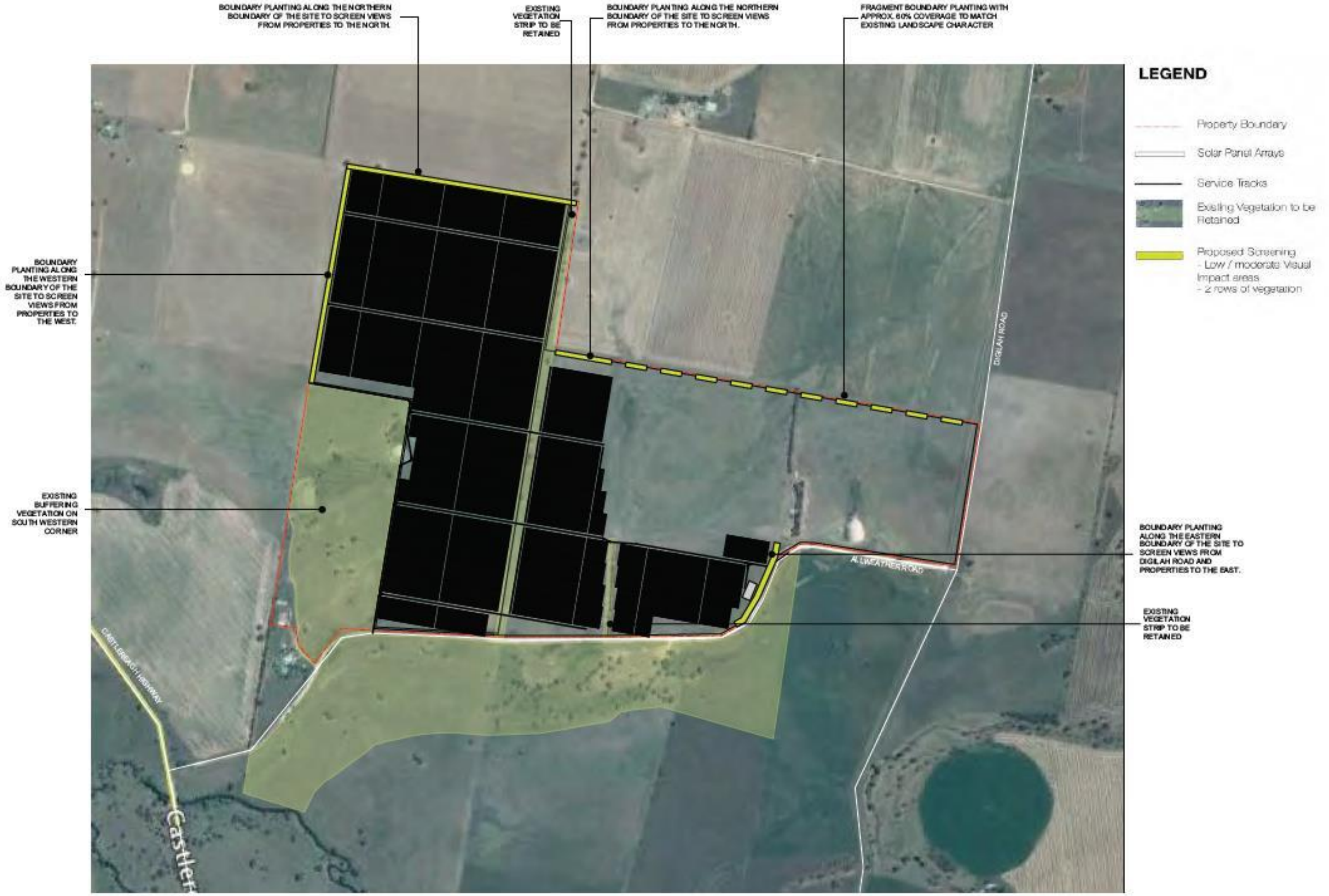


Figure 8-21 Proposed location of screen planting

Table 8-19 Mitigation measures for visual and landscape character impacts

Mitigation measures	Phase

A Landscape Management Plan is recommended to address the 'as built' visual impacts of the proposed solar farm. The plan should include:
• On-site vegetation screening generally in accordance with **Figure 8-21**). This would include details of:
    o selected species aimed at 'breaking up' not blocking views of onsite infrastructure. These should generally be native to the area, fast growing small trees and bushes and low lying vegetation
    o Location of planting locations, generally expected to be between the security fencing and the property boundary
    o Band width, generally expected to be approximately 6m with three (3) rows of vegetation in high visual impact areas and two (2) rows in low / moderate visual impact areas
    o Maintenance schedule for a period of 24 months. Maintenance should generally include the removal of weeds and replacement of dead or non-performing plants
• General methods to reduce visual impact of buildings. This would centre on the colour and materials of infrastructure, to reduce the overall visual contrast and reflectivity of the project.
The plan would be implemented nearing completion of construction.
	Construction

8.4 HYDROLOGY AND FLOODING

A Flood Impact Assessment (FIA) has been carried out by BMT WBM. The objective of the study is to identify the likely impacts of flooding on the infrastructure of the Proposal and surrounds. The detailed report is provided in Appendix G.

8.4.1 Existing Environment

Murray-Darling Basin

Three (3) major rivers comprise the surface water system in the Central West subregion: Macquarie, Castlereagh and Bogan River. These rivers define the Macquarie-Castlereagh Catchment within the Murray-Darling Basin.

The following table provides a summary of the Catchment's key factors (Murray-Darling Basin Authority):

Table 8-20 Macquarie-Castlereagh Catchment attributes

Item	Description
Catchment area	7% of the Murray-Darling Basin
Contribution to basin water	8.4%
Annual stream flow	1,175 GL (Macquarie at Dubbo)
Key water uses	Irrigated agriculture, urban water, industrial water supply.

Rivers associated with the Catchment are highly regulated, with many small dams built to secure town water supplies. Burrendong Dam near Wellington provides flood mitigation and stores water for environmental purposes, including watering of the Macquarie Marshes.

The Talbragar River is a major tributary to the Macquarie River. The Talbragar River drains the western slopes of the Great Dividing Range – its headwaters being situated in the Coolah Tops – and discharges to the larger Macquarie River, downstream at Dubbo. The Macquarie River forms part of the broader Murray-Darling Basin. The contributing catchment area of the Talbragar River at Dunedoo is approximately 2,000 km^2.

The Talbragar River has the characteristics of an ephemeral system. Flow levels are at their lowest in the summer and autumn, whilst flooding may occur in the winter and spring. A monitoring gauge for the river, operated by NOW and located near Dunedoo (421904), indicated a water level of 0.802 metres, in January 2020. The mean annual discharge rate at the Elong gauge (421042) for the year 2016 was 288.68 ML/d, and in 2017 was 1.87 ML/d, no discharge was recorded for 2018 and 2019, which is indicative of the severe drought experienced in the last years. Elong gauge station is located 40 km downstream of the site. The maximum recorded discharge was in 1998 at 264,366 ML and no discharge data has been recorded since January 2018.

Flood Management

A Flood Management Plan (FMP) has been prepared for the Macquarie River floodplain, from Narromine to Oxley Station. The Macquarie River is a regulated river with two (2) dams in its headwaters: Windamere Dam and Burrendong Dam. Windamere Dam has a relatively insignificant impact on flooding in the Macquarie River at and below Narromine, and Burrendong Dam can be operated to have a significant mitigating effect on minor to medium sized floods within the FMP floodplain. As such the FMP does not cover the Development Site.

Warrumbungle Shire Council has implemented a Local Flood Plan, developed by the State Emergency Services (Warrumbungle Shire Council Local Flood Plan, May 2007). The purpose of the plan is to ensure the appropriate implementation of preparedness, response operations and coordination of recovery, between the council and local safety and security services. The plan provides information on flood threat by river and a brief historical account of flood events in Dunedoo and along the Talbragar River.

Historically, the council area averages 500-600 mm of rain annually (during non-drought periods), with the summer months being the wettest and the period between November and March receiving more than half the annual rainfall. Heavy rains do however occur in other seasons of the year.

With regards to flooding, records dating back to the 1970s reveal that flooding in the Council area is infrequent and levels are generally low. In specific regards to the Talbragar River, flooding is known to occur on a periodic basis, however the severity of the floods is too low to cause any damage to buildings and infrastructure. In Dunedoo, flooding can occur in the north portion of the town and across the low flats, but not within the town itself. Under extreme flood conditions, the main east-west highway may be closed.

Flood events which have broken the bank of the river and exceeded the Annual Exceedance Probability (AEP) occurred in 1870, 1920, 1926, 1950 and 1955. The following extracts from the Warrumbungle Shire Council Local Flood Plan (May 2007) provide further detail of the 1955 flood and predicted flood levels:

> ‘*The flood of 1955 was the largest on record. This flood, which was produced by record rainfalls in the upper catchment, caused extensive damage. By comparison the floods of 1920 and 1950, which were the next highest, only backed up into the low spots along the river, filling old meander arms and covering low flats, and caused little damage. The floods of the period since 1955 have only rarely broken the river's banks and then only for short periods and short reaches’.*
>
> *‘No calculation of the gauge heights which would be reached by floods of PMF (Probable Maximum Flood) proportions have been made for locations within the council area, but an indication of the potential height of an extreme event at Mendooran is given by an estimate at Gilgandra of the level which would be reached in a `once-in-2500-years' flood. Such a flood, which would have a peak discharge three times that of the 1% AEP event (which is roughly approximated by the 1955 flood at Gilgandra) is thought likely to reach a level 3.5m higher than the 1955 flood’*.

Typically, the impacts from flooding in the Warrumbungle Shire Council area result with road closures and inundation of property and dwelling, but do not specifically require evacuation of properties. Where impacts are more sever, damages range from loss of farm operations to washing away of fences, small structures and removal of large volumes of topsoil.

Development Site

The natural surface hydrology of the Development Site and surrounding properties has been moderately modified by minor levelling for agricultural activities and the construction of stock dams. There are currently no natural watercourses or wetlands within the Development Site.

Gradients are very low and there is no evidence of soil erosion or channel instability, as such run-off of surface waters from precipitation is unlikely.

The BMT WBM Flood Study (Appendix G) used TUFLOW modelling software to simulate various flood conditions, as requested by the SEARs, from the Talbragar River and assess the Development Site's flood risk.

The flood study comprised of the following data analysis and activities:

- Flood frequency analysis at the Elong gauge to derive design flood flows
- Analysis of recorded flood events to determine typical durations of flood inundation
- Development of a TUFLOW model for hydraulic assessment
- Simulation of design flood conditions to establish the site flood risk.

Flood Frequency Analysis

The TUFLOW FLIKE extreme value analysis package was used to undertake the flood frequency analysis. The flood frequency analysis was developed using annual series of maxima flows (AMAX), which were derived from the peak water levels recorded from the Elong gauge station over a 46-year period, as such the flood frequency analysis for the Talbragar River at Elong presents the best available data from which to estimate design peak flood flows at Dunedoo.

The flood frequency analysis flows at Elong was scaled down from a 3,000-km^2 catchment area to a 2000-km^2 catchment area, to better reflect the flooding capability for the Talbragar. The following table summarises the design peak flows derived from the Elong flood frequency analysis and those derived for Dunedoo.

Table 8-21: Design peak flood flows

Design Event	Elong (m^3/s)	Dunedoo (m^3/s)
20% AEP (1 in 5-year)	180	160
10% AEP (10-year)	320	280
5% AEP (20-year)	500	420
2% AEP (50-year)	770	650
1% AEP (100-year)	1,000	850
0.5% AEP (200-year)	1,250	1,100
0.2% AEP (500-year)	1,600	1,400

AEP: Annual Exceedance Probability.

Extrapolation for the Probable Maximum Flood (PMF) for a 2,000-km^2 catchment, using the above data reveals, that for a 0.0002% AEP (1 in 5000 year) the peak flow would be 4000 m^3/s.

The flood model was developed using a 2D TUFLOW HPC software. The model used the following data and assumptions:

- Catchment areas and slopes derived from available LiDAR and NSW Department of Finance Services and Innovation (DFSI) Surface Model Enhancement (SME) product.
- Hydraulic roughness for runoff calculations assumed to be 0.06
- 24-hour design rainfall intensities from BoM 2016 Intensity Frequency Durations
- 24-hour design rainfall temporal pattern from Zone 1 of Australian Rainfall and Runoff 1987
- Initial loss of 35 mm and continuing loss of 2.5 mm/h.

Flood Model Results

Flood modelling results for the AEP presented in Table 8-11 are provided in Appendix A of the specialist BMT WBM study (refer to Appendix G). The model results reveal that the riparian corridor of the Talbragar River conveys the majority of flow. However, there are also a number of flood runners within the floodplain that act as significant conveyors of floodwater.

Modelled 1% AEP peak flood velocities within the Talbragar River channel are typically between 1.5 m/s and 2.5 m/s and between 0.5 m/s and 1.0 m/s within the major flood runners. Outside of the major flood runners the modelled velocities on the floodplain are less than 0.5 m/s.

Figure 8-7 represents the flow distribution across the floodplain for the 1% AEP design event.

The modelled peak flood levels at the reporting locations presented in Figure 8-7 are provided in the following table.

Table 8-22 Modelled design peak flood levels, metres AHD

Design Event	Location A	Location B	Location C	Average Flood Levels (m AHD)	Average Flood Levels (m)
Ground Surface	380.5	380.7	379.2	380.1	N/A
20% AEP	380.9	380.9	379.2	380.3	0.2
10% AEP	381.0	380.9	379.3	380.4	0.3
5% AEP	381.1	381.0	379.3	380.5	0.4
2% AEP	381.2	381.1	379.4	380.6	0.5
1% AEP	381.3	381.2	379.4	380.6	0.5
0.5% AEP	381.6	381.3	379.5	380.8	0.7
0.2% AEP	381.8	381.4	379.6	380.9	0.8
PMF	382.5	381.7	380.3	381.5	1.4

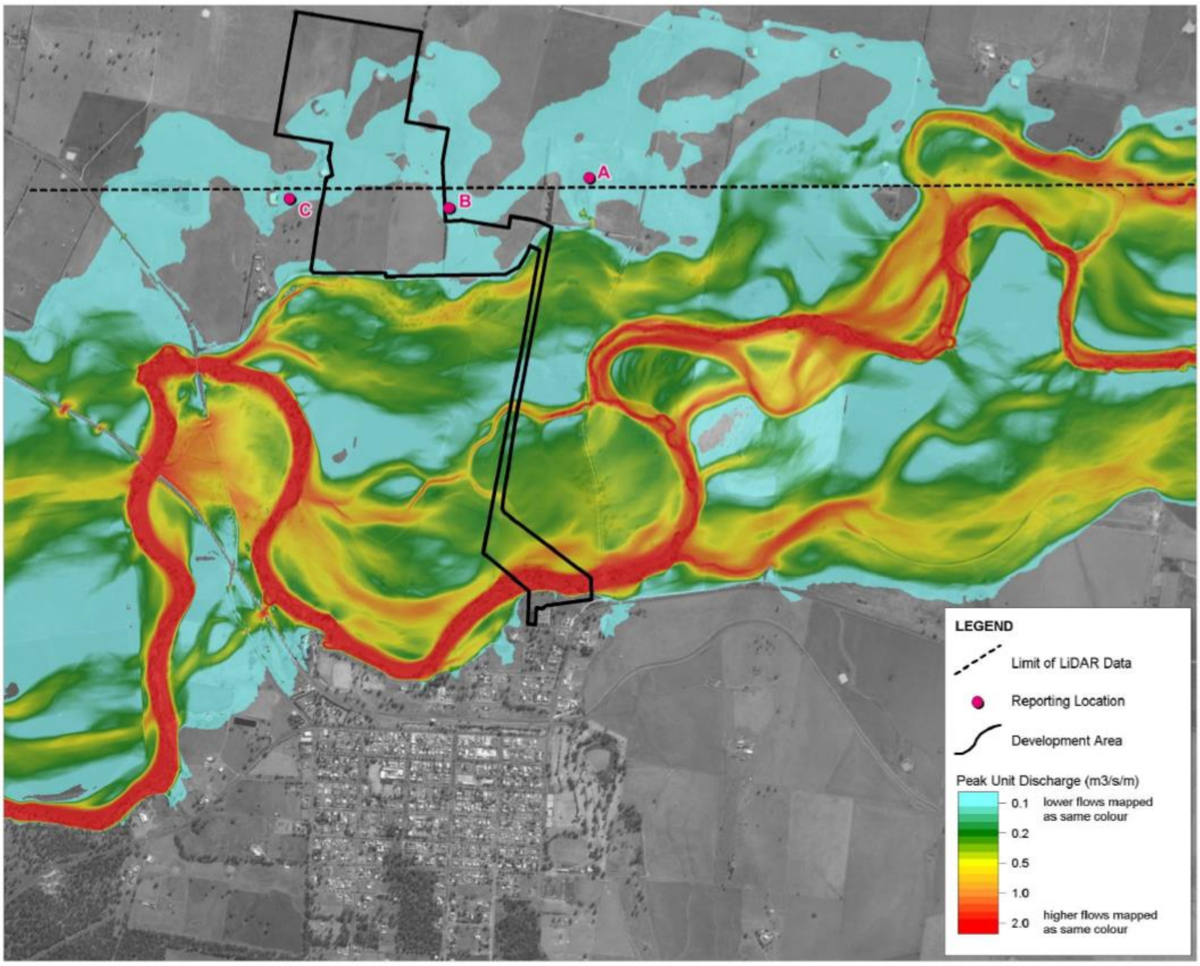


Figure 8-22 1% AEP flood flow distribution (BMT, 2020)

The elevation across the majority of the Development Site ranges between 379 and 382 metres AHD, where representative elevations at Locations A, B and C are provided above. The proposed substation location is sited on elevations ranging 380.3 - 381.0 metres AHD.

The highest flood level achieved would be 382.5 metres AHD at Location A during the PMF, which represents a flooding of approximately 2 metres. During a 0.2% AEP, the flood levels would achieve 381.8 metres AHD at the same location and for a 2% AEP the levels would be 381.2 metres AHD.

The average flooding across the Development Site for each design event ranges from 380.3 metres AHD to 381.5 metres AHD. With the average elevation of representative locations being 380.1 metres AHD, this would represent an average flooding of 0.2 metres for a 20% AEP event to 1.4 metres for a PMF event, however, the occurrence of this event is extremely unlikely within the operational life of the Proposal.

The results of the modelling study conclude that the Development Site is not located within an area of high flood risk.

The flood event of November 2000 was the second largest event recorded at the Elong gauge, since 1971. The peak flow rate was approximately 535 m^3/s, which is similar to the 5% AEP flood design magnitude. The Landsat 7 imagery shown in Figure 8-8, has been processed into a false colour composite using the near-infrared, shortwave-infrared and red channels. These highlight areas of standing water and wet ground. Relatively dry areas appear as greens within the image, with the extent of flood inundation appearing as blue/purple. The areas of inundation within the Development Site are readily identifiable.

Figure 8-23 November 2000 Landsat 7 Imagery (BMT, 2020)

8.4.2 Potential Impacts

Construction

Activities occurring during the construction of the Proposal would be confined to the Development Site shown in Figure 4-14. There would also be some additional works to include a passing lane on All Weather Road and upgrade the intersection of Castlereagh Highway / All Weather Road.

Construction works associated with the proposed development would be located within the designated floodplain. Much of the Development Site is either flood-free or flood-fringe. There are some areas of floodway and flood storage (refer to Figure 8-5), however, given the nature of the Proposal, it is considered a compatible use (subject to flood impact assessment) given that it presents limited obstruction to the flow of flood waters or loss of flood storage.

The Proposal would therefore not result in modifications within the floodway or modifications to existing levees.

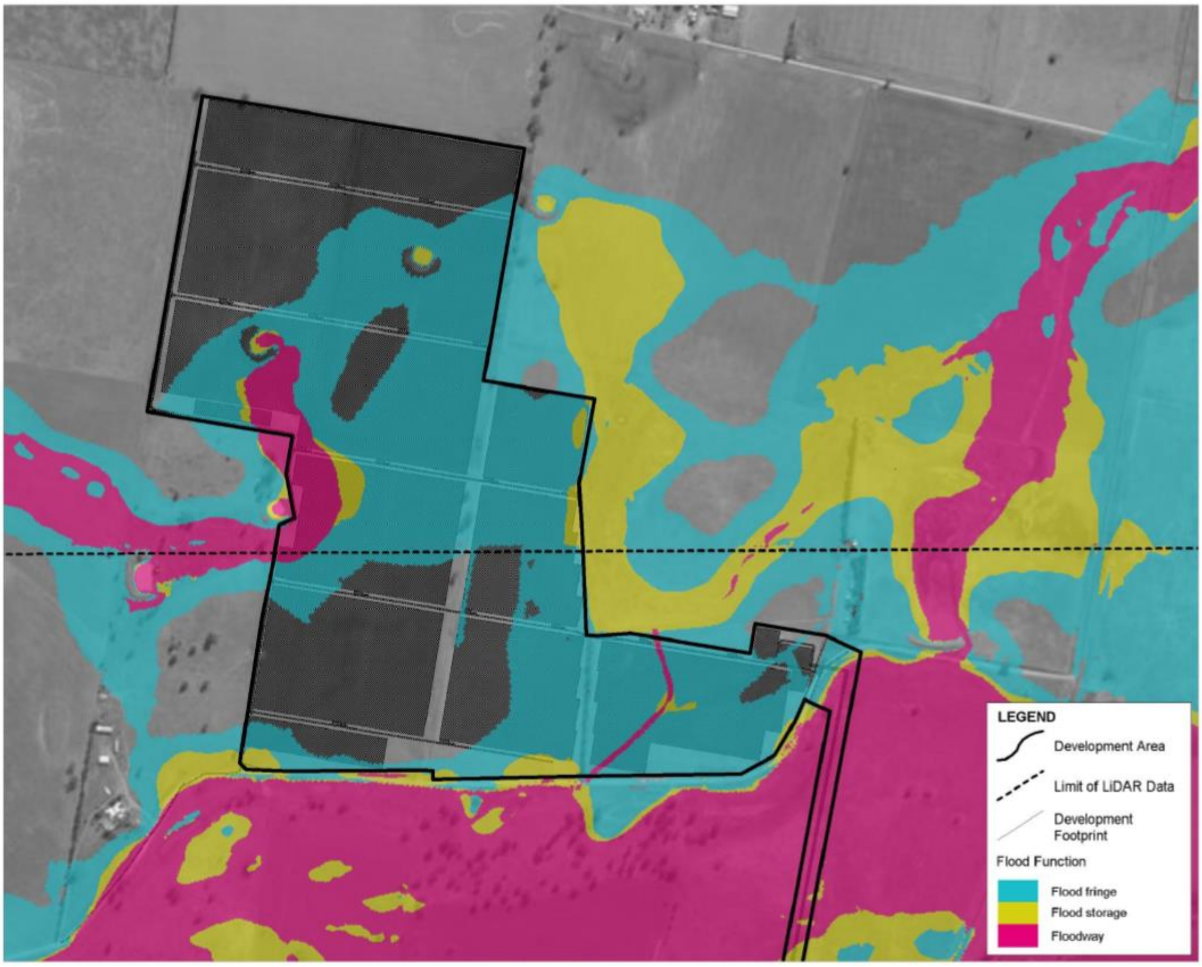


Figure 8-24 AEP flood function (BMT, 2020)

It is noted that while the Development Site is located outside of the floodway network, events greater than 5% AEP would overflow onto the floodplain, which last occurred in 1971. Potential sedimentation impacts may result if this event were to take place during construction period.

These risks will be managed by the implementation of appropriate erosion and sediment control measures. If a heavy rainfall event was predicted, the site should be stabilised, and work ceased until the wet period had passed. This measure is included in Section 9.1.

The design of the solar farm includes the construction of surface drainage structures in association with roads and buildings at the site. A Site Drainage Plan covering the construction and operation phases would be developed prior to commencement of works.

Operation

Flood impacts can relate to the potential of a development to increase the risk of flood occurrence or severity, or the potential to create hazards in the event of a flood affecting the site. Based on available information, the site does not appear to be at high risk from flooding from natural watercourses or channel overflow.

The Proposal would not substantially affect landforms at the site and existing flood patterns are unlikely to be affected. Surface drainage structures would be constructed in association with roads and buildings at the site. A Site Drainage Plan covering the construction and operation phases would be developed prior to commencement of works.

The Proposal has potential to create the following hazards in the event of a flood:

- Electrical hazards to staff, emergency workers and assets due inundation of infrastructure
- Pollution risks from leakage of stored pollutants (hydrocarbons, pesticides, solvents)
- Physical damage from the mobilisation of components in flood waters.

The design of buildings and equipment foundations would consider the potential for flooding at the site. Inverter/transformer stations would be constructed on concrete footings approximately 300 mm above ground level. At the 0.2% AEP event, four (4) inverter/transformer stations are predicted to be subject to flood depths exceeding 300 mm. As such, a 600-mm clearance for these units should provide for a comparable level of flood immunity at the following inverter locations (GDA 94, Zone 55) as shown in Figure 8-25.

No components are considered susceptible to becoming mobile and entering waterways. All potential pollutants stored on-site would be bundled and stored in accordance with HAZMAT requirements.

The establishment of perennial grass cover across the site would help maintain soil stability during floods and would improve soil permeability over time.

A flood response plan would be developed to manage the safety of workers and equipment in the event of extended flooding in the region.

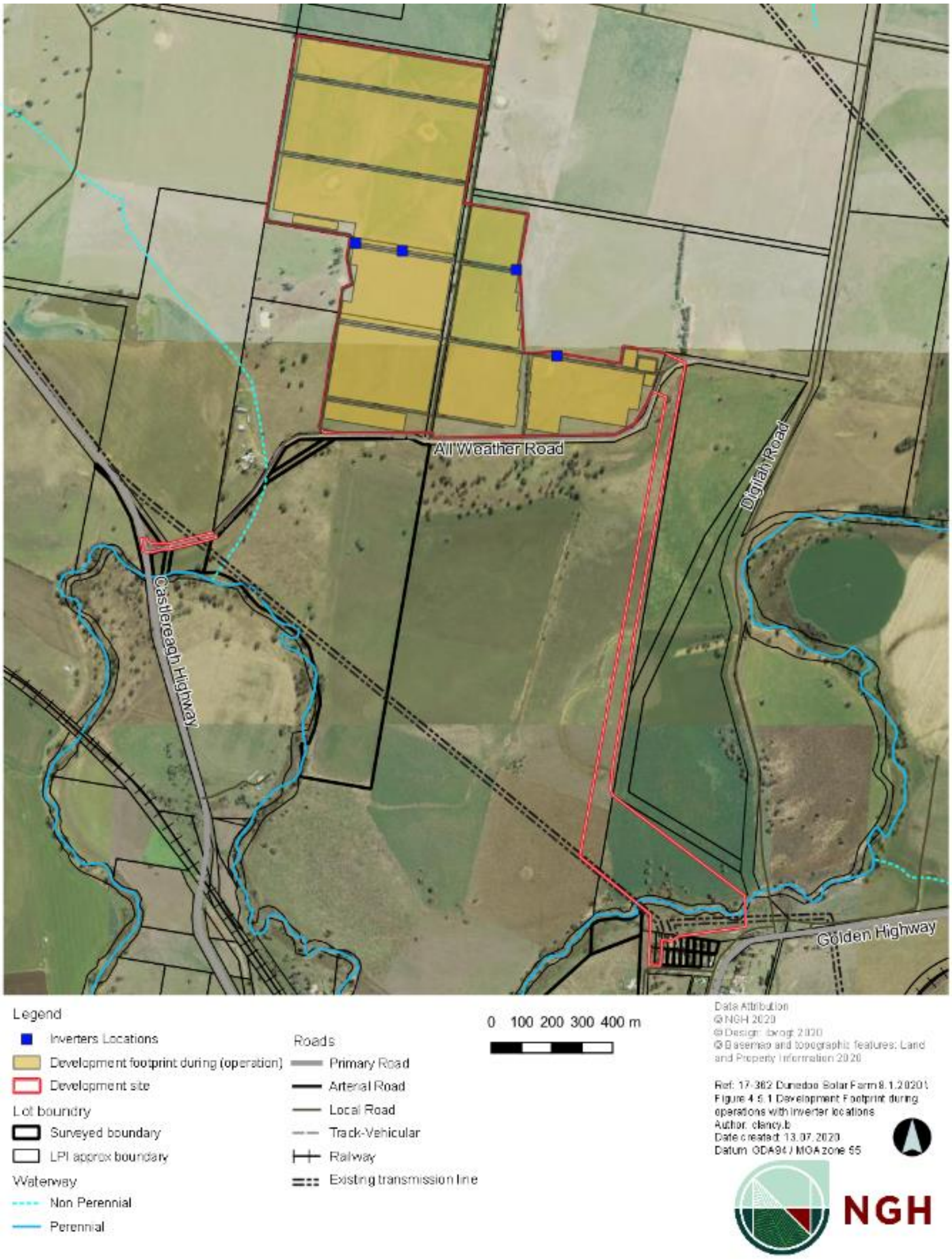


Figure 8-25 Inverter locations recommended for 600-mm clearance

8.4.3 Mitigation Measures

Table 8-23 shows the management and mitigation strategy is recommended to manage flooding impacts associated with the development.

Table 8-23 Mitigation measures for hydrology (including flooding)

Mitigation measures	Phase
The design of buildings and equipment foundations would consider the potential for flooding at the site including designing locations, footings for buildings and other infrastructure to cater for or avoid predicted flood depths and are to be consistent with relevant standards.	Design/ Pre-Construction
A Soil and Water Management Plan will be implemented including provisions for sediment and erosion control and site drainage.	Construction
An Emergency Response Plan will be implemented, including provisions for response to spills and contamination for chemical and fuel use, storage and in case of spills or other incidents.	Construction
The design and construction of the internal access tracks will include soil erosion and sediment control measures.	Design Construction
The Flood Response Plan covering all phases of the Proposal would: • Detail who would be responsible for monitoring the flood threat and how this is to be done • Detail specific response measures to ensure site safety and environmental protection • Outline a process for removing any necessary equipment and materials offsite and out of flood risk areas • Consideration of site access in the event that some tracks or site access points (such as Digilah Rd) become flooded • Establish an evacuation point • Define communications protocols with emergency services agencies. • Be prepared in consultation with the State Emergency Services (SES and WSC	Preconstruction Construction Operation Decommissioning

9 ASSESSMENT OF ADDITIONAL ISSUES

9.1 SOILS AND LANDFORMS

This chapter assesses the potential impacts to soil resulting from the construction and operation activities of the Proposal.

The construction phase may potentially increase the risk of contamination to soil through poor site management practices and inadequate waste disposal management. At the operational stage of the proposal, the only risk of contamination may be from hydrocarbon leaks over unsealed grounds.

Other general contamination risks are associated with the handling and processing of products where liquid waste and hazardous material can escape into the soil. These are associated with the transport, handling and storage of such materials and the potential threat of releases and spills onto the ground.

Topsoils are critical for agriculture and cannot be easily replaced within a human time scale. Adverse soil impacts can also have ecological impacts, affecting habitat condition, water quality and riparian ecosystems. Risks to soils are influenced by landscape position, slope, soil type, hydrology and land use.

9.1.1 Existing Environment

Topography and Geology

The Development Site occurs on alluvial plains and low alluvial terraces associated with the upper Talbragar River. The terrain is relatively flat with a very gentle slope (<2%) southward in the direction of the town of Dunedoo. The highest elevation of the site is approximately 383 metres ASL, occurring in the portion of the solar array's proposed footprint. The south portion of the Development Site is bordered by the Talbragar River, which is approximately 3 metres lower.

Desktop analysis of the region, relying on data from DPIE Resource and Energy web portal of geological maps, identifies that the geology within the Development Site is dominated by quaternary alluvial silt deposits of the Cenozoic period, and Tucklan Formation of the Cabonne group from the Palaeozoic period, in the southern third of the site closest to the Talbragar River. Minor formations of Liamena Rhyolite from the Permian unit of the Palaeozoic period are likely to be encountered in patches of the northern most portion of the Development Site.

- The deposits from the Tucklan formation are described as dark mudstone, basalt latite boulder conglomerate or breccia, lithic sandstone, rare chert.
- The deposits from the Cenozoic are described as alluvial silt, clay and sand. Variable humic content, sporadic pebble to cobble sized unconsolidated conglomeratic lenses.
- The deposits from the Liamena Rhyolite formation are described as shale, sandstone, conglomerate and coal.

Soils and Landscape

The Development Site occurs on the Eastern Uplands Division, Macquarie Uplands Province on the Mitchell Slopes Region.

The distribution of soil landscape at the Development Site is mapped in the DPIE eSPADE tool (DPIE 2020) and correspond to soil landscape 'Talbragar', as shown in Figure 9-1. This soil landscape occupies the entire Development Site, and is summarised below (Murphy, B.W. & Lawrie, J.W. 1998):

Note that the mapped area in the eSPADE tool is cut off for the top half of the Development Site. However, based on the site topography, geology and land use it is expected that the Talbragar landscape covers the entire site.

Table 9-1 Soil landscapes at the Development Site (eSPADE v. 2.1)

Talbragar (Recent Alluvial Deposits)
Soils Fertility – chemical High to moderate fertility and surface soils mainly neutral to slightly alkaline. Surface soils of Non-calcic Brown Soils and Red-brown Earths are slightly acidic to neutral.
Soil Fertility – physical Moderate to high soil physical fertility. Most surface soils (Black Earths) are self-mulching or friable and relatively stable to soil structure degradation. The soil profile is slowly permeable and water holding capacity is generally high to very high. Subsoils have few limitations for root growth. The Non-calcic Brown Soils and Red-brown Earths have fragile, light textured surface soils which are susceptible to soil structure degradation.
Erosion Hazard Soils are only moderately erodible, but slopes are quite flat (0 to 3%) and so the erosion hazard is generally low; however, there is high erosion hazard along some sections of streambanks.
Salinisation Isolated low levels of salinity occur along some drainage lines and depressions.

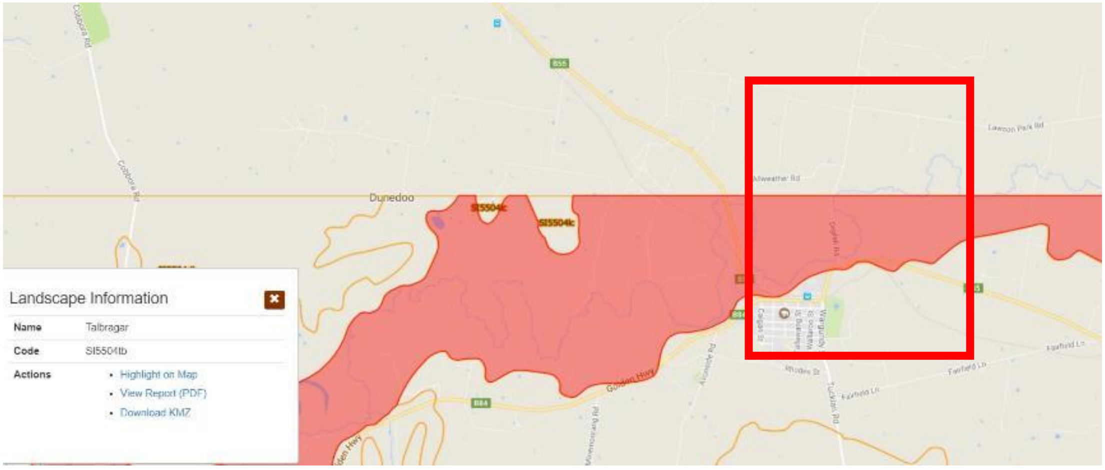


Figure 9-1 Soil Landscape at the Development Site (red rectangle) (eSPADE v. 2.1)

Field Investigation

A soil survey was conducted on the land that would be directly impacted by the solar farm to identify protection and amelioration requirements and provide a baseline for post-solar farm rehabilitation. The soil survey report is provided at Appendix I and summarised here.

Soil investigations were undertaken for the Proposal on 20 March 2018. The purpose of the testing was to identify protection and amelioration requirements and provide a baseline for post-solar farm rehabilitation. The scope of soil investigations across the site included:

- Determining the sodicity of soils, assess the risk of water erosion, and provide recommendations
- Identify any soil limitations in relation to the agricultural value of the site, with reference to ‘biophysical strategic agricultural land’ (BSAL) definitions from NSW Government
- Identify any soil nutrient problems and recommend soil improvement strategy

- Provide an overview of soil factors relevant to construction of the solar farm, e.g. shrink-swell potential, acidity, and subsoil salinity.

Analytical results and plans indicating the soil test locations are provided in Appendix I. The following text summarises the main findings and conclusions.

Methods

The survey was based on four (4) test pits, dug to a depth of 1.2 metres. The locations of the soil pits are shown in Figure 9-2. Sampling and classification methods followed the *Australian Soil and Land Survey Field Handbook* (NCST 2009), the *Australian Soil Classification* (Isbell 1996) and AS1726:1993. The density of investigation pits was determined using the *Guidelines for Surveying Soil and Land Resources* (McKenzie *et al.* 2008). Soils were analysed in situ and at a laboratory to AS/RMS methods. Representative topsoil samples were analysed for topsoil nutrient status, Cation Exchange Capacity (CEC), pH, Electrical Conductivity (EC), Chlorides, Organic Carbon (OC) and soil dispersibility.

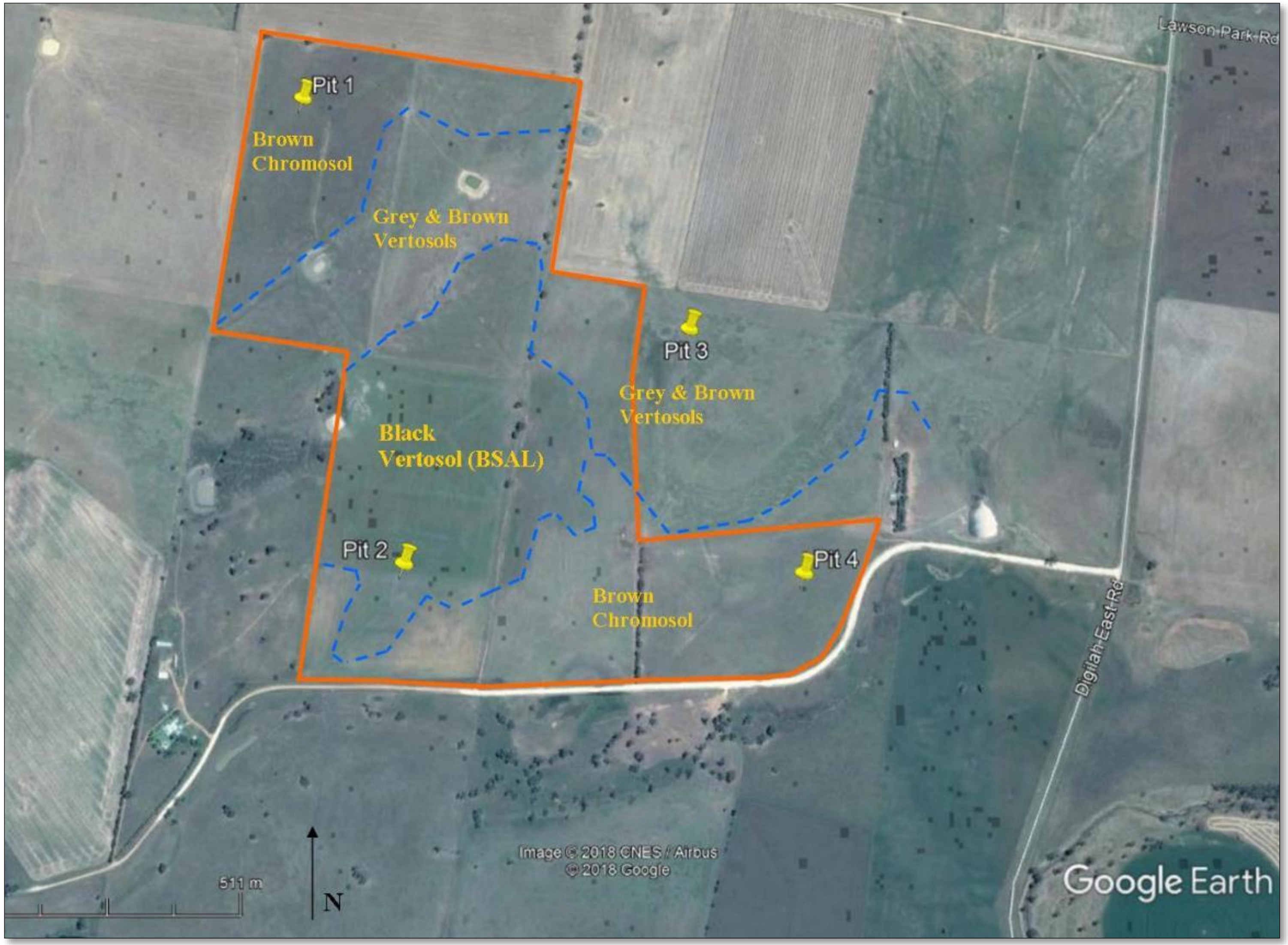


Figure 9-2 Soil Test pit locations

Results

The soil landscape map (OEH 2017) was generally validated by the soil survey. Soils at the site are classified as Chromosols and Vertosols. Chromosols (Pits 1 and 4) have little or no expansive clays, are generally non-dispersive, can be salty, and have low to moderate fertility. Vertosols present at the site are Brown, Grey and Black Vertosols (Pits 2 and 3). Vertosols are often very fertile but have shrink-swell properties that exhibit strong cracking upon wetting and drying cycles, often have dispersive subsoils, and can have high salt levels.

Limitations

A summary of the potential landscape limitation assessment is provided in Table 9-2.

Table 9-2 Potential landscape limitation assessment

Limitation	Description
Water erosion	Water erosion is unlikely to be a serious issue, except in the north-western corner (3% slope) where a protective organic groundcover needs to be maintained where possible (preferably perennial pasture). However, the absence of extreme subsoil sodicity in the sloping area represented by Pit 1 means that tunnel erosion is very unlikely.
Wind erosion	Wind erosion is a potential problem on Brown Chromosols in the vicinity of Pit 4. The sandy topsoil will be prone to loss by wind erosion if left bare. Protection by perennial pasture is recommended
Shrink-swell	All of the Vertosols have a strong shrink-swell potential in both topsoil and subsoil, so structures such as solar panels on piles may move as the soil wets and dries.
Site drainage	The areas represented by Pits 2 (Grey and Brown Vertosols) have poorer drainage than the Black Vertosols and are likely to have trafficability problems when there is prolonged wet weather. Gypsum application will reduce this risk. The poor drainage for Pit 2 is caused by moderately high exchangeable sodium percentages and low calcium-magnesium ratios and is aggravated by landscape flatness. The restricted drainage in subsoils of the Brown Chromosol zones (evidenced by mottling and strong grey colouration) is caused by low electrolyte concentrations.
pH and Nutrients	Nutrient status of Pits 1 to 4 was favourable. Severe pH imbalance is not an issue at the study site. However, lime application will help to overcome a slight acidity issue that will be difficult to treat once the solar panels have been installed
Compaction	There was no obvious need for deep ripping to improve plant root growth across the Development Site.
Salinity	Moderate salinity in the depth interval 60-100 cm was observed at Pits 2 and 3; this may have an impact on rates of corrosion of piles

The soils in the Development Site are expected to be susceptible to erosion due to previous vegetation clearing and agricultural activities. Rural land capability mapping indicates that the site is not subject to severe limitations, and is generally suitable for cultivation (eSPADE v2.1).

Based on observations from the site visit, soils at the site have been extensively disturbed by paddock levelling, repeated cultivation and stock grazing. No evidence of soil erosion (surface or tunnel) or salination was apparent. The risk of erosion of soils at the Development Site is considered low given the very low sloping aspect of the site. However, it should be noted that along the riverbanks, the risk of erosion is higher.

The dominant soil type at the Development Site is 'black earths' consisting of medium clay with slow permeability and high water-holding capacity. The erodibility of such topsoils and subsoils is considerate moderate.

Contamination

A search of the OEH contaminated land public record (NSW Government, 2020) undertaken for contaminated sites within the Warrumbungle LGA in March 2020, did not identify any contamination in the area. The online List of NSW contaminated sites notified to EPA (NSW Government, 2020) was also searched in March 2020. There was one (1) site listed in the Dunedoo area, the former Shell Depot, on the corner of Bolaro and Redbank Street.

There is however a risk of contamination associated with agricultural activities (e.g. use and disposal of pesticides). The landowner is not aware of any contamination at the site and no evidence of potential contamination within the Development Site was detected during the field inspections undertaken for the EIS. The contamination risk at the site is considered to be very low.

Acid Sulphate Soils

There are no soil profiles recorded in the eSPADE database (DPIE, 2020) within the Development Site. However, two (2) profiles are located on either side of the south portion of the Development Site. Neither of these profiles showed evidence of salinity or acid sulphate soils (ASS).

There is an extremely low probability of occurrence for ASS at the Development Site and in the locality indicated in the ASRIS database (CSIRO 2020; refer to Figure 9-3).

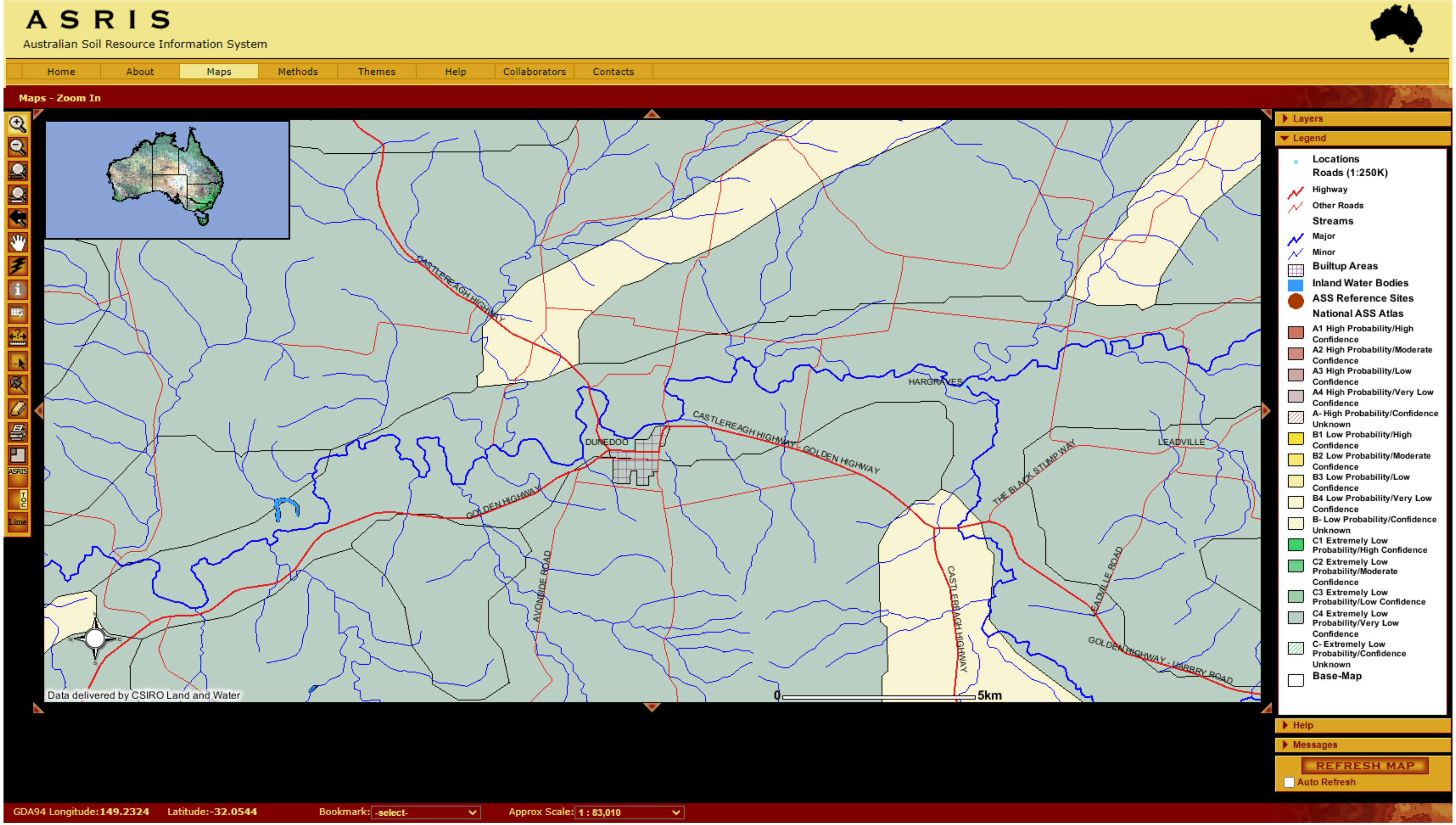


Figure 9-3 Acid sulphate soil probability in the Proposal's locality (CSIRO 2020)

9.1.2 Potential Impacts

Construction and Decommissioning

Civil Works and Excavation Activities

Construction activities at the Development Site have the potential to damage soils through loss of organic matter, structural breakdown and compaction, alteration of hydrological conditions, contamination with pollutants and imported material, mixing of profiles and wind/water erosion.

Earthworks are required during the construction phase including for the construction of access roads, compound, laydown and parking areas, pile erection, trenching and boring and fencing:

- Based on a worst-case scenario using the NexTracker system, approximately 30,000 piles at approximately 20 x 20 cm will be pile driven into the ground = 0.12 ha of disturbance (0.15% of the 79-ha Development Footprint).
- 4.1 km of track at 5 metres wide = 2.05 ha of disturbance (2.60% of the 79-ha Development Footprint).
- Substation pad of 60 x 40 metres = 0.24 ha of disturbance (0.38% of the 79-ha Development Footprint).
- 18 inverter transformer stations of 13 x 3 metres = 0.07 ha of disturbance (0.09% of the 79-ha Development Footprint).
- 18 battery units of 16 x 3 metres = 0.086 ha disturbance (0.11% of the 79-ha Development Footprint).
- Excavation of trenched for cabling will also be required typically up to 1,200 mm deep and 1,000 mm wide as required to meet relevant standards.

Soil compaction would occur as hardstands and internal access roads are created, which would reduce soil permeability thereby increasing run off and the potential for concentrated flows. During excavations mixing of different soil horizons can retard plant growth due to inadequate topsoil layer. Overall, these impacts would occur in small, discrete parts of the Development Site and are not considered substantial.

The access track system would be constructed in association with drainage measures designed to minimise concentrated and accumulated runoff and flow distances. Wind erosion and the generation of dust would be minimised as required, for example using regular water applications.

Given the majority of soils on site are classified as ‘non-sodic’ and are of low salinity, the risk of salt build-up in discharge areas is low. However, changing direction of surface waters and any run-on should be avoided as local changes in the water regime are likely to mobilise any salts stores, however low, in the soil. Deep rooted vegetation will be maintained where present and established where absent, with ground clearing minimised.

Pile driving/screwing of piles supporting the arrays as well as installation of fencing uses light equipment within a small and discrete footprint and is unlikely to result in substantial disturbance of soils. The areas of disturbance would be sparsely distributed, and groundcover would be retained as far as possible prior to, during and post-construction.

The soils at the site are assessed as having a minor erosion risk, mitigated by flat terrain and over 100-metre distance from any watercourses. Runoff is considered to be readily manageable and unlikely to cause substantial erosion or lead to substantial sediment loads entering any natural waterways. Concrete spill risk is unlikely due to no overland flow paths or waterways present within the Development Footprint for solar panels and infrastructure.

Soil impacts associated with the construction and decommissioning activities would be minimised by undertaking works in accordance with the *Managing Urban Stormwater: Soils and Construction* series:

- Volume 1 Managing Urban Stormwater: Soils and Construction, 4th edition (Landcom 2004), known as 'the Blue Book'
- Volume 2A Installation of Services (DECC 2008a)
- Volume 2C Unsealed Roads (DECC 2008b).

During excavation works, topsoil would be stockpiled separately and replaced above subsoils to restore the original soil profile, maintain site productivity and assist revegetation. Topsoil salvaged from the construction of the access tracks and other works would also be securely stored for use in site rehabilitation. Any topsoils stockpiled for an extended period would be managed to avoid contact with overland runoff, minimise weed infestation, and maintain soil organic matter, soil structure and microbial activity.

Spills and Leaks

The risk of accidental spills and leaks of hazardous products, such as oils, fuels, lubricants and sanitary wastewater is present. Such negative impacts may occur at the construction site's storage areas or during transportation of hazardous products on and off the site. Inadequate procedures for storing, transferring, and handling may also result in spills to the ground and lead to soil contamination. Additionally, migration of the contaminants to groundwater may occur, with the potential for further spreading of pollutants through the groundwater system dependent on the physical and chemical properties of the contaminants and the interconnectivity of the groundwater system. Soil contamination risks from the use and storage of fuels and other chemicals would be managed using best practice storage, use and spill response procedures (refer to Section 9.2). Overall, these risks are low and considered readily manageable.

Inadequate Waste Management

Construction activities typically generate solid and hazardous waste fractions, as well as hazardous liquid wastes. Although these types of wastes (used oil, machinery lubricants and sludge) represent a small proportion of the total amount of construction waste, the inadequate handling, storage and disposal of these wastes, increases the risk of soil contamination at the Development Site. Overall, these risks are low and considered readily manageable.

Post Construction

Following the construction phase, a Site Rehabilitation Plan would be implemented remediating soils as required, removing rubbish, restoring profiles and decompaction of soils in the construction areas.

Perennial grass cover would be established across the site as soon as practicable after construction. This would protect soils and improve soil stability, structure and landscape function over time. An Operational Environmental Management Plan would be prepared to ensure grass cover is achieved as soon as possible, adequate cover is maintained at the site (subject to climatic conditions) and soils are protected on a continuing basis. Soil test results conducted as part of the assessment would be used to inform soil preparation for groundcover establishment and provide a baseline for rehabilitation following decommissioning.

The management recommendations contained in the soil survey report prepared for the Proposal (Soil Management Designs 2018) would also be implemented to minimise construction impacts to soils at the site. Key recommendations from this report have been incorporated in Table 9-3.

Operation

Contamination Risk

During operation, the volume and variety of hazardous materials used at the Proposal would be negligible. Nonetheless, the risk for spills is still present, and would result from poor handling, storage and disposal procedures. The potential sources of soil contamination would include:

- The use of solvents, lubricants and oils for maintenance activities.
- Synthetic oils in the on-site transformers (typically these structures are contained in a bund).
- Sanitary wastewater.

Soil contamination risks from the use and storage of hazardous materials would be managed using best practice storage, use and spill response procedures.

Erosion Risk

The primary risk of erosion during operation is from concentrated runoff from the panels. Such runoff could lead to increased soil erosion below the solar array modules during significant rain events and could be influenced by seasonal droughts. The soils have a low to moderate erosion risk and retaining vegetation underneath the panels would assist in reducing erosion from rainfall run-off. During high rainfall events, panels would be placed in a vertical position to decrease the concentrated surface runoff and increase the exposure of ground surface roughness

Vegetation and ground habitats are also likely be affected by reduced insolation and temperature and increased humidity underneath the solar modules. In the grazed paddocks, existing native and exotic pasture across the site is likely to decline initially due to shading following PV array installation. A reduction in cover may lead to bare ground and susceptibility of the soil to erosion.

Soil stabilisation would be achieved by using a species mix which is tolerant of intermittent shading for the groundcover at the site. This would also minimise the impact from wind erosion.

Soil underneath the solar arrays would likely receive less rainfall than surrounding soil, although evapotranspiration losses would also be lower due to shading and reduced air movement. Lateral movement of surface and subsurface water from adjacent rain-exposed areas would likely occur. As such, the net amount of moisture available to vegetation under the solar arrays should not be substantially altered.

Operational maintenance activities and vehicles would be largely confined to the formalised access tracks, minimising impacts to soils. Occasional vehicle access in between panel arrays would require traversing over undisturbed soils. This is expected to be infrequent and not likely to increase the erosion risk.

Soil stability and erosion throughout the site, including beneath the array would be monitored in association with the regular monitoring of groundcover under the Operational Environmental Management Plan.

The management recommendations contained in the soil survey report prepared for the Proposal (Soil Management Designs 2018) would be implemented to protect soils during the operation phase, assist revegetation planting and manage identified soil limitations. Key recommendations from this report have been incorporated in the mitigation table below.

9.1.3 Mitigation Measures

Mitigation measures to avoid and minimise impacts to soils and landforms at the Development Site are provided in Table 9-3.

Table 9-3 Mitigation measures for soils and landforms

Mitigation measures	Phase
The solar array would be designed and installed to allow sufficient space between panels to establish and maintain perennial groundcover (subject to climatic conditions). Groundcover management details (including stocking levels etc) and rehabilitation of civil work completed during construction are to be included in the Construction Environmental Management Plan and Operational Environmental Management Plan.	Preconstruction Construction Operation
A Construction Environmental Management Plan (CEMP) would be implemented to manage runoff, soil erosion and sedimentation and pollution risks at the site. The CEMP would be prepared in accordance with the 'Blue Book' Volume 1 Managing Urban Stormwater: Soils and Construction (Landcom 2004), Volume 2A Installation of Services (DECC 2008a) and Volume 2C Unsealed Roads (DECC 2008b).	Pre-construction Construction
As part of the CEMP, a Soil and Water Management Plan (incorporating a Site Drainage Plan and Erosion and Sediment Control Plan) would be prepared, implemented and monitored during the Proposal to minimise soil and water impacts. These plans would include provisions to: • Install, monitor and maintain erosion controls • Identify and protect sensitive features such as native vegetation, dams and Talbragar River • Ensure that machinery leaves the site in a clean condition to avoid tracking of sediment onto public roads • Manage topsoil: in all excavation activities, separate subsoils and topsoils to restore natural soil profiles and assist revegetation, guided by the findings of the pre-works soil survey. Topsoils stockpiled for extended periods would be managed to avoid contact with overland runoff, minimise weed risks, and maintain soil organic matter, soil structure and microbial activity • Minimise the area of disturbance from excavation and compaction and rationalise vehicle movements to minimise soil impacts • Ensure any discharge of water from the site is managed to ensure ANZECC (2000) water quality criteria are met as far as practicable, ensure excavations are not scheduled when heavy rainfall events are predicted, or soils are saturated.	Pre-construction Construction
The Spill and Contamination Response Plan prepared as part of the Emergency Response Plan would include measures to: • Respond to the discovery of existing contaminants at the site (e.g. Pesticide containers or asbestos), including stop work protocols and remediation and disposal requirements • Manage the storage of any potential contaminants on-site • Mitigate the effects of soil and water contamination by fuels or other chemicals (including emergency response and EPA notification procedures) • Ensure that machinery and materials arrive on site in a clean and secure condition	Construction Operation Decommissioning

Mitigation measures	Phase
• Prevent contaminants affecting adjacent pastures, irrigation channels, dams and native vegetation • Monitor and maintain spill equipment including spill kits in relevant machinery • Induct and train site staff. • Detail fuels, chemicals, and liquids storage locations that are at least 50 metres from any waterways or drainage lines, in an appropriate bunded area Disposal process for contaminated materials.	
The site design and, if required the CEMP, OEMP and DEMP and relevant sub-plans should incorporate where possible the management recommendations in the site soil survey report (Soil Management Designs 2018), including: • Maintain protective ground cover in the north-western corner (3%-slope) where possible • Maintain protection with perennial ground cover on Brown Chromosols in the vicinity of Pit 4 • Consider engineering and design solutions for the installation of the piles in all Vertosol areas, which have a high shrink-swell potential in top and sub soils • Apply Gypsum (6t/ha) in areas with Grey and Brown Vertosols, to improve drainage and avoid trafficability issues following heavy rain events. • Apply Gypsum (3t/ha) for the remainder of the area • Apply lime at a rate of 2t/ha to help overcome a slight acidity issue that will be difficult to treat once the solar panels have been installed • Apply fertilizer produce rich in nitrogen and zinc for the Vertosol zone represented by Pit 5 • Moderate salinity in the depth interval 60-100 cm was observed at Pits 2 and 3; this may have an impact on susceptibility to corrosion of piles.	Preconstruction Construction Operation Decommissioning

9.2 LAND USE

The nature of a development determines whether a permanent land use change occurs or whether the development is reversible. Apart from direct uses of the land, such as agriculture, electricity generation or mining, associated impacts, such as the degree of visual impact and traffic regimes, can affect the compatibility of alternative land uses.

The Proposal is consistent with the aims and planning principles of the Rural Lands SEPP. Part 4 of the SEPP relates to state significant agricultural land. Given the Development Site is not identified in schedule 2, it is not identified as state significant agricultural land and Part 4 does not apply.

9.2.1 Approach and Methods

The land use and resource values of the Subject Land and locality, and potential impacts of the proposed solar farm have been assessed with reference to the NSW land and soil capability assessment scheme, Primefact 1063 Infrastructure Proposals on rural land, Biophysical Strategic Agricultural Land and Important Agricultural Land identification processes, LUCRA, the MinView and Common Viewer databases and landholder, ABS and ABARES agricultural production and water use figures.

9.2.2 Existing Environment

Land Use

Murray Darling Basin

Information provided on the Murray-Darling Basin Authority website (www.mdba.gov.au/discover-basin/people/economy-basin), reveals that agriculture is the driving force behind the Basin's economy, and is the main user of land and water resources. The development of agriculture has enabled the growth of processing and manufacturing industries, as have the sectors of construction and health & education. As such, several cities in the basin have transitioned from a primarily agricultural economy to a diverse economic structure comprising of health care, education, mining and tourism.

The main land use in the Basin is grazing, which takes up 69% of the Basin's land area, followed by dryland agriculture (13%), irrigated agriculture (2%), and forestry (3%) (ABARES 2010).

The Basin accounts for 20% of Australia's total agricultural land area, and produces 1/3 of the nation's food supply. The Basin contains 40% of all Australia's farms and 65% of all irrigated farms. 80% of the basin water sources are used for agriculture.

Central West Region

Agriculture in the Central West Region occupies 57,244 km^2 (81%) of the Central West Region land. The most common land use by area is grazing modified pasture, which occupies 54% of the land area. (ABARES About my Region 2017). Whilst 14% of the land area in the region is classified as conservation and natural areas.

The gross value of agricultural production in 2015-2016 for the Central West Region was $1.7 billion (13%) of total gross agricultural production in NSW of $13.1 billion. The primary sectors of agriculture production in the region are wheat, cattle, and wool in order of value. These commodities contribute 51% of the total value of agricultural production in the region.

The following table summarises the number and type of farms in the Central West Region, 2014-2015.

Table 9-4 Number of farms, by industry classification, Central West Region, 2014-2015

Industry Classification	Central West Region		NSW	
	No.	% of region	No.	Contribution of region to state total %
Beef Cattle Farming	1,496	26.8	13,059	11.5
Other grain	1,185	21.2	4,454	26.6
Sheep farming	873	15.6	3,397	25.7
Grain sheep or grain beef	866	15.5	2,826	30.7
Sheep-beef cattle farming)	589	10.5	3,053	19.3
Horse farming	147	2.6	1,405	10.4

Industry Classification	Central West Region		NSW	
	No.	% of region	No.	Contribution of region to state total %
Grape growing	76	1.4	756	10.0
Other	353	6.3	6,503	5.4
Total Agriculture	5,585	100	35,453	15.8

Note: Estimated value of agricultural operations $5,000 or more. Industries that constitute less than 1% of the region's industry are not sown. ABS 2016

Development Site

The Development Site is zoned RU1 Primary Production in the Warrumbungle LEP (refer to Section 5.4.1).

Land use at the Development Site includes improved pasture (lucerne) in the south-eastern corner, sown oats in the north-western paddock, and weedy pasture elsewhere. The land has mainly been used for sheep grazing (80%) and cattle grazing (20%) by the current landowners. On occasion, oats and winter grasses have been cultivated. The main production value from the lot is meat, and wool is secondary.

Land Uses Surrounding the Development Site

Similar agricultural land uses are undertaken on freehold properties surrounding the Development Site, which are also included in the RU1 LEP zone. The principal activities on surrounding properties are cattle grazing, sheep grazing, horse stud, and oat growing. Other land uses in the locality include:

- NSW rail transport link, located 2 km south of the Development Site and adjacent to Dunedoo township
- Dunedoo Public School, post office and other township public services located just over 2 km south of the Development Site
- Residential dwellings and associated buildings
- Electricity connection and transmission infrastructure
- Two (2) highways (Castlereagh Highway and Golden Highway) and two (2) Council roads (All Weather Road and Digilah Road).

Details of Dunedoo township, regarding population size, public services and commercial business is described in Section 9.5.

Land and Soil Capability

Land capability is the inherent physical capacity of the land to sustain a range of land uses and management practices in the long term without degradation to soil, land, air and water resources (OEH 2012). The NSW land and soil capability assessment scheme (OEH 2012) describes and maps eight land and soil capability classes. The classification is based on the biophysical features of the land and soil (including landform position, slope gradient, drainage, climate, soil type and soil characteristics) and susceptibility to hazards (including water erosion, wind erosion, soil structure decline, soil acidification, salinity, waterlogging, shallow soils and mass movement).

The distribution of soil capability at the Subject Land is mapped in the DPIE eSPADE tool (DPIE 2020) and correspond to the soil capability Class 2, 3 and 5; refer to Figure 9-4. Class 3 occupies the majority of the area that would be directly impacted by the solar array footprint. Class 2 occupies the majority of the site located south of All Weather Road and which is not subject to any development of the solar farm, however the alignment of the TL would run along the eastern boundary of the Development Site and on Class 2 land. The capability classes are described in Table 9-5 (OEH 2012).

Table 9-5 Land and soil capability classes at the Development Site (OEH 2012)

Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, nature conservation)
Class 2
Very high capability land: Land has slight limitations. These can be managed by readily available, easily implemented management practices. Land is capable of most land uses and land management practices, including intensive cropping with cultivation.
Land capable of a wide variety of land uses
Class 3
High capability land: Land has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation.
Land with limited capability
Class 5
Low capability land: Land has severe limitations for high impact land management uses such as cropping. This land is generally more suitable for grazing with some limitations or very occasional cultivation for pasture establishment.

The following table summarises the total area of Class 2, 3 and 5 land, present in the Subject Land, and the relevant area that would be directly impacted by the Development Footprint of the solar array and TL.

Table 9-6 Total Area and Impact Area on Land Capability Classes 2, 3 and 5

Land Capability Class	Total Area in Subject Land (ha)	Area in Solar Array Footprint (ha)	Area in TL Footprint - Option 1	Area in TL Footprint - Option 2	% Impact Area in Subject Land - Option 1	% Impact Area in Subject Land - Option 2
2	48.96	4.118	1.805	1.66	12.10%	11.80%
3	103.9	70.493	0	0	67.85%	67.85%
5	3.73	2.416	0	0	64.77%	64.77%

Figure 9-4 Land and soil capability classes in the vicinity of the Subject Land

Prime Agricultural Land

Soil Conservation Service defines soils with land capability Class 1 or 2 as Prime Agricultural Land (Soil Conservation Service of NSW/ Emery, K.A. 1986). Given the portion of land south of All Weather Road consists of Class 2 land, as shown in Figure 9-2, it is considered that this portion of the land is Prime Agricultural Land.

Class 2 land is capable of sustaining high impact land uses and is capable of a wide variety of agricultural uses that involve cultivation. Erosion and land degradation can be controlled by land management practices that are readily available and easily implemented. Class 3 land can sustain cultivation on a rotational basis. To prevent soil and land degradation, the limitations of this land must be managed. (OEH, 2012).

It is important to note that solar farms do not preclude the use of land for agriculture. Some agricultural activity is still possible whilst a solar farm is operating (e.g. grazing). Additionally, the degree of permanent land disturbance in the construction and operation of solar farms is small, and upon decommissioning of the Proposal, the Development Footprint would be rehabilitated to restore land capability to pre-existing agricultural use.

Biophysical Strategic Agricultural Land

The State Government has mapped Biophysical Strategic Agricultural Land (BSAL) across the State; this is land that meets specific scientific criteria levels for soil fertility, land and soil capability classes and access to reliable water and rainfall levels. An amendment to the State Environmental Planning Policy (*Mining, Petroleum Production and Extractive Industries 2007*) gave legal effect to the BSAL (NSW Government, 2014).

The NSW BSAL mapping shows that up to 90% of the Subject Land does occur within an area classified as Biophysical Strategic Agricultural Land (BSAL). However, the soil study's 'first approximation' based on a 4-pit assessment indicates that only the Black Vertosol zone (about 30% of the Development Site) is BSAL.

Reasons for four (4) out of five (5) soil pits being non-BSAL are as follows:

- Pit 1 distinct mottling (an indicator of waterlogging in the subsoil when moist) within 75 cm of the soil surface.
- Pit 3 prominent mottling in the topsoil and a sodic/dispersive subsoil below 30 cm.
- Pit 4 prominent mottling within 75 cm of the soil surface.

It should be noted that BSAL identification and mapping was developed to ensure that any Proposal for State significant mining or coal seam gas (CSG) on BSAL would be subjected to an additional level of scrutiny via the Gateway process - an independent, upfront and scientific assessment of the land and water impacts of the Proposal.

The construction and operation activities of a solar farm are significantly less intrusive than mining or coal seam gas developments. With a solar farm, all disturbances to soils are occurring in the top 2 metres layer of soil. Furthermore, the impacts to the soil and land use are temporary in line with the operability of the land. Once the solar farm is decommissioned, the former land use of the site can be re-instated.

In comparison, coal mining results with permanent changes to the landscape, topography and soil condition of the site. These changes are irreversible, as such the previous land use may not be re-instated. Equally, the resulting landscape of the site, is not favourable for most commercial activities, and particularly not for rural redevelopment.

Important Agricultural Land

Important Agricultural Land (IAL) maps identify lands that are highly suitable for important agricultural industries at a local and regional scale. They complement the mapping of state/nationally significant agricultural lands developed for Strategic Regional Land Use Plans (SRLUP). IAL maps are not suitable for assessing development proposals; rezoning proposals; nor for property specific planning purposes.

Given that the majority of the Development Site is not classified as BSAL, it is also not considered IAL as defined in existing mapping (refer to Figure 9-5), and is not land that is 'highly suitable for important agricultural industries at a local and regional scale'.

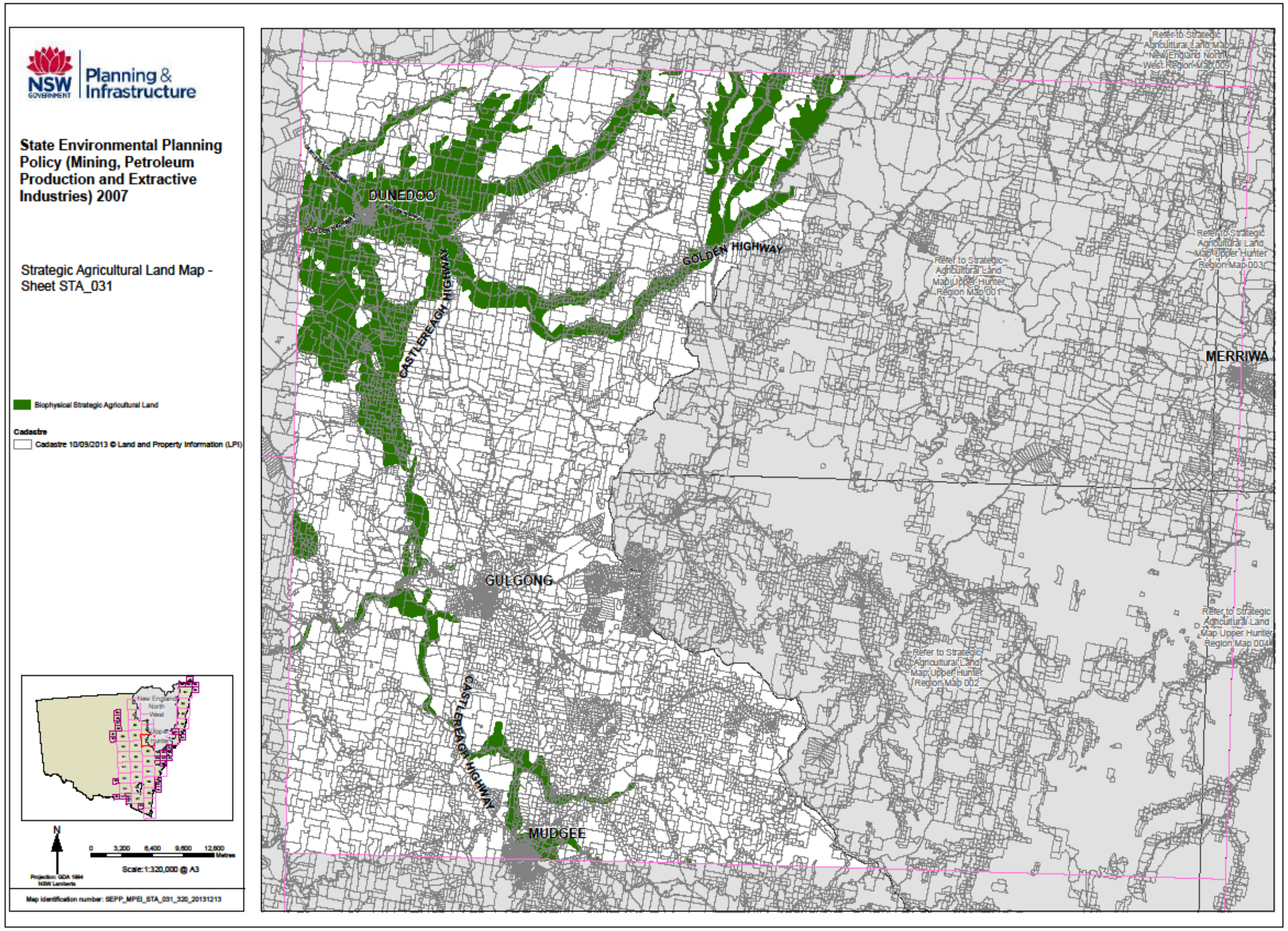


Figure 9-5 Biophysical Strategic Agricultural Land

Mineral Exploration License

The Proposal falls within a coal Exploration Licence (EL 6093) held by the Secretary of the Department of Planning, Industry and Environment. Figure 9-4 depicts the extents of the EL. The following table summarises the details of the license, sourced from NSW DPE Coal Titles, accessed November 2018.

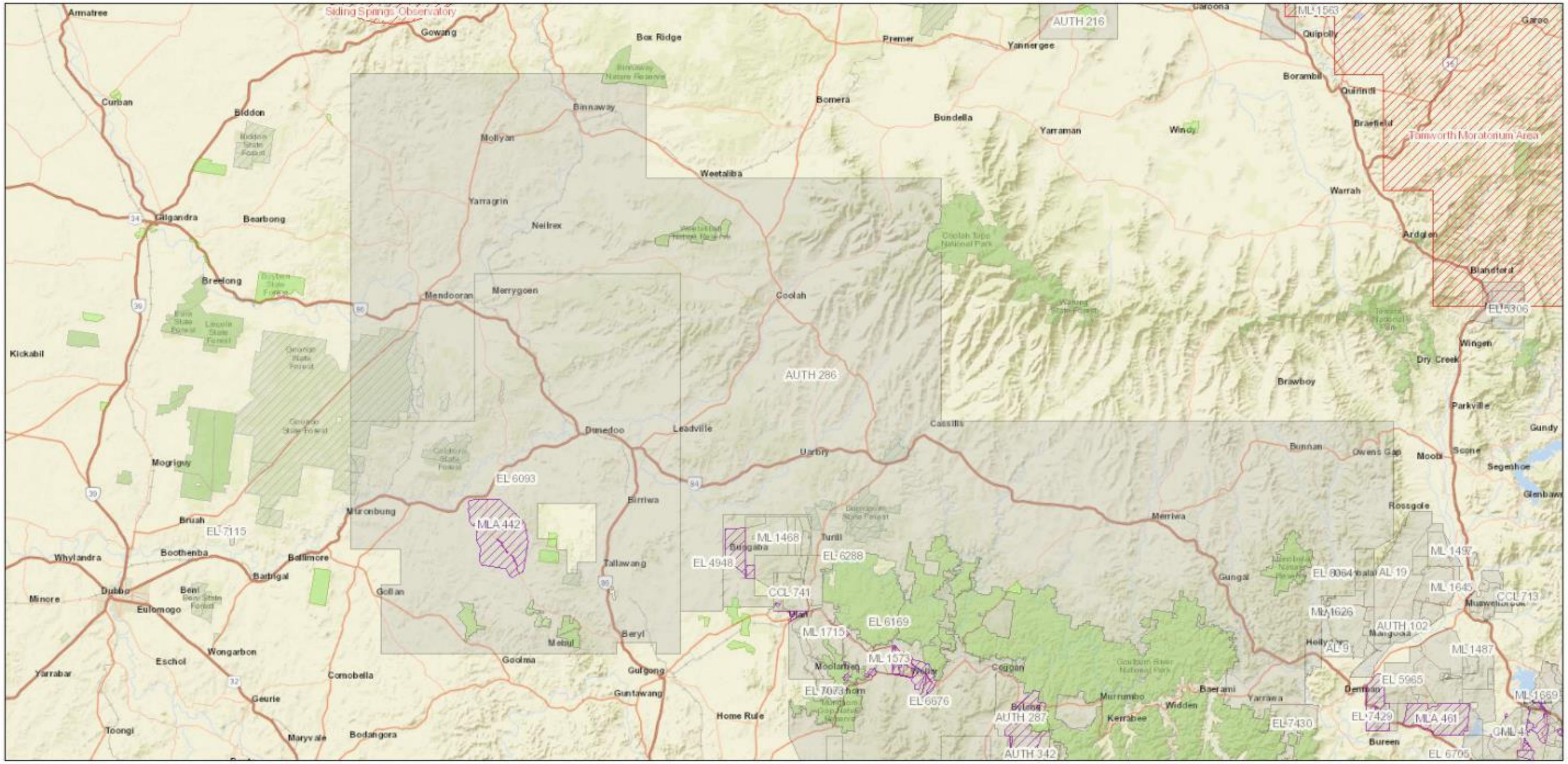
Table 9-7: Details of EL 6093

Title	Grant Date	Expiry Date	Area	Location
EL 6093(1992)	25 June 2003	24 June 2018	2,514 km^2	About 38 km NW of Gulgong

Consultation with the titleholder (refer to Appendix C, letter reference OUT18/4270 DPE Resources & Geoscience) has indicated that the Proposal would not have any significant impact on current or future extraction of coal resources (including by limiting access to, or impeding assessment of, those resources), and the Proposal is not incompatible with current or future exploration.

It is noted that the license has expired, however a renewal application is pending.

The Subject Land does not hold any exploration applications, assessment lease applications, assessment leases, mining or production applications, or mining or production leases (DPIE, 2020).



January 5, 2018

	General Restrictions		State Conservation Area
	Wetlands		Current Coal Applications
	Sepp Littoral Rainforests		Current Coal Titles
	State Forests		State Border
National Parks and Reserves			World Street Map
	<all other values>		

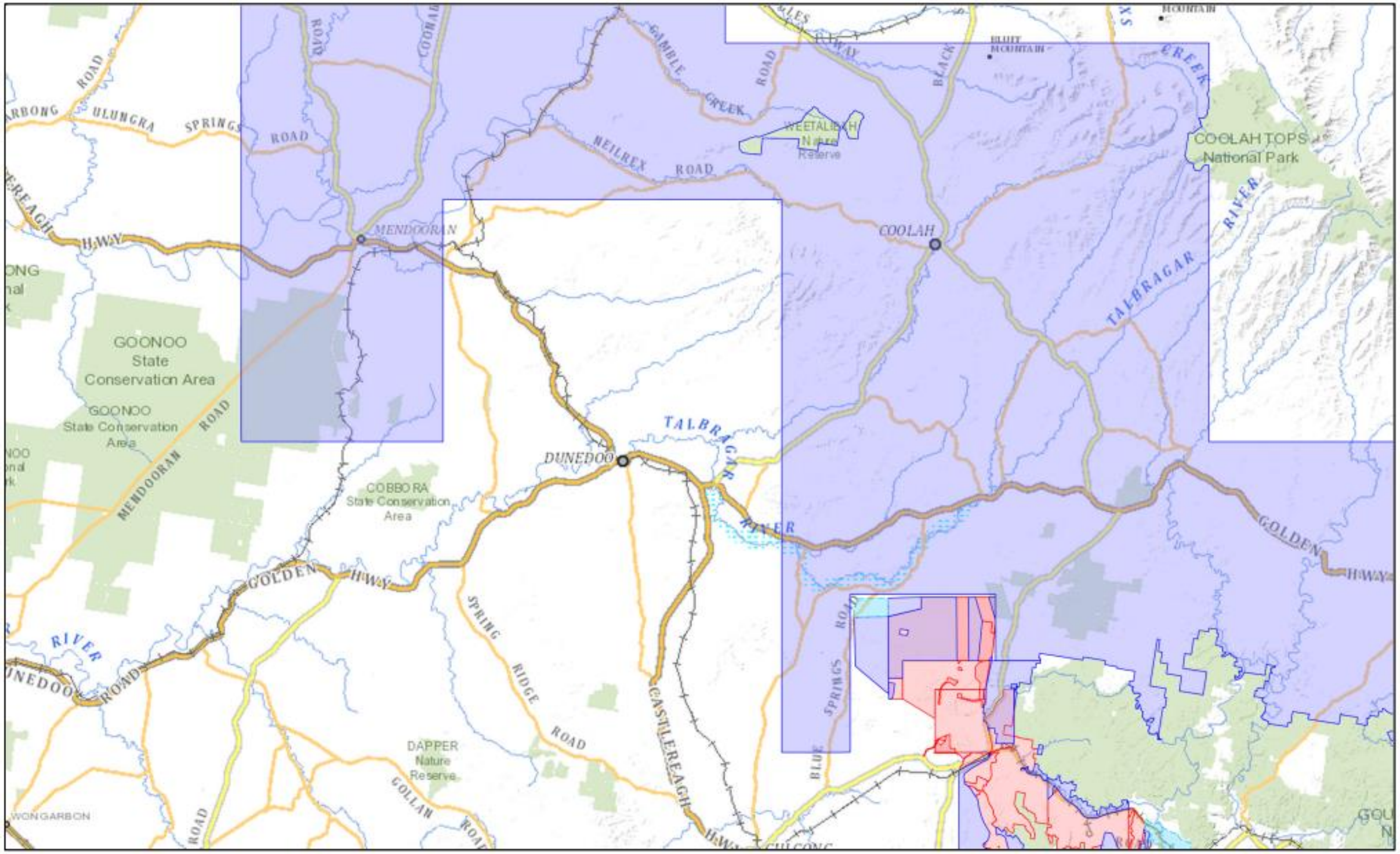
1:722,991

0 5 10 20 mi

0 12.5 25 50 km

Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

Figure 9-6 Coal Exploration in the Proposal's locality



Coal Exploration surrounding Dunedoo

N

23km

Contact: geoscience.products@planning.nsw.gov.au
Date Saved: 08/07/2020 06:29

- Mining/Production Lease (CCL, ML, PPL)
- Mining/Production Lease Application (MLA, PPLA)
- Assessment Lease (AL)
- Assessment Lease Application (ALA)
- Exploration Licence (EL)
- Exploration Lease Application (ELA)

NSW GOVERNMENT

Legend

Contact: geoscience.products@planning.nsw.gov.au
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9.2.3 Potential Impacts

Construction and Decommissioning

Land and Soils Capability Impacts

The Proposal is not expected to negatively impact the total area of land with Class 2, 3 and 5 in the LGA. The area of Class 2 land that would be developed is approximately 5.9 ha, Class 3 is approximately 70.5 ha, and Class 5 is approximately 2.4 ha. These areas respectively represent 0.01%, 0.04% and <0.001% respectively of the total area of Class 2, Class 3 and Class 5 soils in the Warrumbungle Shire LGA. As such, in terms of surface area losses, the impacts are negligible.

It should also be noted that the construction activities of the Proposal are not expected to adversely affect any of the biophysical factors or hazards which determine land and soil capability. During any broad area or trench line excavations at the site, topsoil would be removed, stockpiled separately and replaced to restore the original soil profile. Topsoil salvaged from the construction of the access tracks and other works would also be securely stored for use in site rehabilitation. Following construction, a perennial cover would be established to protect soils, enhance landscape function and prevent wind and water erosion. Some soil nutrients are expected to run down over time with the cessation of the crop fertiliser regime. Soil impacts and mitigation measures are addressed in Section 9.1. Soil restoration and treatments would be guided by the findings of a pre-works soil survey conducted at the site (refer to Section 9.1). Consequently, any physical impacts to soil quality during construction are assessed to be short term, temporary and reversible.

By maintaining perennial cover, the Proposal would positively affect soils at the site by providing many of the benefits of long-term fallow, including increasing soil moisture, building soil carbon levels, allowing structural recovery and improving conditions for soil biota. Depending on the results of soil testing, treatment for acidity may be required prior to the establishment of groundcover (refer to Section 9.1). No loss of productive potential is expected to result from the Proposal.

Increased Weeds, Biosecurity and Bushfire Risks

The Proposal would result in the increased movement of vehicles and people to the Development Site. Higher numbers would access the Development Site during the construction and decommissioning phases. The primary risk to biosecurity is the spread of weeds that may result from the increased movement of vehicles in and out of the Development Site. Weed seeds can be transported through and from the Development Site on the tyres and undercarriages of vehicles and on the clothing of staff. The risk of weed dispersal would primarily be mitigated by confining vehicle and machinery movements to formed access tracks during all phases of the proposal and implementing a wash down procedure for vehicles entering the Development Site.

To assist in the management of weeds, a Weed Management Plan would be prepared for the construction and decommissioning phases, based on Warrumbungle Shire Council and NSW DPI requirements. Management measures would focus on early identification of invasive weeds and effective management controls.

Establishment of a temporary construction site compound, specifically rubbish bins containing food, can potentially increase the risk of pest animals at the Development Site (mostly cat and fox). Covered rubbish bins and regular waste removal during construction and operation would minimise this risk by removing the food source.

Resource Impacts

The Proposal would require approximately 5,000 m^3 of gravel to surface the access road and internal service track network, inverter/transformer, BS, and substation hardstand. Approximately 900 m^3 of sand may be required for the bedding of underground cables, depending on the electrical design and ground conditions. Approximately 350 m^3 of concrete would be required to construct the substation, CCTV, inverter/transformer, and BS foundations. The availability of these resources is not declining or limited in the region.

Materials used in the fabrication and construction of the solar farm infrastructure would include precast masonry products and concrete, steel, aluminium, copper and other metals, glass, plastics and fuels and lubricants. These are common industrial and construction materials. Silicon and silver are the major raw materials for crystalline silicon PV; resource availability is not limiting for these materials (Solar Power Europe 2017a). Most components would be reused or recycled when infrastructure is replaced or decommissioned (refer to Section 9.11).

In view of the nature of the resources, the limited quantities required and the opportunities for recycling, the Proposal is unlikely to place significant pressure on the availability of local or regional resources.

Site Rehabilitation

Following decommissioning of the solar farm, a Site Rehabilitation Plan would be implemented to fully restore agricultural potential and land use opportunities at the Development Site. All infrastructure to a depth of 500 millimetres and internal track surfacing would be removed, soils would be decompacted as required, any required reinstatement of paddock levels, small dams and irrigation and drainage channels would be undertaken and a suitable cover crop sown to stabilise the site (refer to Section 8.1). Soil restoration and treatments would be guided by the findings of a pre-works soil survey conducted at the site (refer to Section 9.1).

Operation

Land Use Impacts

Primefact 1063 Infrastructure Proposals on rural land (DPI 2013) provides the following guidelines to minimise impacts on agricultural resources and enterprises (summarised):

- Proposals should be clearly justified in a regional context and merits and community benefits identified
- Agricultural resource lands should be identified and avoided
- Land use conflicts should be minimised
- Landholders should be effectively consulted during planning, construction and rehabilitation works and the expectations of local communities should be managed
- Development proposals should identify suitable mitigatory/remediation responses for all likely agricultural impacts.

This EIS has strategically justified the Proposal and identified community benefits (refer to Sections 2 and 11). The Proposal would result in reduced agricultural production for the life of the solar farm, but would not affect long term capability or use options. A Community Consultation Plan has been developed to inform the community and respond to concerns (refer to Section 6). Neighbours in particular have been consulted to avoid land use conflict. A comprehensive set of mitigation measures has been developed to avoid impacts to long term land use capability (refer to Section 10.11).

The potential sustainable agriculture impacts identified in the Primefact are addressed below in relation to the current Proposal.

Resource Loss and Fragmentation

The Proposal would not impact on land identified by the NSW Government as BSAL. Construction works involve only minor excavation with minimal disturbance to soils and soil profiles, and minimal risk of soil loss (refer to Sections 9.1 and 9.3 for soil and water quality impacts). At the end of the operational period, solar farm infrastructure would be removed, the land would be rehabilitated to its pre-existing condition and available for agricultural use. The Proposal would not result in the permanent removal of agricultural land.

The Proposal has been designed to minimise the Development Footprint.

The Proposal will not result in rural land fragmentation or alienation of resource lands as defined under the Rural SEPP. It is considered that the Proposal would not generate any land use conflicts or have an impact on the nature of existing surrounding agricultural holdings given the Proposal will not alter the existing environment. The proposed subdivision and consolidation of lots would help facilitate the management of the solar farm while ensuring surplus land remains as productive agricultural land.

Given the presence of a coal exploration licence that includes the site, the Proposal would be likely to preclude the extraction of mineral resources from the site for the life of the solar farm. However, consultation with the titleholder has indicated that the Proposal would not have any significant impact on current or future extraction of coal resources (including by limiting access to, or impeding assessment of, those resources), and the Proposal is not incompatible with current or future exploration.

It should also be noted that the Proposal would not prevent future resource exploitation following decommissioning of the solar farm.

Disturbance to Farming Operations and Livestock

The Proposal would displace pasture land at the site for the life of the solar farm (around 30 years). The property is typical of much of the land use in the locality, LGA and region. Approximately 79 ha of agricultural land would be needed to accommodate the Proposal, representing less than 0.1% of all productive cropping land in the Central West Region.

The Subject Land is a satellite farm and comprises a small component (20%) of the landowners' total agricultural operation. Additionally, only 1/3 of the land would be developed for the Proposal, so the remainder would still be available for agricultural production. As such the comparative reduction in agricultural production from the conversion of land use, is negligible for the landowner.

The sheep and cattle currently on the lot would be transferred to the south portion of Lot 80 (south of All Weather Road) which has sufficient capacity to sustain the stocks

Sheep grazing within the Development Site for production purposes and to control grass and weed growth around the solar arrays may also be considered. Two (2) flood refuges would be maintained on the north lot, which would be used to coral cattle and sheep, during heavy flood events. These areas would be fenced off from the solar array.

Grass fuel levels within the site would be managed to minimise bushfire risks (refer to Section 9.7). Adequate groundcover would be maintained to protect soil and water values, subject to climatic conditions (refer to Section 9.1).

The Proposal would not affect access or agricultural land uses on surrounding properties during the operation phases.

Best practice waste and wastewater management, fuel storage and re-fuelling and chemical handling would be stringently applied to prevent soil and water pollution (refer to Sections 9.1, 9.7 and 9.11).

Impacts on soils and erosion risk are assessed in Section 9.1, impacts on downstream water quality are assessed in Section 9.3. These assessments conclude that the Proposal would not be likely to adversely affect land uses or activities on neighbouring properties or elsewhere in the locality, subject to identified mitigation measures.

An Operational Weed Management Plan would also be prepared to manage impacts associated with weeds such as the risk of weed ingress along the boundary of the Development Site and the importation and spread of weeds through vehicle movements. The Plan would also focus on weed control techniques including herbicide and grazing pressure. Rabbit and fox numbers would be controlled through targeted pest management during the operational phase of the proposal. Grazing pressure and reduced plant matter would also reduce resources and cover for pest species.

LUCRA Assessment

A LUCRA has been carried out in accordance with the Department of Primary Industries Land Use Conflict Risk Assessment Guide (DPI 2011). Given the proposed solar farm is different to the surrounding land use activities, primarily agriculture, this assessment aims to identify and rank potential land use conflicts so that they may be adequately managed. Where expected conflicts are adequately managed, the rights of the existing and proposed land uses can be protected.

The risk ranking in Table 9-9 has been determined using the risk ranking matrix shown in Table 9-8, and in accordance with the probability table and measure consequence table in Department of Primary Industries Land Use Conflict Risk Assessment Guide (DPI 2011). The matrix ranks the risk of impacts according to the probability of occurrence and the consequence of the impact. Probability 'A' is described as 'almost certain' to probability 'E', which is described as 'rare'. The level of consequence starts at 1 – Severe to 5 – Negligible. The risk ranking from 1 to 25 is a result of the probability and consequence. For example, a risk ranking of 25 is the highest magnitude of risk (DPI 2011).

Table 9-8 Risk ranking matrix (Source: DPI 2011).

PROBABILITY	A	B	C	D	E
Consequence					
1	25	24	22	19	15
2	23	21	18	14	10
3	20	17	13	9	6
4	16	12	8	5	3
5	11	7	4	2	1

Table 9-9 Land use conflict risk assessment summary

Identified Potential Conflict	Risk Ranking		Management Strategy	Revised Risk Ranking	
Agricultural spraying (aerial).	D4	5	There is unlikely to be an impact to aerial spraying activities given low levels of glare and the limited height of infrastructure.	D4	5
Contaminated surface water runoff.	B3	17	Implementation of a soil and water management plan and an erosion and sediment control plan would minimise the potential impact.	D4	5
Dust.	B3	17	Dust generated during the construction and decommissioning stages to be managed by the use of water carts when required. Dust is not expected to generate a land use conflict during operation.	C5	4

Identified Potential Conflict	Risk Ranking		Management Strategy	Revised Risk Ranking	
Fire/ Bush fire.	C1	22	Implementation of a Bush Fire Management Plan would significantly reduce the probability of solar farm operation starting a fire or a bush fire damaging the solar farm infrastructure.	D3	9
Visual amenity.	C2	18	Screen landscaping along boundaries where identified in Section 8.3 would mitigate expected impact on visual amenity.	D5	2
Noise.	C4	8	Noise generated during construction and decommissioning stages would be minimised through the implementation of mitigation measures. Where regular maintenance practices are incorporated into operation, noise is not expected to generate a land use conflict.	D4	5
Traffic generation and disruption.	B3	17	Traffic generation and disruptions during construction and decommissioning stages are considered likely however the impact would be temporary and able to be managed (refer to Section 9.6). There are no Travelling Stock Reserves near the Development Site. Traffic would enter the site via All Weather Road, which is unsealed road. There are wide shoulders if stock movement is required. It is considered unlikely that traffic movements would generate a land use conflict with movement of local stock. Traffic is not expected to generate a land use conflict during operation.	C4	8
Weed and pest control.	A3	20	Implementation of pest and weed management plan during construction and operation phases.	D4	5
Mining land use					
Resource extraction/exploration	D3	9	It is unlikely there would be an impact on resource extraction or exploration. In the long term (after decommissioning), the solar farm infrastructure would be removed, and the site made available for alternate land uses including for mining purposes, if desirable.	D5	2

9.2.4 Mitigation Measures

Mitigation measures to ensure that adverse impacts to land use and resource values at the Development Site are avoided and minimised are provided in Table 9-10. Mitigation measures in the EIS relating to the protection of soils (Section 9.1) and water quality (Section 9.3) and control of pest plants and animals (Section 8.1) and waste management (Section 9.11) are also relevant to the protection of land use and resource values at the Development Site.

Table 9-10 Mitigation measures for impacts to land use and resource values

Mitigation measures	Phase
Essential Energy would be consulted prior to commencement of works to ensure that the works do not adversely affect electricity transmission or impede access for inspection and maintenance.	Pre-construction
Consultation with relevant landholders would be ongoing to manage interactions between the solar farm and other properties.	Construction Operation Decommissioning
Construction and operations operate in accordance with the Traffic Management Plan, to minimise dust generation and disturbance to livestock.	Construction Operation Decommissioning
The following landholders and residents would be consulted and notified to minimise, where possible, the noise, dust, traffic and other disturbance impacts: • Those adjacent to the Development Site, • Those located on All Weather Rd between the junction of Castlereagh Highway and All Weather Road and the Development Site; and • Those located on Digilah Road or All Weather Road between the junction of Golden Highway/Bolaro Road and Digilah Road and the Development Site.	Construction Decommissioning
Underground cabling and other works to remain in situ following decommissioning of the solar farm would be installed deeper than 500mm to allow cultivated cropping to resume following decommissioning.	Construction
A Decommissioning Environmental Management Plan (DEMP) would be prepared and submitted to DPIE for approval prior to decommissioning. The DEMP would include a Site Rehabilitation Plan covering: • Criteria and indicators for the restoration of land capability and agricultural potential based on pre-works soil survey results • Details of rehabilitation actions such as removal of infrastructure, remediation of soils, reinstatement of dams and irrigation/drainage channels as required and establishment of suitable groundcover vegetation on bare areas • A monitoring and assessment process to demonstrate that the target state has been achieved • An expected timeline for the rehabilitation program.	Decommissioning

9.3 WATER USE AND WATER QUALITY

This chapter identifies the main issues associated with water use and wastewater management, resulting from the construction and operational activities of the Proposal.

9.3.1 Existing Environment

Water Resources and Quality

The Development Site is within the floodplain of the Macquarie-Castlereagh River Catchment, as shown in Figure 9-7. The Talbragar River is the closest waterway to the site, which demarcates the western and southern boundaries of the Development Site. Talbragar River is an ephemeral system, which flows into the Macquarie River approximately 8 km north of Dubbo. As mentioned in Section 8.4.1, the river's levels are lowest in the summer and autumn, and the current water level is 0.772 metres at gauge station 421904.

Water quality of the river was investigated by EMGA Mitchell McLennan for the preparation of Environmental Assessment for the Cobbora Coal Project, in September 2012 (Cobbora EA) (EMM 2012). The Cobbora EA collected baseline water quality samples from five river gauge stations on a monthly basis from August 2009 to September 2011. The relevant monitoring stations to the current Subject land:

- SW4 Talbragar River at Elong gauge (421042)
- SW5 Talbragar River at Cobbora (discontinued gauge).

These monitoring stations are located downstream of the Development Site, as such they would provide an indication of the water quality following potential inputs from adjacent land use and agricultural activities to the river.

The results were assessed against Water Quality Objectives (WQOs) from the NSW Government Water Quality and River Flow Objectives (Dec 2006) and ANZECC/ARMCANZ (2000) guidelines. The ANZECC/ARMCANZ guidelines provide several WQOs, based on the condition of the system being tested. With regards to the monitoring sites, the WQOs for "slightly to moderately disturbed systems" were selected, as the sites have been impacted by long-term agricultural activities.

The following table summarises the water quality monitoring results.

Table 9-11: SW4 and SW% mean water quality monitoring results (EMM 2012 Cobbora EA)

Parameter	WQO	SW4	SW5
pH	6.5-8.5	7.9	7.9
Total Dissolved Solids	500-1,000 mg/L	570	570
Total Nitrates	500 µg/L	1,500	1,500
Total Phosphorus	50 µg/L	470	500
Total Suspended Solids	<40 µg/L	200	200

Total Nitrates, Total Phosphorus, and Total Suspended Solids were elevated. This is indicative of the impacts from land uses and degraded riparian habitat along the river banks.

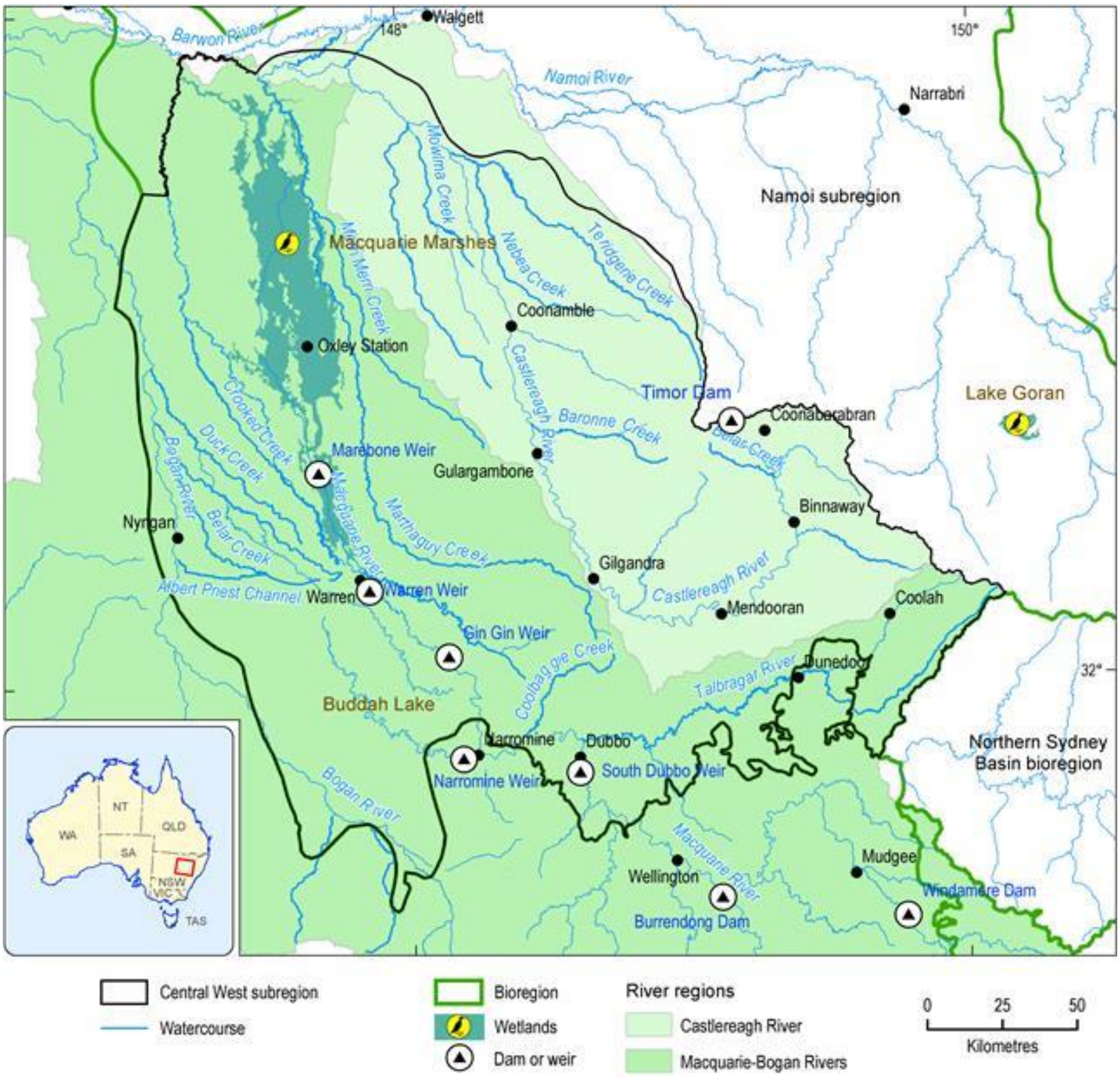

Figure 9-7 Central West Catchment

Figure 9-8 Talbragar River at Development Site

One (1) unnamed ephemeral creek is located on the north-western edge of the Development Site, passing through the landowner's residential property. This creek is not located within the Development Site of the solar farm. The creek is not used as a water source for the agricultural activities of the Development Site.

Four (4) small stock dams are located within the Subject Land where two (2) are located outside the Development Site and are used by grazing cattle and sheep; and the other two (2) dams are located within the Development Site, specifically where the solar panels will be located. No irrigation channels run through the Development Site; however, hydrology, landform and soils have been heavily modified by paddock development.

A search of the National Pollutant Inventory (NPI) for the Warrumbungle LGA indicated no facility pollution sources, but did indicate diffuse source emissions of phosphorous and nitrogen from agriculture and forestry within the wider Murray-Darling Catchment (NPI, 2020).

Groundwater

The Development Site is situated within the Coolaburragundy-Talbragar Alluvium, which has a thickness ranging 15-60 metres and a total area of 150 km^2. The dominant groundwater recharge processes are rainfall infiltration and connective to the Coolaburragundy and Talbragar Rivers. Groundwater is generally situated at a 10-metre depth and is temporally and spatially variable. The area is part of the larger Sydney Basin Groundwater Province which covers 38,000 km^2 from northern NSW to southeast QLD (refer to Figure 9-9). Figure 9-10 presents groundwater levels at the Development Site over the last 20 years.

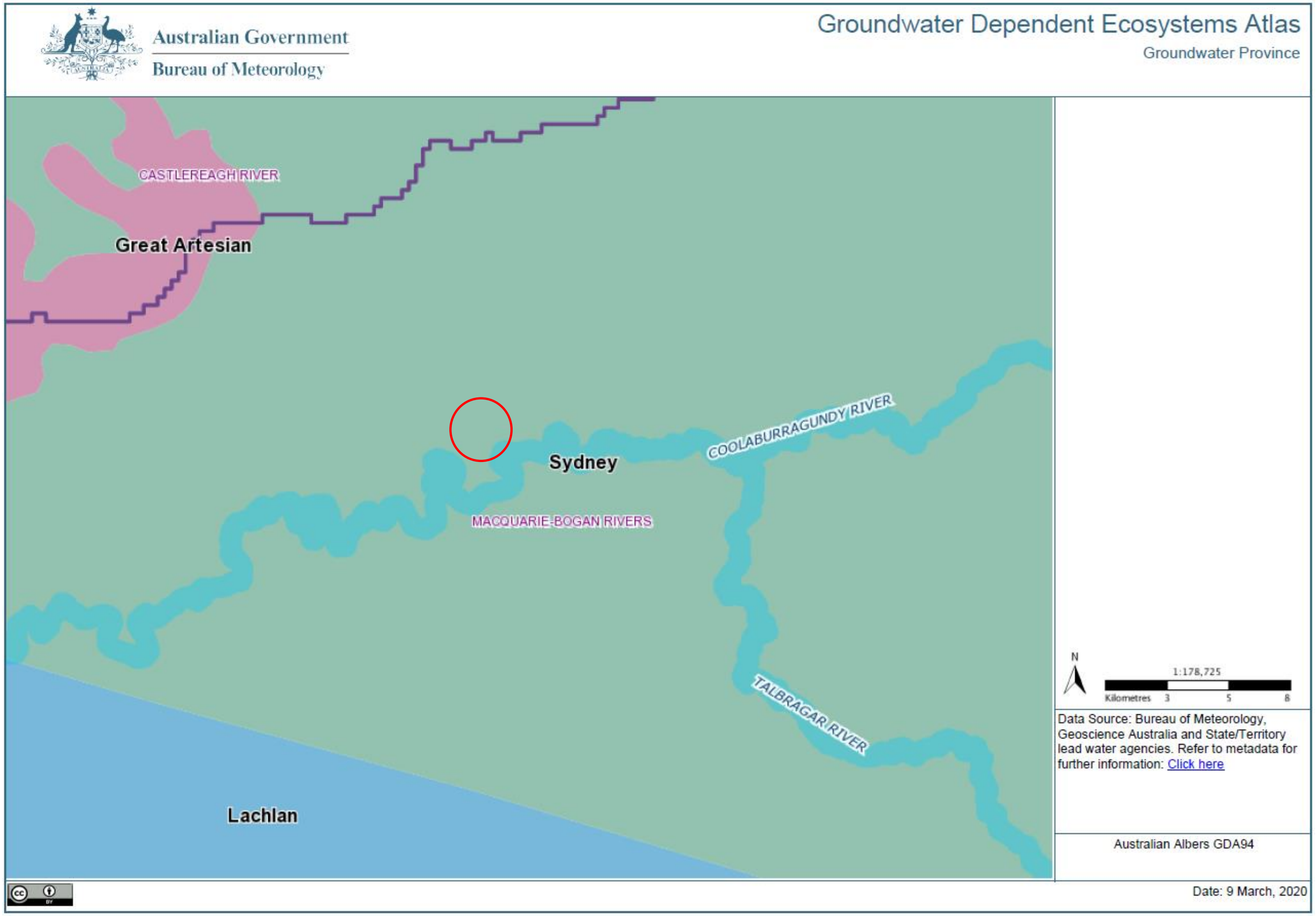

Figure 9-9 Groundwater Province in the vicinity of the Proposal (circled) (BOM 2020)

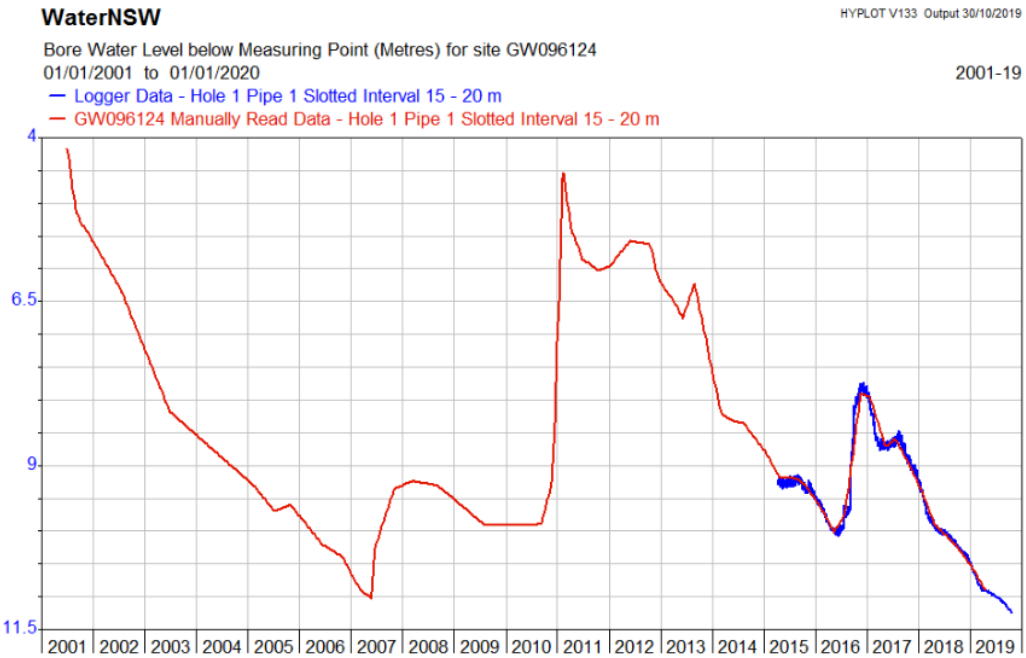

Figure 9-10 Groundwater levels at GW096124

Groundwater in the area is managed under the Water Sharing Plan for the Macquarie – Bogan Unregulated and Alluvial Water Sources (2012). Groundwater is utilised by the local water utility which has a water licence for 656 ML/year. The town water entitlement for Dunedoo is 400 ML/year. An additional 5,355-unit aquifer shares are provided for other purposes. The long-term average annual extraction limit (LTAAEL) has been set at 3,473 ML/year for the Talbragar Alluvium Region.

Groundwater is used for irrigation, town water supply, domestic and stock uses. Typically, within the alluvial aquifer of the region salinity is around 1,000 µs/cm. Yields of up to 80 L/s can be expected (NSW DPI 2018A). Major water use within the area includes intensive cropping irrigation of vegetables and improved pasture.

There are 34 registered bores within 1,500 metres of the Development Site (NSW DPI database). The alluvium within the Development Site is considered a fractured or fissured, extensive aquifer of low to moderate productivity (BOM 2020). Three (3) bores are situated within the Development Site (refer to Table 9-12). Figure 9-11 presents the location and purpose of groundwater bores surrounding the Development Site and the location of GDEs and watercourses.

Table 9-12 Bores within the Development Site

Name	Drilled Date	Depth (metres)	Purpose
GW032946	1950	30.80	Stock
GW096124	2001	Unknown	Monitoring well
GW03052	2001	57	Irrigation

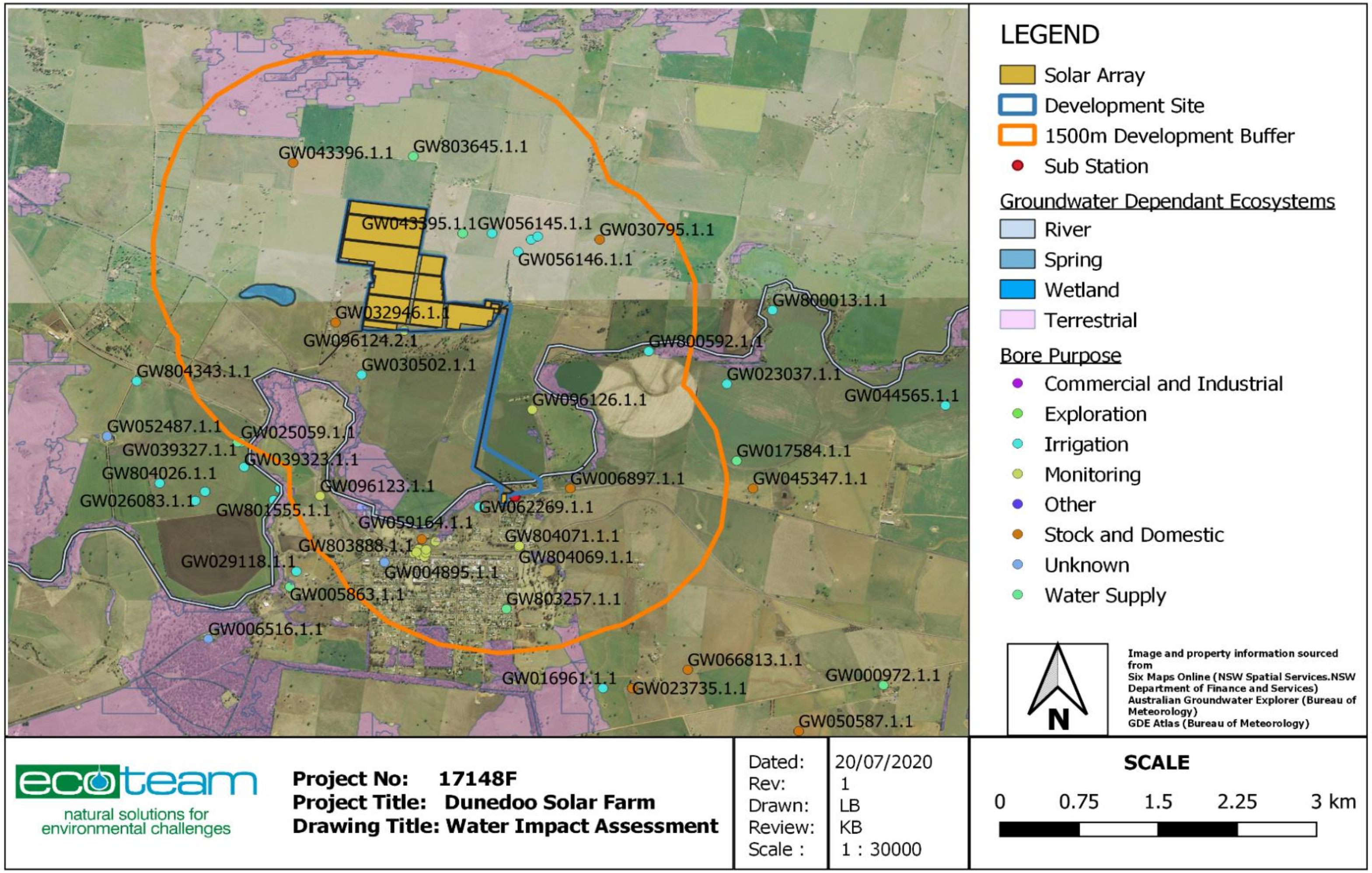

Figure 9-11 Surface and groundwater locations and purposes

Salinity

Based on soil surveys and desktop research conducted for the Cobbora EA, the wider region surrounding the proposed mine development area was mapped as high salinity. Indeed, groundwater salinity measurements collected by the BOM at several bores located within the Development Site and adjacent revealed variable concentrations of salinity ranging from brackish to saline.

The following table summarises the salinity measures at bores in the locality of the solar farm.

Table 9-13 Salinity measurements (Groundwater Explorer, BOM.com.au, Jan 2020)

Bore ID	Bore Depth (m)	Purpose	Status	Salinity µS/cm	Latitude	Longitude	Date
GW030502.1.1	58.8	Irrigation	Unknown	810	-31.999543	149.387553	5/02/1979
GW039327.1.1	42	Water Supply	Function	793 787	-32.005655	149.376998	4/11/1983 22/04/1985
GW042835.1.1*	45.7	Irrigation	Unknown	1,020	-31.987043	149.402553	26/01/1977
GW042835.1.1	45.7	Irrigation	Unknown	1,650	-31.987043	149.402553	4/06/1980
GW059185.1.1	33	Unknown	Unknown	940	-32.011488	149.387553	10/10/1983
GW043395.1.1*	33.5	Irrigation	Unknown	579	-31.986765	149.396164	17/09/1991
GW026083.1.1	32.9	Irrigation	Unknown	733	-32.010932	149.373386	21/10/1966
GW030795.1.1	40	Stock / Domestic	Unknown	1,150 1,200	-31.987321	149.40783	12/06/1980 12/06/1980
GW006897.1.1	29.8	Stock / Domestic	Unknown	1,730	-32.009821	149.405331	26/09/1988

*Bores located on Lot 80/DP754309, proposed Development Footprint.

The groundwater quality status for pesticides or other contamination in the regional deep aquifers is not known (Office of Water 2011).

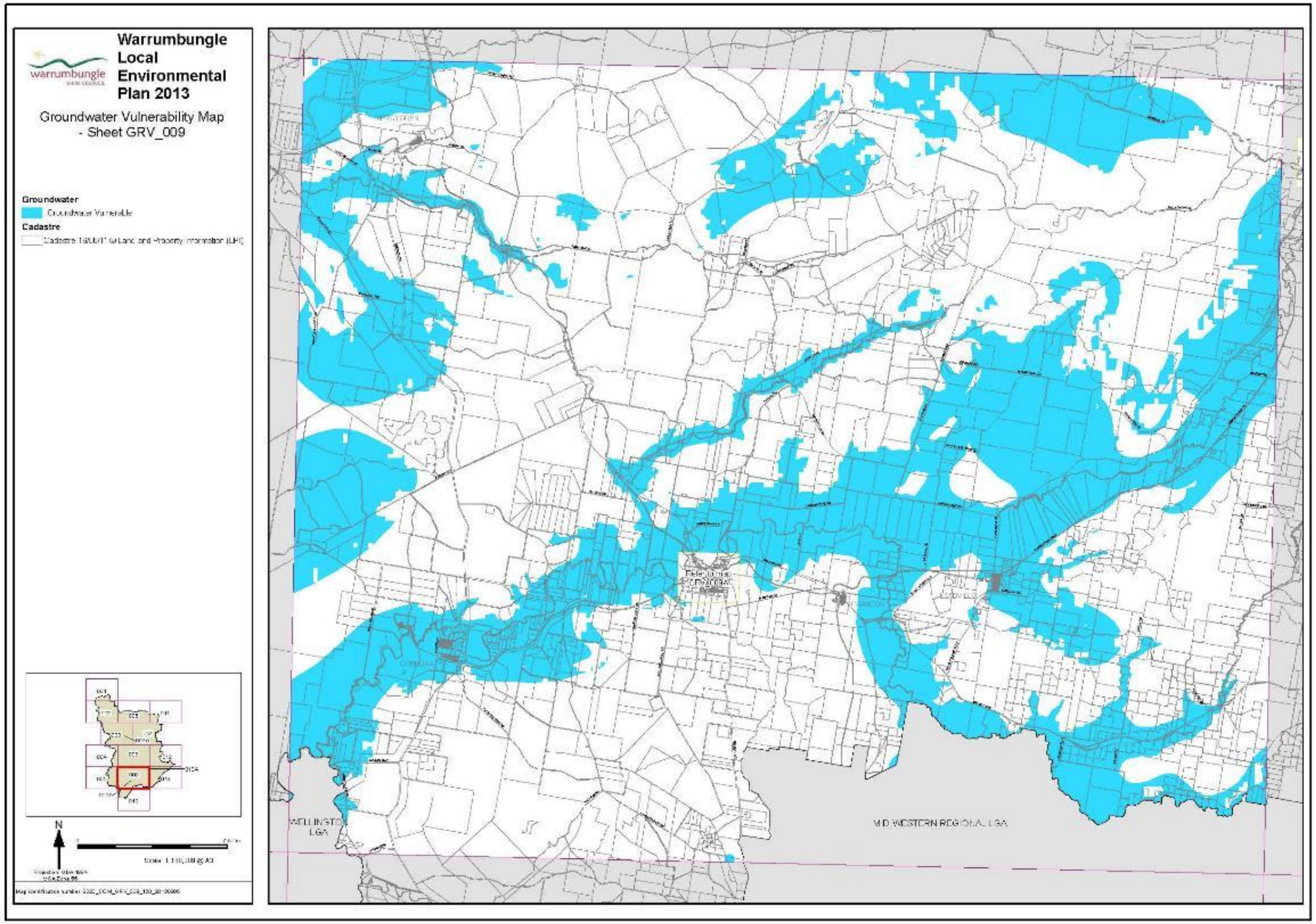

Figure 9-12 Groundwater systems surrounding the Proposal (Warrumbungle LEP)

Groundwater Dependent and Inflow Dependent Ecosystems

The assessment of likelihood of groundwater dependent and inflow dependent ecosystems in the locality is based on the Bureau of Meteorology Groundwater Dependent Ecosystems Atlas (BOM 2020b).

Groundwater Dependent Ecosystems (GDEs) include ecosystems which may rely on the surface expression of groundwater (including surface water ecosystems that may have a groundwater component) and ecosystems which may rely on the subsurface presence of groundwater (including vegetation ecosystems). There is a mapped Terrestrial GDE area (vegetation reliant on subsurface groundwater) with low and high potential for groundwater interaction in the southern portion of the Development Site, which is associated with the Talbragar River (refer Figure 9-13). The north portion of the site (north of All Weather Road), does not have any mapped GDEs.

Inflow Dependent Ecosystems (IDEs) are ecosystems which are likely to be accessing water in addition to rainfall from soil water, surface water or groundwater, these areas are shown in Figure 9-14. The majority of the site is characterised as ‘likely to be IDE’.

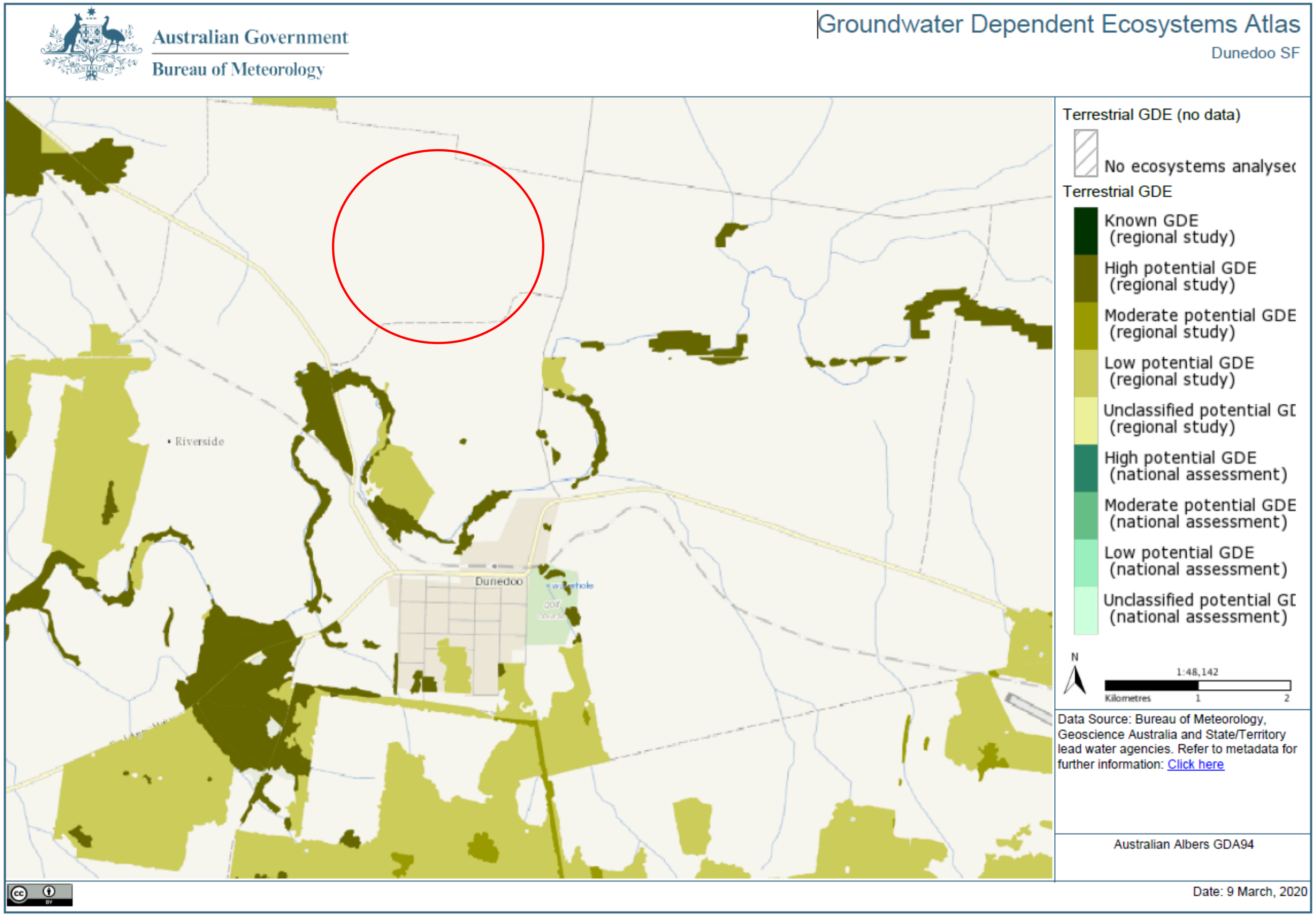

Figure 9-13 Potential Groundwater Dependent Ecosystems in the vicinity of the Proposal (circled) (BOM 2020b)

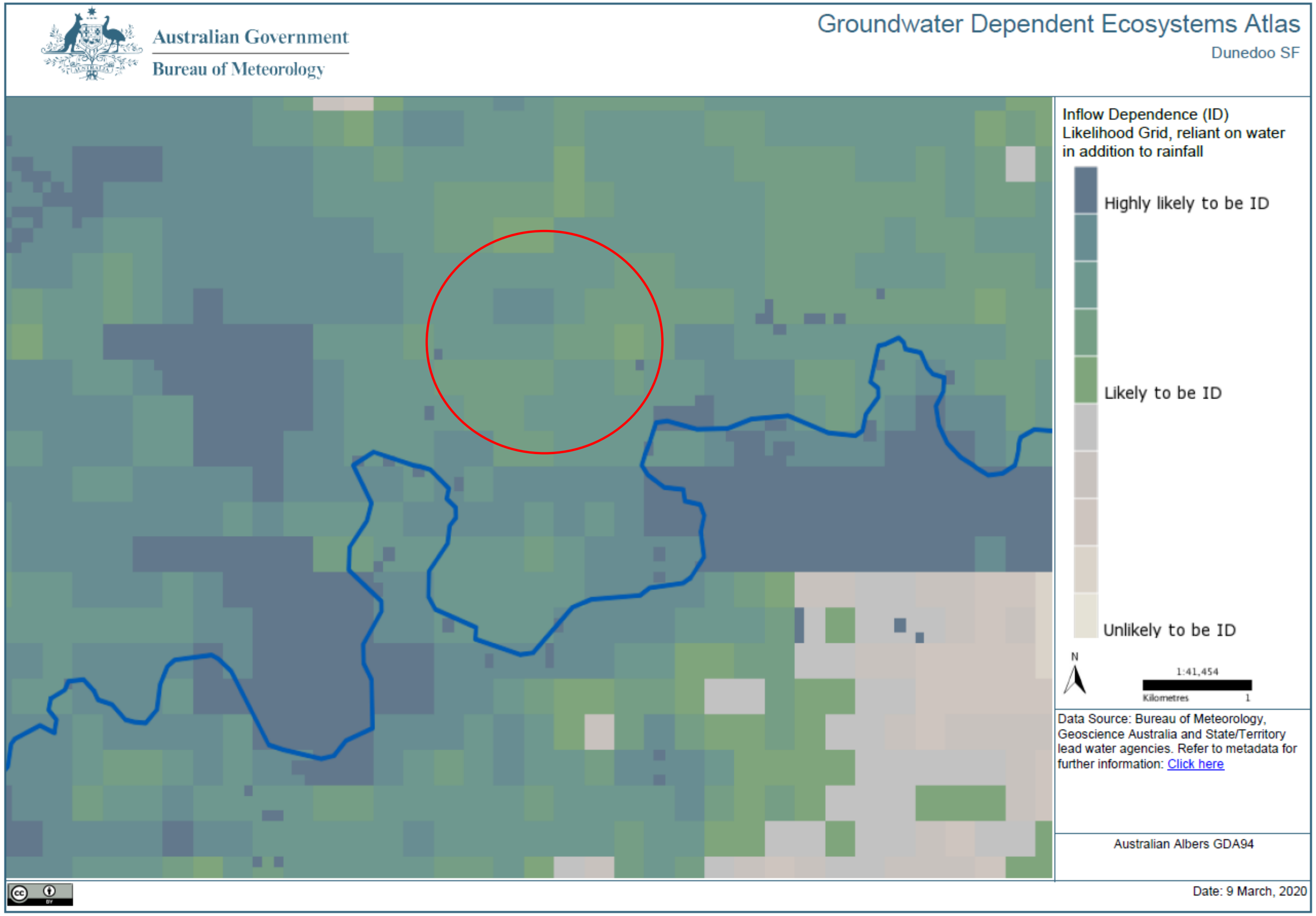

Figure 9-14 Potential Inflow Dependent Ecosystems in the vicinity of the Proposal (circled) (BOM 2020b)

Water Sharing Plan

The water sharing plan for the Development Site is governed by the Macquarie Bogan Unregulated and Alluvial Water Source. Specifically, the water licenses for the Development Site are based on the Macquarie Bogan Alluvial Groundwater Sources - Talbragar Alluvial.

Within the area covered by this plan, there are approximately 1,427 water licenses, totalling 264,342 ML of entitlements. Most of the licenses are for irrigation water, followed by town water, and these entitlements are divided between unregulated surface water and alluvial groundwater. The water source for the town of Dunedoo is Talbragar Alluvial, the quantity of entitlements are 6,005 ML/year and 24 licences. The town water entitlements for Dunedoo is 400 ML/year (DPI-W, p. 2020).

There has been an embargo on granting new water licenses across NSW for unregulated catchments since 1995, and since 2008 for alluvial aquifers. However, it should be noted, that water is also extracted from watercourses and aquifers within the plan area through basic landholder rights, as such these do not require licenses.

Schedule 6 of the Water Sharing Plan for the Macquarie Bogan Unregulated and Alluvial Water Sources (2012), has to date not identified any high-priority GDEs.

The following Figure 9-15, identifies the location of irrigation bores in the Development Site and surrounds.

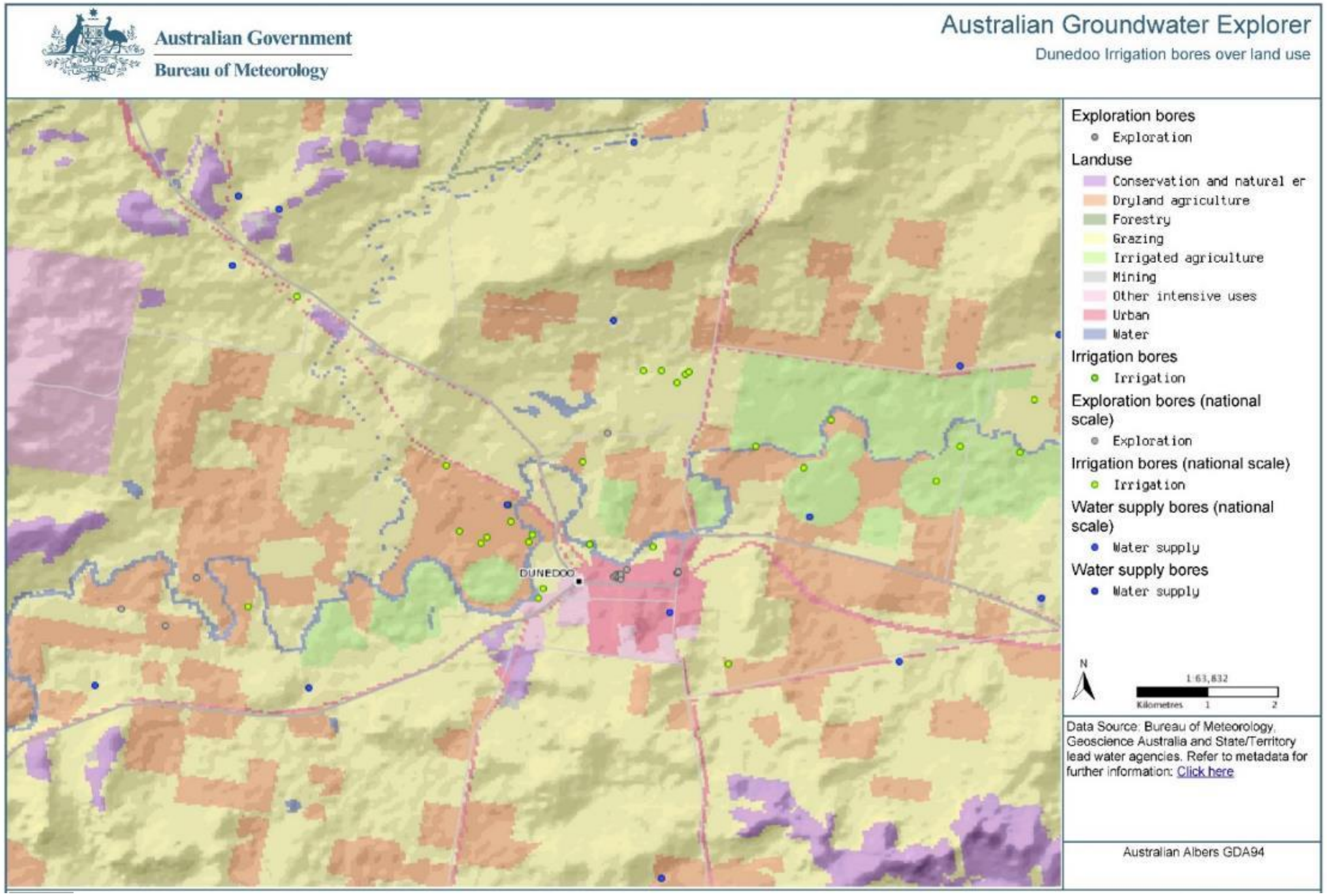

Figure 9-15 Irrigation bores in the Proposal's locality

9.3.2 Potential Impacts

Warrumbungle Shire Council has advised that '*the water supply for Dunedoo is drawn from a well on the southern end of the proposed development area'*. Due to this, Council has significant concerns if the developer intends on accessing groundwater aquifers in the area. The following section discusses the proportion of water and source that would be used for the construction and operation of the Proposal.

Construction and Decommissioning

Water Use

Water usage during construction would be about 41,760 KL over a 10-12 month construction period, mainly for dust suppression, cleaning, concreting, on-site amenities, and landscaping. This equates to approximately 3.480 KL per month and 114 KL/day or 2 to 3 water trucks with a capacity of 44 KL. This water requirement is likely to vary depending on weather conditions.

A small amount of potable (drinking) water (approximately 90 KL) would be imported to the site during the construction period. The potable water supply would be augmented by rainwater collection in tanks installed beside site buildings as constructed. Any requirement for potable water would be limited and confined to the construction phase, and would not place pressure on local drinking water supplies.

The source for water for the concrete batching plant would be define once the Proponent completes consultation with the Council. The batching plant's water use minimisation policy provides for mechanisms and procedures to re-use the wastewater generated during the wash down of the concrete trucks. Such practices target to re-use 100% of the wastewater, and only top up with new water lost to evaporation and concrete curing. As such over the entire construction period, the total demand on water resources from the concrete batching process would also be minimal.

Water Sourcing

Several water sources may be utilised during construction. Under the EP&A Act, SSDs do not require a water use nor water management work approval for activity approvals as per the WMA (refer to Section 5.1.9). However, a permit for aquifer interference as per section 4.41(g) of the EP&A Act would be required to penetrate the aquifer.

Aquifer water made available for the 2019/2020 year is 5,355 ML. The water required for the Proposal construction (41,760 KL) is 0.78% of the available aquifer water. In the 2019/2020 year, 2,162.3 ML were used from this allocation, which represented 40.4% of the available aquifer water, and the water required for the Proposal would be about 5.6% of the water used in the year to date. The impact of drawing the 41,760 KL is negligible as sufficient remaining water is available in the system based on this year's figures. The Proposal would source the majority of its required water via this method.

During drought conditions water use may increase slightly, particularly with increased requirement for dust management. However, there is unlikely to be material impact on the groundwater system. Given the construction period of 10 months and minimal water use required for construction, this is considered low risk. Chemical dust suppression can be used as an alternative to water trucks if required but is not preferred by the Proponent. In the event on-site water supply is insufficient during construction, water access can be secured through commercial arrangements with local water supply authorities.

Impacts on water use during decommissioning would be similar to those during construction. They are considered low risk and manageable.

Water Quality – Turbid Runoff and Sedimentation

The construction phase of the Proposal involves a range of activities that would disturb soils and potentially lead to sediment-laden runoff, affecting local waterways. These risks and the relevant pollution control measures have been discussed in Section 9.1 Soils and Landforms.

Water Quality – Chemical Pollution Risks

The construction phase would entail the following water chemical pollution risks:

- A hydrocarbon spill risk from use and re-fuelling of construction vehicles and machinery
- On-site concreting for building and equipment foundations
- Wash-off from curing asphalt pavement and road seal
- Storage and use of paints, cleaning solvents and other chemicals
- Pesticide storage and use for pest plant and animal control
- Escape of fertilisers used for revegetation
- Runoff from waste materials.

Construction activities at the site have minimal potential to degrade the water quality of Talbragar River as the substation and associated facilities, which are sites of the main earthworks are located over 1.5 km from the river. Furthermore, All Weather Road acts as a berm, impeding the overflow of any surface runoff resulting from construction activities, to the southern portion of the Development Site.

Equally, there is no direct connection to watercourses subject to the relevant Water Quality Objectives and River Flow Objectives identified for the Macquarie-Bogan River Catchment.

Contamination and spill risks would be managed using best practice and mitigation measures coordinated through the Environmental Management Plan. The limited excavation depths involved in the Proposal (up to 2.4 metres) would avoid physical impacts to the groundwater resource. These areas of disturbance would be small and sparsely distributed, and the surrounding groundcover would be retained, helping maintain sediments onsite. These risks are considered minimal and manageable with standard sediment and erosion control safeguards.

Groundwater

Considering the relatively shallow depth of local groundwater, local groundwater resources could be impacted by excavation at depth. Minimal excavation is proposed for slab footings, and the limited excavation depths involved in the solar farm Proposal (up to 2.4 metres) would avoid physical impacts to the groundwater resource. Similarity, contamination of groundwater would be highly unlikely given that chemicals and fuels would be appropriately stored, and spills procedures would be implemented (spill management is discussed in Section 9.1).

Subject to the implementation of the Blue Book measures and additional safeguards presented in Section 9.1 and Table 9-3, the proposed works are not considered likely to significantly affect surface water quality at or downstream of the site, or groundwater quality in the shallow aquifer under the site.

Clearing of trees can impact on groundwater; saline groundwater can move up through the soil profile if there is a reduction in water uptake and transpiration by trees in the landscape, exacerbating salinity impacts. The clearing proposed during construction is very minor in this context. Most trees can be retained by the Proposal. No operational impacts would affect groundwater at the site.

As the Proposal 's construction demand for groundwater resources is limited in duration (10 months) and the proportion of water-use relative to agriculture and farming water demand is minimal (<2%), the risks of impacts to GDE and IDE systems are considered very low.

Additionally, it is noted that there are currently no high-priority GDEs as listed on Schedule 6 of the Water Sharing Plan for the Macquarie Bogan Unregulated and Alluvial Water.

Impacts on groundwater during commissioning would be similar to those during construction. They are considered low risk.

Operation

Water Use

The operation of the solar farm would require approximately 171.4 KL per year of non-potable water, which would be used for:

- Staff amenities for up to three people at the control and maintenance building
- Cleaning of PV modules and other maintenance activities.

The solar farm would include washroom facilities for maintenance and administration workers. Sanitary/domestic wastewater requirements for the solar farm are anticipated to be no more than 100 litres per day per person. This is a conservative estimate as office consumption of water is significantly less than household consumption.

With regards to potential contamination of soils and groundwater, this may occur if containment and disposal mechanisms are inadequately managed resulting with uncontrolled discharge to ground. The appropriate design and installation of a septic system in accordance with Council requirements and regular wastewater removal by a licensed service supplier would minimise any risks of contamination. The potential negative impacts are considered negligible.

Solar panels would require regular cleaning to remove settled particulates and ensure optimal operation. Silt laden runoff would be directed to ground where it is likely to be lost to evaporation, the risk of any adverse impact is therefore considered minimal.

Water consumption is anticipated to be approximately 0.8 litres per panel, per cleaning exercise. A 20-KL rainwater tank would be installed on site to provide water for panel cleaning, irrigation and other non-potable uses, such as sanitary/domestic water and cleaning of equipment and plant.

If rainwater volumes are not sufficient, supplemental or alternative water sources would be required. The estimated total operational water use of 171.4 KL per year would represent 0.003% of the available aquifer water (5,355 ML). The Proposal is exempt from requiring a permit to construct a bore, however a permit for aquifer interference as per section 4.41(g) of the EP&A Act would be required to penetrate the aquifer.

Alternatively, if local water utility were used, it would represent 0.04% of the 400 -ML allocation. As such it is reasonable to assume the operational needs of the Proposal can be easily met from the either the new onsite bore water or the local water utility allocation.

It should also be noted that in the event of drought conditions, water purchases may still be available as a temporary supply on the open market. Additionally, the Proposal’s draw on this supply would be a low percentage and may form part of the unutilised proportion of the allocation. As such, the potential impact on agricultural users especially those who rely on low cost water is likely to be minor.

Hydrology and Water Quality

Operation phase risks to hydrological values and water quality include:

- Storage and use of hydrocarbons and other chemicals (pesticides, cleaning solvents, paints)
- Increased runoff from impermeable surfaces (tracks, carparks, hardstand areas)
- Spill risk from the substation (if oil-cooled).

There would be increased localised runoff from impermeable surfaces created at the site, including tracks, parking areas and hardstands surrounding facilities. Drainage from these structures would be managed to prevent long distance or concentrated flows, and to discharge onto adjacent well-developed groundcover vegetation.

No negative impacts to water quality to any downstream watercourses, GDE's and Inflow Dependent Ecosystems are expected to result from the operation of the solar farm.

The application of best practice and the mitigation measures provided in this section and Table 9-14 would be adequate to manage risks to water values in the Development Site. The increased runoff from these surfaces is likely to be offset by the enhanced infiltration and landscape function resulting from the establishment of perennial groundcover over the majority of the site.

By ceasing farming practices - soil cultivation, application of irrigation water and fertilisers - and by maintaining groundcover, the Proposal would be likely to improve the quality of water draining off the property and infiltrating into the shallow groundwater system. The Proposal is likely to have a positive effect on the local groundwater table by reducing the amount of irrigation and water influx from sources other than precipitation (McMahon Earth Science 2017).

The impact of the Proposal on flood risk in addressed in Section 8.4.

9.3.3 Mitigation Measures

Mitigation measures to avoid and minimise impacts to water use and water quality are provided in Table 9-14 below. Many of the measures identified for soil protection in Section 9.1 are also relevant for the protection of water values and are not repeated here.

Table 9-14 Mitigation measures for hydrological values and water quality

Mitigation measures	Phase
The Spill and Contamination Response Plan prepared as part of the Emergency Response Plan would include measures to: • Respond to the discovery of existing contaminants at the site (e.g. Pesticide containers or asbestos), including stop work protocols and remediation and disposal requirements • Manage the storage of any potential contaminants on-site • Mitigate the effects of soil and water contamination by fuels or other chemicals (including emergency response and EPA notification procedures) • Ensure that machinery and materials arrive on site in a clean and secure condition • Prevent contaminants affecting adjacent pastures, irrigation channels, dams and native vegetation • Monitor and maintain spill equipment including spill kits in relevant machinery • Induct and train site staff. • Detail fuels, chemicals, and liquids storage locations that are at least 50 metres from any waterways or drainage lines, in an appropriate bunded area • Disposal process for contaminated materials.	Construction Operation Decommissioning
If the substation is oil-cooled, the layout, design, size etc of the oil containment bunding and drainage would comply with the relevant standards and guidelines.	Pre-construction Construction Operation

Mitigation measures	Phase
The bund would be regularly inspected and cleaned, including removal of rainwater.	
A Soil and Water Management Plan will be developed to incorporate the following: • **That no detergents or other chemicals would be added to the solar panel cleaning water** • Specify concrete washout process and location • Specify the procedures for testing, treatment and discharge of construction wastewater • Detail staff training required	Construction Operation
If ground water is to be used, A Groundwater Management Plan would be incorporated into the CEMP to manage impacts on groundwater. This would be informed by onsite survey by an appropriately trained expert and include: • Pollution controls • Management of dewatering.	Pre-Construction
If a new bore is to be constructed, the construction and maintenance of the groundwater extraction bore will be in accordance with the *Minimum Construction Requirements for Water Bores in Australia (3rd edition*) produced by the National Uniform Drillers Licencing Committee (NUDLC). The minimum requirements for consideration include: • Only a licensed driller shall carry out the bore installation works and shall be present at all times during bore construction activities. • The bore design should aim to ensure the protection of the groundwater resource from surface contamination. The headworks and casing are sealed so that there is no potential for flow outside the casing. • To minimise the possibility of contaminating the bore and any surrounding bores, the new bore should be located away from existing bores, surface water sources and any sources of pollution (e.g. dairies, septic tanks and absorption trenches, refuse dumps, landfill, effluent discharges from drainage ditches, cattle/stock dips). • Chemicals and other drilling fluid additives that could leave a residual toxicity should not be added to any drilling fluids or cement slurries (i.e. grouts) used to drill and complete any water bore.	Pre-Construction Construction Operation Decommissioning

9.4 NOISE AND VIBRATION IMPACTS

Renzo Tonin & Associates Pty Ltd was engaged to complete a Noise and Vibration Assessment (NVA) for the Proposal (Appendix H). As per the SEARs, the purpose of the NVA was to quantify potential environmental noise levels associated with the construction and operation of the Proposal and identify mitigation measures, where required.

The assessment includes the following:

- Review of construction and operation to identify noise generating plant, equipment, machinery or activities proposed to be undertaken.
- Identify the closest and/or potentially most affected receptors situated within the area.
- Establish existing noise levels to determine project-specific construction Noise Management Levels (NMLs) and operational noise criteria.

- Undertake 3D noise modelling to predict levels that may occur as a result of the construction and operation of the Proposal at the closest and/or potentially most affected receptor.
- Provide a comparison of predicted noise levels against relevant construction NMLs and operational criteria.
- Assess the potential noise impacts associated with construction and operational aspects of the Proposal.
- Provide feasible and reasonable noise management measures, and monitoring options where NMLs or operational criteria may be exceeded.

9.4.1 Policy Setting

The NVA was conducted in accordance with the following key policies, guidelines and standards (where relevant):

- NSW Department of Environment and Climate Change - *NSW Interim Construction Noise Guideline* (ICNG) 2009
- Environment Protection Authority (EPA) - *Noise Policy for Industry* (NPI) 2017.
- NSW Department of Environment, Climate Change and Water (DECCW) - *NSW Road Noise Policy* (RNP) 2011
- Standards Australia AS2436-2010 (R2016) (AS2436) – *Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites*
- NSW Department of Environment, Climate Change and Water (DECCW) – *Road Noise Policy* (RNP) 2011.

Construction Noise

The NSW *Interim Construction Noise Guideline DECC 2009* (ICNG) provides direction for the assessment and management of construction noise impacts. The guideline indicates that a quantitative assessment of noise impacts is warranted where works would impact an individual or sensitive land use for more than three (3) weeks in total.

The ICNG provides direction on the calculation of 'noise management levels' (NMLs) for noise sensitive receivers. The NMLs are relative to the time of day. During standard construction hours construction noise levels measured at a receiver should comply with Table 9-15. Receivers are 'highly noise affected' when measured construction noise is above 75 dB(A) at the receiver. Adhering to the levels described in the guidelines will minimise the impact of construction noise on adjacent receivers. The rating background noise level (RBL) is a single figure that represents background noise levels for noise assessment purposes. The noise descriptor L_{AF90} is the noise level that is exceeded for 90% of the time and is used to measure the RBL. Measurements of the RBL are made at likely noise receivers over seven (7) days without rain, strong wind or extraneous noise.

Table 9-15 Construction noise levels

Recommended Construction Hours	Noise Levels dB(A)
Monday to Friday 7 am to 6 pm Saturday 7 am to 1 pm No work on Sundays or public holidays	RBL + 10
Justified work outside standard construction hours	RBL + 5

Recommended Construction Hours	Noise Levels dB(A)
Highly noise affected, likely strong community reaction	75

As no work outside standard working hours is proposed, only the daytime noise management levels have been assessed.

Construction Vibration

Vibration generating activities would occur only during the construction phase of the Proposal. There are no vibration generating activities expected during the operational phase. As the nearest identified receivers unrelated to the Proposal in excess of 150 metres from the proposed construction activities, structural damage due to vibration is not expected. Assessment for vibration impact on human comfort is assessed in accordance with EPA requirements.

The preferred and maximum values for continuous and impulsive vibration are defined in Table 2.2 of the guideline and are reproduced in Table 9-16 for the applicable receivers.

Table 9-16 Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)

Location	Daytime[1]		Night-time[1]	
	Preferred	Maximum	Preferred	Maximum
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and	0.40	0.80	0.40	0.80

[1]Daytime is 7:00am to 10:00pm and Night-time is 10:00pm to 7:00am

Operational Noise

The purpose of NSW Noise Policy for Industry (NPI) (EPA 2017) is to ensure noise impacts associated with the operation of an industrial development are evaluated and managed consistently and transparently. The NPI specifies noise criteria to protect the community from excessive intrusive noise. The NPI provides guidance on the calculation of project noise trigger levels. Those trigger levels include:

- Intrusive noise levels
- Amenity noise level.

The L_{Aeq} descriptor is used for measuring and describing both intrusive noise levels and amenity noise levels. The NPI describes a process for determining the intrusive noise levels for an industrial noise source. The NPI describes intrusiveness of a mechanical noise source. Generally, the noise level is acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the RBL by more than 5dB(A). The level for intrusive noise is described in Table 9-17.

Table 9-17 NSW Noise Policy for Industry intrusive goals

Time of day	RBL dB(A) L_{A90}	Intrusive noise = RBL + allowance	NML dB(A) $L_{A90\ (15min)}$
Day	35	= RBL + 5	40
Evening	30	= RBL + 5	35
Night	30	= RBL + 5	35

The acceptable intrusive noise level from an industrial noise source is the RBL + 5 dB(A).

The NPI describes a process for determining the project amenity noise levels. This aims to limit continuing increases in noise levels from industrial development. The recommended amenity noise levels aim to protect against noise impacts such as speech interference, community annoyance and some sleep disturbance. The project amenity noise level represents the objective for noise from a single industrial development at a receiver. The NPI calculates the project amenity noise level for industrial developments as the recommended amenity noise level minus 5 dB(A).

Furthermore, given that the intrusiveness noise level is based on a 15-minute assessment period and the project amenity noise level is based on day, evening and night assessment periods, the NPI calculates the $L_{Aeq,15min}$ level by adding 3 dB(A) to the $L_{Aeq,\ period}$ level. The industrial noise during operation should not normally exceed the acceptable noise levels for rural residential properties as detailed in Table 9-18.

Table 9-18 NSW Noise Policy for Industry amenity goals

Receiver type	Noise amenity area	Time of day	Recommended amenity noise level	Project amenity noise levels	
				Noise Level $L_{Aeq.period}$ dB(A)	Noise Level $L_{Aeq.15min}$ dB(A)
Residence	Rural	Day	50	45	48
		Evening	45	40	43
		Night	40	35	38
Commercial premises	All	When in use	65	60	63

Comparing the amenity and intrusiveness criteria indicates that the intrusiveness criteria are more stringent for day, evening and night. Compliance with the intrusiveness criteria would result in compliance with the amenity criteria.

9.4.2 Existing Environment

In terms of existing noise levels, land uses surrounding the Development Site are generally limited to sheep and cattle grazing land on improved irrigated pastures and irrigated horticulture. Noise generating equipment would include large harvesters (often operating during harvest late into the night), large grain haulage trucks (double or triple bogey), irrigation systems including pumps as well as tractors, quad bikes and 4WD vehicles. These land uses are frequent but intermittent and would create limited background noise within the area. Noise levels are likely to be concentrated at particular times, determined by farm activities, rather than continuous.

Sensitive Receivers

Residential properties surround the Development Site (Figure 9-16), with 9 sensitive receivers identified within a 2-km buffer of the Development Site. The nearest uninvolved residential dwelling, R4, is about 730 metres north of the solar farm boundary. The majority of the receivers are over 1,200 metres from the boundary, and the furthest property is 1,900 metres south of the Development Site.

The distance between the selected receivers and the proposed solar farm boundary are shown in Table 9-19.

Table 9-19 Sensitive receivers within 2-km buffer of the Proposal

Receiver	Lot / address	Receiver type	Approximate distance to Proposal
R1	Lot 157, DP754291, Dunedoo – Polocrosse Club	Commercial	1,150 metres south
R2	202 All Weather Road, Dunedoo (involved receiver)	Residential	220 metres west
R3	485 Castlereagh Highway, Dunedoo – Stud Manager's residence	Residential	620 metres west
R4	485 Castlereagh Highway, Dunedoo – Farm Manger's residence	Residential	310 metres northeast
R5	332 Digilah Road, Dunedoo	Residential	1,570 metres northeast
R6	126 Lawson Park Road, Dunedoo	Residential	1,730 metres east
R7	1 Evans Street, Dunedoo	Residential	1,730 metres south of PV footprint 120 metres south of Option 1 easement
R8	Lot 2, DP749515, Dunedoo	Residential	1,780 metres south of PV footprint 150 metres south of Option 2 easement
R9	27 Nott Street, Dunedoo	Residential	1,900 metres south of PV footprint 280 metres south of Option 2 easement

Background Noise Monitoring

Background noise levels for the Development Site were determined in accordance with Fact Sheet A of the NPI. Background noise measurements were recorded at site L1, near residential receiver R4, located at 485 Castlereagh Highway (Figure 9-16), on the northern boundary of the Development Site. The noise monitor was installed in the 'free field' (i.e. away from building facades).

The noise monitoring used in the survey was designed to comply with the requirements of AS 1259.2-1990 “Acoustics - Sound Level Meters. Part 2: Integrating - Averaging” and carried appropriate and current calibration certificates. The equipment utilised for the noise surveys comprised of a RTA04 (CESVA SC310) Noise Monitor, fitted with a microphone wind shield.

Sound level measurements occurred from the 5th December to 13th December 2017. During the monitoring, sound level meter was set to ‘fast’ time weighting and an ‘A’ frequency weighting. During that period, eight (8) days of weather met the required meteorological conditions.

Existing background and ambient noise levels are presented in Table 9-20 below. The identified receivers surrounding the Development Site are all classified as rural under NPI guidelines. The recorded background noise levels were close to levels typical for a rural area, with a day RBL less than 40 dB(A), an evening RBL of 35 dB(A) and a night RBL of 30 dB(A).

Table 9-20 Measured existing background (L_{90}) and ambient (L_{eq}) noise levels, dB(A)

Location	Background (L_{90}) noise levels			Ambient (L_{eq}) noise levels		
	Day	Evening	Night	Day	Evening	Night
L1	26	23	18	50	43	43

In accordance with the NPI, where background noise levels are less than the minimum assumed RBLs, the minimum assumed RBLs are adopted for all receivers. Furthermore, the NPI recommends that the intrusiveness level for evening be set at no greater than the intrusiveness noise level for daytime. Therefore, the background noise levels for sensitive receivers have been set at the levels detailed in Table 9-21 below.

Table 9-21 Rating Background Level used for the assessment, dB(A)

Time of Day	Measured existing background (L_{90})	Minimum assumed RBLs	RBLs used for assessment
Day	26	35	35
Evening	23	30	30
Night	18	30	30

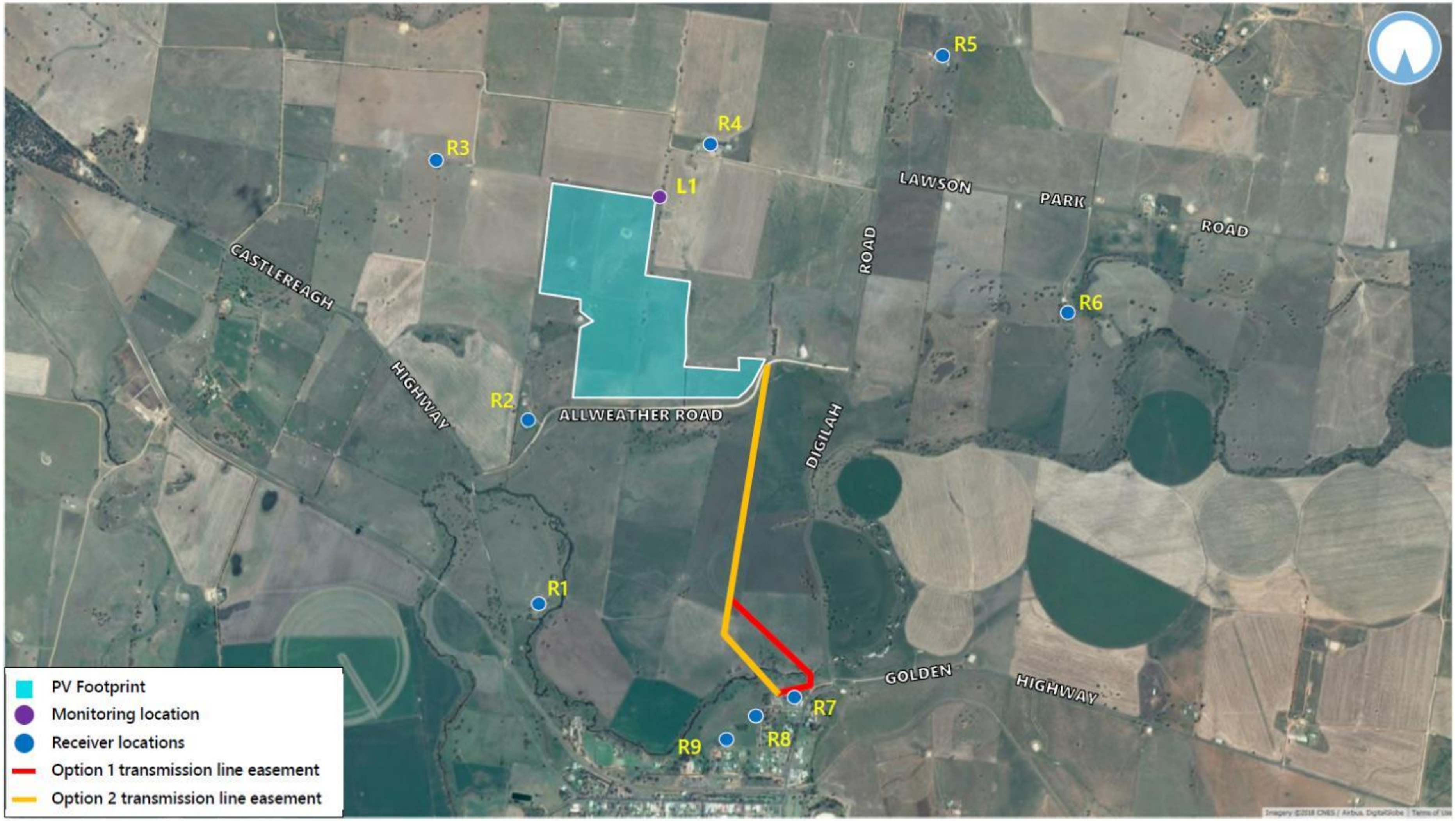

Figure 9-16 Location of nearest sensitive receivers (Renzo Tonin, 2020)

In terms of existing noise levels, land uses surrounding the Development Site are generally limited to sheep and cattle grazing land on improved irrigated pastures and irrigated horticulture. Noise generating equipment would include large harvesters (often operating during harvest late into the night), large grain haulage trucks (double or triple bogey), irrigation systems including pumps as well as tractors, quad bikes and 4WD vehicles. These land uses are frequent but intermittent and would create limited background noise within the area. Noise levels are likely to be concentrated at particular times, determined by farm activities, rather than continuous.

Residential properties are sparsely distributed in the locality (Figure 9-16). Properties in the locality are known to utilise generators and on demand pump pressurised domestic water systems, generating low levels of background noise. The nearest non-involved (in the Proposal) residential dwelling is approximately 1.7 km north of the solar farm boundary (construction activity 1) and 350 metres from the TL and road works (construction activity 2).

9.4.3 Potential Impacts

Construction Noise

Sound Power Level Application

Table 9-22 lists typical plant and equipment likely to be used by the contractor to carry out the necessary construction works within the PV footprint depicted in Figure 9-16, while Table 9-23 details the equipment required to construct the easement (Option 1 or Option 2) for the Proposal.

Table 9-22 Typical solar farm construction plant / equipment and sound power levels, dB(A)

Plant Item	Plant Description	L_{Aeq} Sound Power Levels, dB(A) re. 1pW Single Item
1	Small Pile Driver	114
2	Fixed Crane	113
3	Front End Loader	113
4	Backhoe	111
5	Grader	110
6	Vibratory Roller	109
7	Concrete Truck	109
8	Delivery Truck	108
9	Water Cart	107
10	Concrete Pump	105
11	Power Generator	103
12	Concrete Vibrator	103
13	Light Vehicles (e.g. 4WD)	103

Table 9-23 Easement construction plant / equipment and sound power levels, dB(A)

Plant Item	Plant Description	L_{Aeq} Sound Power Levels, dB(A) re. 1pW Single Item
1	Front End Loader	113
2	Grader	110
3	Vibratory Roller	109
4	Delivery Truck	108
5	Water Cart	107
6	Light Vehicles (e.g. 4WD)	103

The sound power levels for the majority of activities presented in the above table are provided by the client, based on maximum levels given in Table A1 of Australian Standard 2436 - 2010 'Guide to Noise Control on Construction, Demolition and Maintenance Sites', the ICNG, and Renzo Tonin databases.

Noise Management Level Application

Table 9-15 above sets out the NMLs and how they are applied for residential receivers. Table 9-24 sets the daytime RBL and NML receivers R2 to R9. For the commercial receiver R1, refer to Table 9-25.

Table 9-24 Construction Noise Management Levels at Residential Receivers, dB(A)

Location Description	Day RBL (L_{90})	Day NML ($L_{Aeq\ (15min)}$)
All residential receivers (R2 to R9)	35[1]	45

[1] *Construction works occur during the daytime period only, hence only the day period assessed*

Table 9-25 Construction Noise Management Levels and Commercial Receivers, dB(A)

Land Use	Where Objective Applies	NML ($L_{Aeq\ (15\ Min)}$)
Receiver R1 – Lot 157 DP754291, Dunedoo (Polocrosse Clubhouse)[1]	External noise level	70

[1] *Noise Management Levels only apply when premises are in use*

Predicted Construction Noise Levels

Noise emissions were predicted by modelling the noise sources, receiver locations, topographical features of the intervening area, and possible noise control treatments using CadnaA (version 2018) noise modelling computer program. The program calculates the contribution of each noise source at each specified receptor point and allows for the prediction of the total noise from a site.

The noise prediction models take into account:

- Location of noise sources and receiver locations
- Height of sources and receivers
- Separation distances between sources and receivers
- Ground type between sources and receivers (soft)
- Attenuation from barriers (natural and purpose built).

Noise levels at any receptors resulting from construction would depend on the above and the type and duration of construction being undertaken. Furthermore, noise levels at receivers would vary substantially over the total construction program due to the transient nature and large range of plant and equipment that could be used.

Table 9-26 presents construction noise levels likely to be experienced at the nearby affected receivers based on the construction activities and plant equipment associated with the works conducted within the PV footprint and TL easement. Table 9-27 and Table 9-28 refers to the noise levels likely to be experienced at the nearby affected receivers due to the construction of the easement for Option 1 and Option 2, respectively. The noise level ranges represent the noise source being located at the furthest to the closest proximity to each receiver location.

Table 9-26 Predicted $L_{Aeq\ (15min)}$ solar farm construction noise levels at receiver locations, dB(A) (Renzo Tonin, 2020)

Plant Item	Plant Description	Predicted $L_{Aeq(15min)}$ Construction Noise Levels								
		R1	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**
Noise Management Level[1]		*70[2]*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*
1	Small pile driver	<20-33	22-**61**	<20-35	21-42	<20-28	<20-29	<20-23	<20-23	<20-22
2	Fixed Crane	<20-32	21-**60**	<20-34	<20-41	<20-27	<20-28	<20-22	<20-22	<20-21
3	Front End Loader	<20-32	21-**60**	<20-34	<20-41	<20-27	<20-28	<20-22	<20-22	<20-21
4	Backhoe	<20-30	<20-**58**	<20-32	<20-39	<20-25	<20-26	<20-20	<20-20	<20-<20
5	Grader	<20-29	<20-**57**	<20-31	<20-38	<20-24	<20-25	<20-<20	<20-<20	<20-<20
6	Vibratory Roller	<20-28	<20-**56**	<20-30	<20-37	<20-23	<20-24	<20-<20	<20-<20	<20-<20
7	Concrete Truck	<20-28	<20-**56**	<20-30	<20-37	<20-23	<20-24	<20-<20	<20-<20	<20-<20
8	Delivery Truck	<20-27	<20-**55**	<20-29	<20-36	<20-22	<20-23	<20-<20	<20-<20	<20-<20
9	Water Cart	<20-26	<20-**54**	<20-28	<20-35	<20-21	<20-22	<20-<20	<20-<20	<20-<20
10	Concrete Pump	<20-24	<20-**52**	<20-26	<20-33	<20-<20	<20-<20	<20-<20	<20-<20	<20-<20
11	Power Generator	<20-22	<20-**50**	<20-24	<20-31	<20-<20	<20-<20	<20-<20	<20-<20	<20-<20
12	Concrete Vibrator	<20-22	<20-**50**	<20-24	<20-31	<20-<20	<20-<20	<20-<20	<20-<20	<20-<20
13	Light vehicles (e.g. 4WD)	<20-22	<20-**50**	<20-24	<20-31	<20-<20	<20-<20	<20-<20	<20-<20	<20-<20
Up to 3 (noisiest) plant operating concurrently		22-37	26-**65**	22-40	25-**46**	<20-32	<20-33	<20-28	<20-27	<20-26

[1] Noise Management Levels for day period (i.e. standard construction hours)

[2] Noise Management Level for commercial type premises

*[3] **Bold** font represents exceedance of the relevant NML*

Table 9-27 Predicted $L_{Aeq\ (15min)}$ Option 1 easement construction noise levels at receiver locations, dB(A) (Renzo Tonin, 2020)

Plant Item	Plant Description	Predicted $L_{Aeq\ (15min)}$ Construction Noise Levels								
		R1	R2	R3	R4	R5	R6	R7	R8	R9
Noise Management Level[1]		*70[2]*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*
1	Front End Loader	22-28	<20-26	<20-<20	<20-26	<20-22	<20-22	22-**51**	21-**49**	20-40
2	Grader	<20-25	<20-23	<20-<20	<20-23	<20-<20	<20-<20	<20-**48**	<20-**46**	<20-37
3	Vibratory Roller	<20-24	<20-22	<20-<20	<20-22	<20-<20	<20-<20	<20-**47**	<20-45	<20-36
4	Delivery Truck	<20-23	<20-21	<20-<20	<20-21	<20-<20	<20-<20	<20-**46**	<20-44	<20-35
5	Water Cart	<20-22	<20-20	<20-<20	<20-<20	<20-<20	<20-<20	<20-45	<20-43	<20-34
6	Light vehicles (e.g. 4WD)	<20-<20	<20-<20	<20-<20	<20-<20	<20-<20	<20-<20	<20-41	<20-39	<20-30
Up to 3 (noisiest) plant operating concurrently		25-31	22-29	<20-22	<20-28	<20-24	<20-25	24-**53**	24-**51**	23-43

[1] Noise Management Levels for day period (i.e. standard construction hours)

[2] Noise Management Level for commercial type premises

*[3] **Bold** font represents exceedance of the relevant NML*

Table 9-28 Predicted $L_{Aeq\ (15min)}$ Option 2 easement construction noise levels at receiver locations, dB(A) (Renzo Tonin, 2020)

Plant Item	Plant Description	Predicted $L_{Aeq\ (15min)}$ Construction Noise Levels								
		R1	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**
Noise Management Level[1]		*70*[2]	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*
1	Front End Loader	22-28	<20-26	<20-<20	<20-26	<20-22	<20-22	22-**47**	21-**49**	20-43
2	Grader	<20-25	<20-23	<20-<20	<20-23	<20-<20	<20-<20	<20-44	<20-**46**	<20-40
3	Vibratory Roller	<20-24	<20-22	<20-<20	<20-22	<20-<20	<20-<20	<20-43	<20-45	<20-39
4	Delivery Truck	<20-23	<20-21	<20-<20	<20-21	<20-<20	<20-<20	<20-42	<20-44	<20-38
5	Water Cart	<20-22	<20-20	<20-<20	<20-<20	<20-<20	<20-<20	<20-41	<20-43	<20-37
6	Light vehicles (e.g. 4WD)	<20-<20	<20-<20	<20-<20	<20-<20	<20-<20	<20-<20	<20-37	<20-39	<20-33
Up to 3 (noisiest) plant operating concurrently		25-31	23-29	<20-22	<20-28	<20-24	<20-25	24-**50**	24-**51**	23-45

[1] Noise Management Levels for day period (i.e. standard construction hours)

[2] Noise Management Level for commercial type premises

*[3] **Bold** font represents exceedance of the relevant NML*

Based on the construction noise levels presented in Table 9-26 for the construction of the solar farm, the noise management levels at Receivers R2 (involved receiver) and R4 may be exceeded when construction works are conducted within close proximity to the receivers. For the construction of the two (2) easement options, Table 9-27 and Table 9-28 indicate that construction noise levels could exceed the noise management levels at Receivers R7 and R8. It is noted that construction noise levels at all receivers are predicted to be less than the highly noise affected level of 75 dB(A) for all construction stages of the Proposal.

Construction Vibration

Based on the proposed plant items presented in Table 9-22 and Table 9-23, vibration generated by construction plant was estimated and potential vibration impacts are summarised in Table 6.4 below. The assessment is relevant to the identified receiver locations.

Table 9-29 Potential vibration impacts for identified receivers (Renzo Tonin, 2020)

Receiver	Approx. Distance to Nearest Buildings from Works, metres	Type of Nearest Sensitive Buildings	Assessment on Potential Vibration Impacts	Vibration Monitoring
R1	1,080	Commercial	Very low risk of adverse comments	Not required
R2[1]	30	Residential	Low risk of adverse comments	Not required
R3	910	Residential	Very low risk of adverse comments	Not required
R4	730	Residential	Very low risk of adverse comments	Not required
R5	1,210	Residential	Very low risk of adverse comments	Not required
R6	1,220	Residential	Very low risk of adverse comments	Not required
R7	100[2]	Residential	Very low risk of adverse comments	Not required
R8	150[2]	Residential	Very low risk of adverse comments	Not required
R9	270[2]	Residential	Very low risk of adverse comments	Not required

[1] *Involved receiver*

[2] *Closest distance to easement construction works (Option 1 or 2)*

The potential for adverse comments to vibration impacts during the construction works was determined to be ‘low’ to ‘very low’ due to the large distances between the receiver locations and the construction activities. Furthermore, it was noted that the closest receiver, Receiver R2, is an involved receiver; hence, it is expected to have no adverse comments despite it being located closer to the proposed works.

Therefore, additional vibration mitigation measures and vibration monitoring are not required at the identified receiver locations during construction works associated with the Proposal.

Operational Noise

Solar Farm Operation

In accordance with the NPI, noise impact should be assessed in terms of both intrusiveness and amenity. As discussed in Section 9.4.1, the intrusiveness criteria are more stringent for day, evening and night than the amenity criteria, therefore the intrusiveness criteria will be used in the assessment of operational impact, refer to Table 9-17.

Noise from the operation of the solar farm would be generated by:

1. The onsite substation.
2. Maintenance activities.
3. Tracking motors and movement of the solar panels
4. Synchronous condenser at the on-site substation.

The Proposal would operate solar panels installed on single-axis trackers that are driven by motors. As such, the tracking motors are a potential source of mechanical noise and approximately 2,850 tracking motors (NexTracker or equivalent) would be evenly distributed across the PV footprint area depicted in Figure 9-16. The tracking motors would turn no more than five (5) degrees every 15 minutes and would operate no more than one (1) minute out of every 15-minute period.

Additionally, the site will require the operation of 18 containerised inverter / transformer units (SMA MV PS 5500SC or equivalent) and 18 containerised BS units with associated converters which are distributed across the PV footprint. The BS units will also utilise air conditioning units to maintain stable temperatures for the batteries, which have also been identified as a potential noise source.

During operations, up to three (3) staff would be required on-site to maintain the solar farm. Noise from maintenance vehicle on site will be infrequent. At times, several vehicles may access the Development Site per day. Maintenance would mostly be activities conducted inside a maintenance/control building located in the western section of the Development Site, near Access Point 2. Noise from other maintenance works (panel cleaning or replacement) would be intermittent and low. Table 9-30 lists the predicted sound levels from the plant and equipment used for the operation of the Proposal.

Table 9-30 Typical operational plant / equipment and sound power levels

Plant item	Plant description	L_{Aeq} sound power levels, dB(A) re. 1pW
1	Tracker Motor (approximately 2,850 in total)	50 (each)
2	Sunny Central SMA SC2750MVPS Inverters (25 in total)	92 (each)
3	BESS Air Conditioning Units (13 in total)	75 (each)
4	Substation Transformer (1 in total)	90 (each)

Plant item	Plant description	L_{Aeq} sound power levels, dB(A) re. 1pW
5	Synchronous Condenser (1 in total)	93 (each)
6	Light vehicle (3 in total)	103 (each)

In accordance with the NPI, where the character of the noise in question is assessed as particularly annoying (i.e. if it has an inherently tonal, low frequency, impulsive or intermittent characteristic), then an adjustment of 5 dB(A) for each annoyance aspect, up to a total of 10 dB(A), is to be added to the predicted value to penalise the noise for its potential increase in annoyance. Therefore, a 5 dB(A) penalty has been applied individually to the predicted noise contributions from the inverters and transformers. Table 9-31 below present the predicted noise levels for the worst-case scenario based on concurrent operation of all the plant and equipment. The tracker motors were time corrected based on their operation of one minute out of a 15-minute period.

Table 9-31 Predicted $L_{Aeq,15min}$ operational noise levels at residential receiver locations, dB(A) (Renzo Tonin 2020)

Receiver	Project noise trigger levels			Predicted operational noise levels, $L_{Aeq,\ 15min}$			Comply?
	Day	Evening	Night	Calm & isothermal conditions	Slight to gentle breeze	Moderate temperature inversion[1]	
R1[2]	*63*	*63*	*63*	21	27	28	Yes
R2	*40*	*35*	*35*	33	**36**	**37**	**No**
R3	*40*	*35*	*35*	26	31	33	Yes
R4	*40*	*35*	*35*	30	35	**36**	**No**
R5	*40*	*35*	*35*	<20	26	27	Yes
R6	*40*	*35*	*35*	<20	24	24	Yes
R7	*40*	*35*	*35*	<20	24	24	Yes
R8	*40*	*35*	*35*	<20	24	24	Yes
R9	*40*	*35*	*35*	<20	23	24	Yes

[1] *Applicable for the night-time period only*

[2] *Commercial receivers assessed only for when in use*

[3] ***Bold font** represents exceedance over project trigger level*

Based on the predicted operational noise levels presented in the table above, predicted noise levels at the nearest receivers generally comply with the nominated project noise trigger levels under all meteorological conditions. Minor exceedances of up to 2 dB(A) were predicted for Receivers R2 and 1 dB(A) at R4 during slight to gentle wind and/or moderate temperature inversion conditions.

However, it is noted that in accordance with Tables 4.1 and 4.2 of the NPfI, an exceedance of up to 2 dB(A) is considered to be negligible and is not discernible or noticeable to the average person.

Therefore, the predicted noise levels at Receivers R2 and R4 are determined to be acceptable and no further reasonable and feasible noise mitigation measures are required to reduce operational noise impacts.

Sleep Disturbance

The NPI states:

> *The potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.*
>
> *Where the subject development/premises night-time noise levels at a residential location exceed:*
>
> - $L_{Aeq,15min}$ *40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater; and/or*
> - L_{AFmax} *52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater;*
>
> *a detailed maximum noise level event assessment should be undertaken.*

During the night time period (before 7am during summer months) only mechanical plant will be operating, including the tracking motors, inverters, and air conditioning units for the BSS. Noise emissions from these plant items are considered to be continuous with no potential for high peak noise level events. Therefore, the L_{Amax} noise levels experienced at the identified receivers will be similar to the predicted $L_{Aeq,15min}$ noise levels shown in Table 9-31. Hence, it is expected that both the $L_{Aeq,15min}$ and L_{AFmax} will be well below the nominated sleep disturbance criteria of 40 dB(A) and 52 dB(A), respectively.

Road Traffic Noise Impacts

Noise impact from the potential increase in traffic on the surrounding road network due to construction and operational activities has been assessed against the NSW '*Road Noise Policy'* (RNP). Haulage and vehicle access to the subject site would be via Castlereagh Highway and All Weather Road. The peak vehicle movements during the 3-month peak construction stage of the Proposal are provided in Table 9-32 and have been used to assess potential traffic noise impacts. Note, vehicle movements will only occur during the day time period during the construction period.

Table 9-32 Summary of the estimated construction traffic volumes during peak construction

Vehicle type	Movements per day (peak)	Average hourly movements
Cars/ light vehicles	24 (12 in / 12 out)	3
Trucks/ heavy vehicles	80 (40 in / 40 out)	8

During the operational stage, vehicle access to the site will be maintenance vans and delivery trucks (3 x site staff light vehicle and 3 x miscellaneous courier deliveries per week) which would occur on an irregular basis. Therefore, traffic noise impacts during the operational stage of the project would be minimal and insignificant and have not been assessed further.

Based on functionality, All Weather Road and Digilah Road are categorised as local roads. For existing residences affected by additional traffic on existing local roads generated by land use developments, the following RNP road traffic noise criteria apply.

Table 9-33 RNP road traffic noise criteria, dB(A)

Road category	Type of project/land use	Assessment criteria	
		Day 7am – 10pm	Night 10pm – 7am
Local road	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq\ (1\ hour)}$ 55 (external)	$L_{Aeq\ (1\ hour)}$ 50 (external)

Results of the road traffic noise predictions are presented inTable 9-34. It is noted that the predicted noise levels represent the traffic noise contribution from the vehicle movements associated with the construction works and does not take into account existing traffic noise levels as existing traffic volumes along All Weather Road and Digilah Road are unknown.

Table 9-34 Predicted road traffic noise contribution levels along public roads, dB(A) $L_{Aeq(1\ Hour)}$

Receiver	Criteria	Traffic movements	Speed (km/h)	Approx. distance to road	Predicted noise level	Comply?
Nearest receivers	$L_{Aeq,\ (1\ hour)}$ 55	As per Table 9-33, Table 9-34	60	13 metres[1]	54	Yes

[1] *Assume distance to closest receiver to All Weather Road*

From the above table, traffic noise levels from the additional traffic during the construction stage of the Project is predicted to comply with the applicable noise criterion at the nearest affected receivers along All Weather Road and Digilah Road.

As the construction traffic noise levels are temporary and comply with the RNP criteria set above, it indicates that the traffic noise levels due to the construction works for the solar farm would not adversely affect the existing residences along All Weather Road and Digilah Road.

9.4.4 Mitigation measures

Table 9-35 Mitigation measures for noise impacts

Mitigation measures	Phase
Works should be undertaken during standard working hours only (except for works that can be performed without noise nuisance):	Construction

<table>
<tr><th>Mitigation measures</th><th>Phase</th></tr>
<tr><td>Construction
Monday – Friday 7am to 6pm.
Saturday 7am to 1pm.
No work on Sundays or public holidays.
Operation
Monday – Friday 7am to 6pm.
Saturday 8am to 1pm.
No work on Sundays or public holidays.</td><td>Operation
Decommissioning</td></tr>
<tr><td>All staff on-site should be informed of procedures to operate plant and equipment in a quiet and efficient manner where possible.</td><td>Construction
Operation
Decommissioning</td></tr>
<tr><td>Endeavour to establish good relations with people living and working in the vicinity of the construction. This could include regular communication of the proposed works including timing and duration.</td><td>Construction
Operation
Decommissioning</td></tr>
<tr><td>If required, implement noise control measures, that are suggested in Appendix C (Table C1, C2 and C3) of Australian Standard 2436-2010 “Guide to Noise Control on Construction, Demolition and Maintenance Sites”.</td><td>Construction
Decommissioning</td></tr>
<tr><td>In addition to physical noise controls that may be required, the following general noise management measures should be followed:
Plant and equipment should be properly maintained.
Provide special attention to the use and maintenance of ‘noise control’ or ‘silencing’ kits fitted to machines to ensure they perform as intended.
Strategically position plant on site to reduce the emission of noise to the surrounding neighbourhood and to site personnel.
Avoid any unnecessary noise when carrying out manual operations and when operating plant.
Any equipment not in use for extended periods during construction work should be switched off.</td><td>Construction
Decommissioning</td></tr>
<tr><td>Establish a procedure to deal with complaints. Each complaint would need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences if exceedances to relevant requirements is established.</td><td>Construction
Operation
Decommissioning</td></tr>
<tr><td>Where noise level exceedances cannot be avoided, then time restrictions and/or providing periods of repose for residents, must be considered where feasible and reasonable. That is, daily periods of respite from noisy activities may also be scheduled for building occupants during construction hours.</td><td>Construction
Decommissioning</td></tr>
</table>

9.5 SOCIAL AND ECONOMIC IMPACTS

Large developments can produce social and economic impacts on local communities. These can be positive, such as the provision of employment and increased retail trade. They can also produce unintended or adverse impacts, such as creating strains on existing infrastructure (such as public transport or accommodation facilities during construction), including social infrastructure (volunteer services, health services, education networks and social ties). This section summarises the key predicted impacts and benefits of the Proposal as further detailed in Appendix N.

9.5.1 Project Context

The proposed Dunedoo Solar Farm (the Project) will be developed on a 112ha site in the central western region of NSW, zoned Rural Use 1 (Primary Production), which is well-connected to a number of major regional centres and towns located within approximately a 60-70-minute drive from the Subject Site. These regional centres are likely to play important roles in supporting the requirements of the Project and include Dubbo, Mudgee, Gulgong, Wellington, Gilgandra, Coolah, Dunedoo, and Mendooran. The Study Area for the Social and Economic assessment has been defined to include the Local Government Areas of Warrumbungle Shire (in which the project is to be located), Gilgandra Shire, Dubbo Regional Council and Mid-Western Regional Council. Refer to Figure 60.

Policy Context

International agreements and government policy settings are important factors in influencing demand and investment in the renewable energy sector. This is further explained in Section 1 and some of the agreements include:

- Paris Climate Accord
- Federal Renewable Energy Target
- NSW Renewable Energy Action Plan 2013
- NSW Large Scale Solar Energy Guidelines 2018
- Central-West Orana Renewable Energy Zone

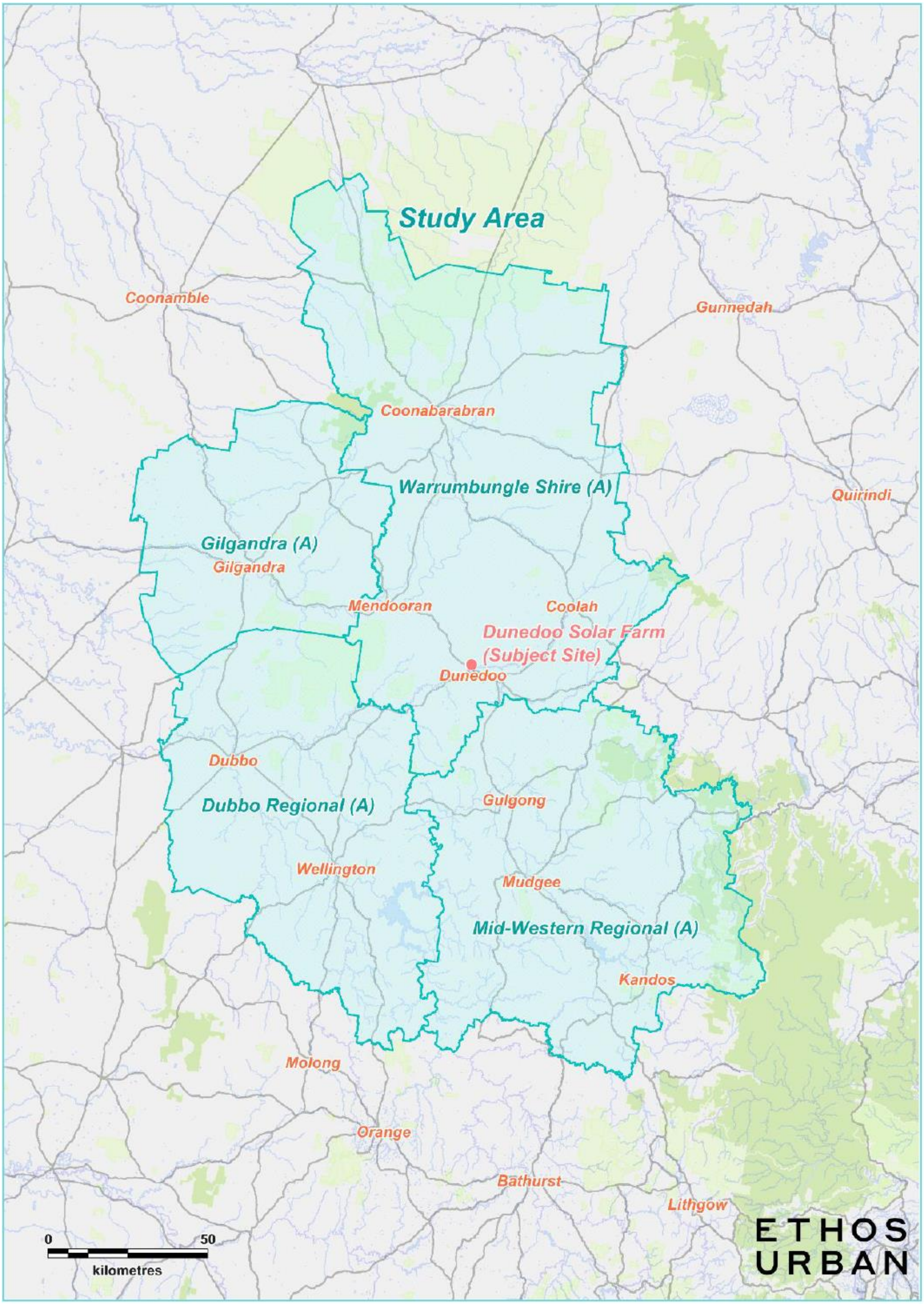

Figure 60: Economic Impact Assessment Study Area

9.5.2 Regional Economic Profile

Population

The population of the Study Area totalled 92,490 persons as of June 2019 (ABS Estimated Resident Population, 2019), including 53,720 persons located in in the Dubbo Regional Council LGA.

Over the period 2019-2036, annual population growth in the Study Area is expected to be +0.3% pa (or +275 persons pa over 17 years) compared to the Regional New South Wales growth rate of 0.5% p.a. While this level of growth is comparatively weak, it is noted that Dubbo Regional Council is projected to experience an average population growth rate (+0.5%) similar to Regional NSW to 2036. However, the Gilgandra and Warrumbungle LGAs are projected to experience a decline in population over the period; this highlights the need for local investment projects such as this Proposal which provide new employment opportunities for residents and alternative income streams for local farmers. Both these factors can contribute to retaining, and potentially expanding, population within these shires.

Population estimates, which are shown in Table 68, are based on official population projections prepared by New South Wales government and rebased using the most recent ABS estimated resident population figures.

Table 68: Population projections

	2019	2036	Average Annual Growth 2019-36	
			No.	%
Dubbo Regional	53,720	58,880	+304	+0.5%
Gilgandra	4,240	3,530	-42	-1.1%
Mid-Western Regional	25,250	26,960	+101	+0.4%
Warrumbungle Shire	9,280	7,810	-86	-1.0%
Dunedoo Study Area	**92,490**	**97,180**	**+276**	**+0.3%**
Regional NSW	**2,777,650**	**3,046,540**	**+15,817**	**+0.5%**

Labour Force

As of March 2020 (latest available), the Study Area had an unemployment rate of 2.5%, which is significantly lower than the rate for NSW (4.6%). The Study Area currently has approximately 1,120 job seekers who are unemployed.

The Dunedoo Solar Farm Project is likely to require 125 workers (at the Project's peak), with potentially 70% of these workers (90 workers) likely to be sourced locally or from within the Study Area, providing new opportunities for unemployed job seekers (subject to appropriate skills match).

In the context of the Study Area's large labour market comprising 44,300 persons as shown in Table 69 (which exclude COVID-19 impacts), the construction phase of the Project is unlikely to cause labour supply issues, rather provide new short-term opportunities for labour force participants.

Estimates sourced from a data provider of area-specific data (REMPLAN) indicate that the initial impacts of COVID-19 (March to June 2020) have resulted in the loss of approximately 2,000 jobs in the Study Area. This highlights the importance of new investment projects in the region to help stimulate new job opportunities in the post-COVID-19 environment. These labour supply factors are further explored in section 1 of this EIS.

Table 69: Study Area labour force

Municipality / Area	Employed	Unemployed	Labour Force	Unemployment rate
Dubbo Regional	25,000	500	25,500	2.0%
Gilgandra	1,910	60	1,970	3.0%
Mid-Western Regional	12,400	440	12,840	3.4%
Warrumbungle Shire	3,880	120	3,990	3.0%
Dunedoo Study Area	**43,190**	**1,120**	**44,300**	**2.5%**
New South Wales	**4,136,900**	**198,500**	**4,335,400**	**4.6%**

Occupational Structure

The skills base of the Study Area according to the ABS 2016 data is reflected in its occupational structure, as indicated in Table 70. ABS Census data for 2016 shows 34.5% of employed residents in the Study Area were occupied in activities generally associated with the types of skills required for the construction of a solar farm (e.g. technicians and trades workers, machinery operators and drivers, and labourers).

Table 70: Study Area workers

Occupation	Study Area		New South Wales	
	No.	Share	No.	No.
Managers	5,660	15.5%	456,090	13.6%
Professionals	5,840	15.9%	798,130	23.8%
Technicians and Trades Workers	5,390	14.7%	429,240	12.8%
Community and Personal Service Workers	4,350	11.9%	350,260	10.4%
Clerical and Administrative Workers	4,270	11.7%	467,980	14.0%
Sales Workers	3,590	9.8%	311,410	9.3%
Machinery Operators and Drivers	2,900	7.9%	206,840	6.2%
Labourers	4,340	11.8%	297,890	8.9%
Inadequately described	280	0.8%	36,180	1.1%
Total	36,620	100.0%	3,354,010	100.0%

Business Structure

A tangible benefit of a major investment project, such as the proposed Dunedoo Solar Farm, is the extent to which local businesses can participate in the Project through project contracts and other service provision.

ABS Business Count data for June 2019 (latest available) shows the Study Area includes 1,400 construction businesses and a further 460 businesses associated with transport, postal and warehousing service, with these two sectors contributing 1,860 businesses or 19.7% of all businesses located in the Study Area (numbers rounded).

This data, which is included in Table 71, indicates a strong presence in the Study Area of the types of firms that are likely to be well-placed to service aspects of the Project.

Table 71: Study Area business structure

Sector	Non-employing	1-19 employees	20-199 employees	Total Businesses	
	No.	No.	No.	No.	%.
Agriculture, Forestry and Fishing	2,070	870	20	2,960	31.4%
Mining	20	20	0	40	0.4%
Manufacturing	130	150	20	300	3.2%
Electricity, Gas, Water and Waste Services	10	0	0	10	0.1%
Construction	800	580	20	1,400	14.8%
Wholesale Trade	120	120	10	250	2.6%
Retail Trade	200	290	30	520	5.5%
Accommodation and Food Services	130	280	30	440	4.7%
Transport, Postal and Warehousing	290	160	10	460	4.9%
Information Media and Telecommunications	20	10	0	30	0.3%
Financial and Insurance Services	410	70	0	480	5.1%
Rental, Hiring and Real Estate Services	570	100	0	670	7.1%
Professional, Scientific and Technical Services	290	250	10	550	5.8%
Administrative and Support Services	130	110	10	250	2.6%

Sector	Non-employing	1-19 employees	20-199 employees	Total Businesses	
	No.	No.	No.	No.	%.
Public Administration and Safety	10	10	0	20	0.2%
Education and Training	50	40	0	90	1.0%
Health Care and Social Assistance	230	150	20	400	4.2%
Arts and Recreation Services	30	40	0	70	0.7%
Other Services	220	240	10	470	5.0%
Currently Unknown	20	10	0	30	0.3%
Total	**5,750**	**3,500**	**190**	**9,440**	**100.0%**

Township Services Capacity

Accommodation

The Study Area has, within a 70-minute drive, a good supply and mix of accommodation including motels, hotels, guest houses, caravan/holiday parks (including cabins). Most accommodation options are located in Dubbo and Mudgee (refer to Table 2.5), which are within relatively close proximity to the Subject Site and provide a regional-level services; however, there are also options in smaller townships located closer to the Subject Site including Dunedoo, Mendooran, Coolah, and Gulgong as shown in Table 72.

Table 72: Study Area commercial accommodation

Locality	Establishments	Rooms	Cabins	Total
Dunedoo	5	33	3	36
Mendooran	1	10	0	10
Coolah	4	25	13	38
Gulgong	4	68	12	80
Dubbo	39	1,040	80	1,120
Mudgee	23	362	115	477
Gilgandra	9	98	12	110
Wellington	10	116	40	156
Study Area Total	**95**	**1,752**	**275**	**2,027**

In Addition, private accommodation is often used to support construction worker needs. This could be through leasing of holiday homes and investment properties, either privately (including Airbnb), or through real estate agents.

As Table 73 shows, 13.3% of Study Area dwellings (4,790 dwellings) were unoccupied at the 2016 Census, which is notably higher than the average for NSW (9.9%). Mid-Western Regional LGA has a significant share of unoccupied dwellings (17.8%) or 760 dwellings, which is likely related to a large number of holiday homes in this well touristed area. Shared private housing accommodation is one potential option for solar farm project workers, with some of the Study Area's unoccupied dwellings having the potential to enter the housing market to support the construction phase of the Project.

Data sourced from *www.airdna.co* shows approximately 500 active short-term rentals are currently (August 2020) advertised on Airbnb and Vrbo in the Study Area. These active rentals have an average of 2.6 bedrooms per rental. Therefore, in the order 1,315 rooms could be available in the Study Area through the short-term rental market.

Table 73: Study Area unoccupied dwellings

Municipality/ Area	No. Occupied Private Dwellings	No. Unoccupied Private Dwellings	Total No. Private Dwellings	Share of Unoccupied Private Dwellings
Dubbo Regional (A)	1,590	250	1,840	13.6%
Gilgandra (A)	8,770	1,660	10,430	15.9%
Mid-Western Regional (A)	3,520	760	4,280	17.8%
Warrumbungle Shire (A)	17,470	2,110	19,590	10.8%
Study Area	31,350	4,790	36,130	13.3%
New South Wales	**2,604,320**	**284,740**	**2,889,060**	**9.9%**

Township Services

In addition to accommodation, workers locating temporarily to the Study Area will require a wide range of other convenience services as detailed in Table 74.

Table 74: Town service offerings in the Study Area

Town	Service offering
Dunedoo	• Small amount of commercial accommodation • Dunedoo Memorial Health Service • Dunedoo Supermarket • Various small cafes, Dunedoo Sports Club (access to Golf Course, squash, tennis and touch football areas) and Hotel Dunedoo • Fuel Supplies • Postal Services • Dunedoo Central School

Town	Service offering
Mendooran	• Accommodation (Royal Hotel and camping) • General store • Pub and café • Post office • Black Gate Distillery (breakfast, dinner) • Police station
Coolah	• Three motels and one caravan parks • Coolah Valley Medical Centre • Supermarket –IGA Plus Liquor • Cafes, butcher, bakeries, restaurants and take-away • Fuel supplies • Postal Services • Automotive Mechanics and Smash repairer • Entertainment (parks, hotels, clubs, sports and recreational activities – golf course etc) • Coolah Central School and Sacred Heart Primary school. • Haynes Farm and Hardware, Bondys Metalworks, Flint's Rural Supplies.
Gulgong	• 3 motels and a hotel (Prince of Wales Gulgong) • Gulgong Timber and Hardware • Automotive Mechanics • Macquarie Geotech (soil testing), Ace Engineering etc. • Supermarkets • Cafes, bakeries, restaurants and take-away • Commonwealth Bank branch • Fuel supplies • Postal Services • Entertainment (parks, hotels, clubs, sports and recreational activities – swimming pool, bowls club etc) • Gulgong District Hospital • primary and secondary schools (both public) and a Catholic primary school (All Hallows Primary School).
Mudgee	• A wide range of hotels, motels, caravan parks etc • Bunnings, Furney's Building & Plumbing Supplies and Supercheap Auto • Coates Hire, Westrac CAT, Mid State Freight. • Full line supermarkets • Cafes, bakeries, restaurants and take-away • banks, solicitors, conveyancing etc • Fuel supplies & Automotive Mechanics • Entertainment (parks, hotels, clubs, sports and recreational activities)

Town	Service offering
	• primary and secondary schools (both public), and a Catholic primary school (St Matthew's Catholic School) • Medical and emergency services (Mudgee District Hospital, police station etc) • Airport
Dubbo	• Wide range of commercial accommodation options • Large range of retail services including malls/shopping centres • Solicitors, accounting, conveyancing etc. • Major banks and financial institutions • Entertainment – parks, hotels, clubs, sports and recreational activities. • Dubbo Airport • Dubbo Base Hospital • University, secondary and primary schools • Expanded range of service industry geared to civil construction works such as – John Holland (depot) – Inland Petroleum (bulk fuel delivery) – NACAP Depot (bespoke equipment for civil projects – roads, mining, dams etc) – MCR Modules (portable building construction) – EMS (depot) – Cobra (plant and crane hire) – Cole for Cranes (crane hire) – Ezyquip Hire (earthmoving equipment hire) – Rod Pilon Transport
Gilgandra	• Seven motels • Gilgandra District Hospital • Supermarkets • Cafes, bakeries, restaurants and take-away • National branded bank • • Fuel supplies • • Postal Services • • Automotive Mechanics • • Entertainment (parks, hotels, clubs, sports and recreational activities – golf course, swimming pool, bowls club etc) • • Education including primary and secondary schools and TAFE. • O'Connor Bros Electrical, Morris & Weir Electrical, Central West Machining & Engineering, Ahrens, etc.
Wellington	• A limited range of commercial accommodation options

Town	Service offering
	• Wellington District Hospital • Two full-line supermarkets • Entertainment & Dining – Federal Hotel, Court House Hotel, Wellington Hotel, Central Hotel Wellington and Calf & Cow Hotel; cafes/restaurants include Smoko & Lunches, Cactus Café & Gallery, Chinese and Thai food restaurants, and KFC and McDonalds • A limited collection of commercial and financial services, including Commonwealth and NAB branches • Fuel Supplies • Postal Services • Education –primary and secondary schools and TAFE. • Train Station

9.5.3 Community Attitudes to Renewable Energy

OEH (Newspoll) Survey

The Office of Environment and Heritage (OEH) commissioned research from Newspoll on community attitudes to renewable energy in NSW (OEH 2015). The survey found very strong support for the use of renewable energy; nine out of 10 respondents strongly supported (49%) or supported (43%) electricity generation from renewables. 83% of respondents wanted more electricity generated from renewable sources over the next five (5) years.

People generally agreed on the environmental benefits of renewables but there were mixed views about the costs, efficiency and reliability of renewable energy. The principal advantages people saw in renewables were environmental benefits (80%), and reduced cost, at least in the long run (37%). The principal disadvantages people saw were higher cost, particularly in the set-up stage (39%), and concerns about efficiency and reliability (18%). About four-in-ten people believed there were no disadvantages to renewables, or could not think of any.

Awareness of commercial solar farms was lower than wind power; 97% were aware of wind farms, 66% said they had heard of the idea of commercial solar farms. 91% of respondents outside the Sydney, Newcastle and Illawarra metro areas supported solar farm development within NSW, 84% supported solar within the local region and 78% supported solar within 1–2 km of where they lived.

Most respondents who supported solar farms in their local area had no concerns (59%). Some said that lack of information or knowledge was a barrier to their acceptance of solar farms (13%). The small group of respondents who opposed solar farms being located near their homes gave a cluster of reasons including unsuitability of their area (33%), the amount of space required (16%), environmental impacts (16%) and visual impacts (20%).

In the South West region (sample size 250 respondents), total awareness solar farms and levels of support for solar farm development in NSW, in the local region and within 1–2 km of home were similar to the state-wide figures.

Ipsos Survey

The Australian Renewable Energy Agency (ARENA) funded research by the Ipsos Social Research Institute which set out the preconditions and best practice principles for establishing the social licence operate large scale solar facilities in Australia (Ipsos 2015). ‘Social licence’ reflects community acceptance of and support for a development, and is considered critical for the long-term sustainability of a development.

The Ipsos findings are generally consistent with the results of the OEH (2015) study.

Ipsos found that a high percentage (77%) of Australians believe that large scale solar farms could supply a significant source of Australia's energy requirements. 63% believe that increasing the number of large-scale solar facilities would assist in the reduction of Australia's carbon emissions, and 53% agree that large scale solar facilities have a positive environmental impact. 14% thought that solar farms would have a negative impact on local ecosystems, 34% thought they wouldn't, and 53% neither agreed nor disagreed or didn't know.

Almost half of Australians (48%) view large scale solar facilities as beneficial for local economies, however, a further 46% neither agreed nor disagreed, or didn't know.

Almost half (47%) neither agreed nor disagreed or didn't know if large scale solar facilities could have a negative effect on the health of the people living nearby. 40% disagreed that large scale solar has a harmful impact, and 13% agreed.

Attitudes are divided about the visual impacts of large-scale solar farms; 30% agree and 26% disagree that large-scale solar farms have a negative visual impact.

Attitudes towards renewable energy developments can vary significantly from community to community, often based on the availability of information about solar farms (IPSOS 2015).

Consultation and Participation

Public attitudes to renewable energy developments are also influenced by the nature of the planning and development approval process; the more open and participatory, the greater the level of public support (Birnie *et al.* 1999; Khan 2003, cited in Warren *et al.* 2005). The OEH (2015) and Ipsos (2015) research points to the prime importance of targeted and accessible information, effective and meaningful community engagement and a transparent, participatory assessment and approval process.

Lessons learnt from the development of other solar farm include the need to engage the community early, openly and effectively, and provide fit-for-purpose consultation and regular status updates (FRV nd).

9.5.4 Proposal Consultation Activities and Results

Community consultation for the Proposal has been coordinated using a Community Consultation Plan (refer to Section 6 and Appendix L). Consultation activities undertaken to date, community responses and relevant sections of the EIS are detailed in Section 6.

Three (3) Community Open Day events were proposed in the Dunedoo township. However, due to COVID-19, the third event planned for March 2020 was cancelled and community feedback forms were made available online. The two (2) Open Day events were well attended by the township, with participants expressing a range of questions and concerns. These issues have been addressed in the EIS; relevant sections are identified in Table 6-3 to 6-3. The assessments conclude that the Proposal would not result in significant or unacceptable impacts, and the site is considered to be appropriate for the Proposal.

9.5.5 Potential Impacts

The total construction cost for the Dunedoo Solar Farm Project is estimated to be approximately $76 million. Generally, with projects of this type approximately 15% to total investment is retained in the Study Area which indicates approximately $11.4 million in wages, contracts and other service provision will flow to the Study Area's economy.

In consideration of the information above, the Proposal's potential impacts are described below:

Construction

Direct Construction Employment

ib vogt indicate 100 jobs (on average) will be generated over the construction phase. The Project's peak job number is estimated to be approximately 125 positions (or 25% higher than the average project number). There is a good mix of the required services available in the Study Area to supply this labour.

Indirect Construction Employment

Significant employment will be generated indirectly through the employment multiplier effect. By applying an industry-standard multiplier for the construction industry of 1.6 (based on ABS Type B multipliers), the Project is estimated to generate an additional 160 jobs over the construction period. For the purposes of this assessment, it is assumed 20% of indirect jobs or 30 jobs (rounded) are supported in the Study Area.

Total Construction Employment

Approximately 260 jobs (100 direct jobs and 160 indirect jobs) are expected to be generated by the Dunedoo Solar Farm Solar Farm Project during the 10-12-month construction phase.

The amount of direct local employment required for the Project is estimated to be approximately 90 jobs (at the peak of construction, or 70 local jobs on average), with a further 30 jobs supported indirectly in the Study Area. This number of local workers (120 workers) represents only 1% of the Study Area's labour force occupied in construction-related activities (12,630 workers) and this should not present a constraint to labour supply for the Project, especially in the ongoing/post-COVID-19 environment.

Operations

Direct Operational Employment

The proponent indicates that three direct jobs will be supported locally (on-site) during the 30 year operational life.

Indirect Operational Employment

A number of additional jobs will also be supported indirectly through the employment multiplier effect. By applying an industry-standard multiplier for the electricity industry of 2.9 (based on ABS Type B multipliers) to the direct operational and maintenance jobs, a further 9 permanent jobs (rounded) would be generated in the wider State and national economies, with some of these jobs supported locally through operational supply chains and consumption impacts.

For the purposes of this assessment it is assumed that 20% of indirect operational jobs are created in the Study Area. This equates to approximately 2 ongoing positions.

Total Operational Employment

In summary, approximately 5 jobs (3 direct and 2 indirect) are expected to be generated by the Dunedoo Solar Farm Project in the Study Area with a further 7 indirect jobs outside the Study Area. .

Cumulative Effects Assessment

The Dunedoo Solar Farm Project may need to compete for labour, accommodation, and other resources with other infrastructure projects, principally renewable energy projects, in the Study Area defined in the Economic Impact Assessment. 8 other solar farms have been considered in this area with the following to be noted:

- The development status of these projects varies; therefore, construction timing is uncertain.
- The Study Area has significant capacity in terms of construction-related workers (12,630 workers) and construction-related businesses (1,860 businesses), including many located in the immediate region to service multiple concurrent infrastructure projects.
- Study Area currently contains 1,120 unemployed labour force participants, some of whom could work on these infrastructure projects (subject to suitable skills mix). Note, it is likely the number of unemployed persons will increase and remain high in the Study Area due to the impacts of COVID-19 and associated recession.
- The Subject Site is located at least 70km from the proposed 8 solar farm facilities; therefore, locally provided resources (labour, accommodation etc.) are unlikely to be impacted.

The above factors indicate that potential cumulative effects associated with the construction of the Dunedoo Solar Farm are manageable.

Housing and Commercial Accommodation Sector Impacts

Information provided by the proponent indicates up to 40 non-local staff may need to be accommodated in the region at the Project's peak. The Study Area has a capacity of approximately 2,030 rooms and cabins in commercial accommodation in locations within a 70-minute drive of the Project site. Assuming each non-local worker requires individual accommodation (40 rooms), only 2% of this accommodation stock would be required at peak times to service the Project.

In reality, this requirement is likely to be lower as some workers may choose to be accommodated in caravan/holiday parks (powered sites), B&Bs, shared private rentals (e.g. holiday homes, Airbnb) or stay with family or friends (where possible) rather than in commercial accommodation. Additionally, other workers may share motel rooms/cabins etc.to reduce personal costs.

This data indicates that adequate capacity exists in the Study Area to accommodate the number of non-local workers expected at the peak of the Project, even allowing for increased demand from other regional infrastructure projects and seasonal demands (holiday periods, harvesting etc.). Importantly, the influx of these workers will support higher occupancy rates and revenues for local accommodation operators, particularly during off-peak periods.

Local Wage Spending Stimulus

The proponent indicates that 30% of the 100 direct construction jobs (i.e. 30 jobs on average) may need to be sourced from outside the Study Area, particularly specialist and management positions.

This level of employment would equate to $1.9 million in wages (2019 dollars) on the basis that each non-local worker is employed for 9 months and earns the average construction wage of $82,000 pa including on-costs (source: ABS, *Average Weekly Earnings 6302.0*, November 2019).

A considerable portion of these wages would be spent in the Study Area, where the workers will be based. An estimated $1.0 million in wages (2019 dollars) would likely be directed to local and regional businesses and service providers during the construction period. This estimate is based on reference to the ABS *Household Expenditure Survey* which indicates that approximately 75% of post-tax wages are likely to be spent by workers in the regional economy in view of the wide range of goods and services available in the Study Area.

This level of personal spending would generate the equivalent of approximately 10 jobs (included in estimates above) in the services sector (based on 1 job allocated for every $100,000 of induced spending), supporting jobs in the Study Area associated with retail, accommodation, trade supplies, cafes and restaurants etc.

Agricultural Impacts

Approximately 112ha of agricultural land will be required to host the solar farm, with this land currently used primarily for cattle grazing. This amount of land represents approximately 10% of the broader landholdings owned by the host landowners. It is anticipated the landowner's existing level of employment will be retained to service the balance of the land; therefore, no agricultural-related jobs will be lost as a result of the solar farm project.

Only minimal supply chain impacts are expected with regard to the Subject Site's change of land use, noting the land's low productive capacity and the sporadic nature of existing maintenance and other services. The proponent is exploring the possibility of sheep grazing in and around the solar farm infrastructure which, if possible, would retain some agricultural activity on the host land.

Ongoing Economic Stimulus

Landowners

Local landowners involved in the Project will receive either purchase or annual lease payments to host solar farm infrastructure. These payments are confidential between the proponent and landowner.

However, as both landowners will continue to undertake agricultural activities on the balance of their land; it can be expected that a portion of purchase/lease revenues will be reinvested back into the local economy through business, household and individual consumption.

Returns to Council

Change in land use to facilitate the development of the Dunedoo Solar Farm will result in an increase in annual payments to Council from the site (compared with existing uses). The amount payable will be subject to discussions between the proponent and Council; however, based on observations from similar utility scale solar farm developments in NSW, the net increase in annual revenue to Council is likely to be significant.

Local Wage Stimulus

The Dunedoo Solar Farm will support 5 jobs in the Study Area (direct and indirect) and will result in no job losses associated with existing site uses (as noted above). These 'net' additional 5 jobs will provide an estimated stimulus within the Study Area of $230,000 in Year 1 of operations.

Total Operational Stimulus

The combined economic stimulus to the Study Area from landowner returns (purchase and lease) and operational wage stimulus is estimated at approximately $12.6 million over 30 years (includes adjustment for CPI @ 2.5% pa, where relevant). Note, net land tax revenue to Council would be in addition to this value.

National Grid Supply Benefits

With an installed capacity of 55 MW, the Dunedoo Solar Farm has the potential to provide sufficient renewable energy to support the annual electricity needs of the equivalent of approximately 24,400 NSW households, according to information provided by the proponent.

In a regional context, the Study Area currently contains approximately 36,130 dwellings (ABS Census 2016); therefore, the Dunedoo Solar Farm has the potential to provide approximately 68% of the annual electricity requirements of the Study Area, highlighting the importance of the Proposal from a clean electrical generation perspective.

Environmental Benefits

The operation of the solar farm would help reduce greenhouse gas emissions intensity and move towards cleaner electricity generation. Based on 144,540 MWh of annual energy generation, the solar farm would offset the equivalent of approximately 147 kilotonnes per annum (pa) of CO_2 emissions from brown coal, or approximately 101 kilotonnes per annum of CO_2 emissions from black coal.

Tourism Impacts

The Dunedoo Solar Farm will have no impact on the Siding Springs Observatory, noting the solar farm will be located approximately 120km south of the Observatory.

Over time, the Dunedoo Solar Farm may provide opportunities to attract new visitors to the area to view the Proposal and to be involved in educational and environmental activities. It is also noted that there are a dozen or so existing/approved or planned utility scale renewable energy facilities in the broader region (stimulated by developer interest in the Central-West Orana REZ) which may provide opportunities for linked tours to these facilities.

Benefits of attracting new visitors to the area include increased expenditures on accommodation, food and beverage, fuel, retail, entertainment etc, all of which will support businesses and employment, especially in nearby townships such as Dunedoo.

9.5.6 Mitigation Measures

Table 9-43 Mitigation measures for social and economic impacts

Mitigation measures	Phase
The Community Consultation Plan would continue to be implemented throughout the planning, assessment and construction phases of the project, and would include: • Regular community updates about the progress of the Proposal and findings of the assessments • Consultation and notification of local residents and other relevant stakeholders regarding the timing of major deliveries and other activities which may produce particular social and economic impacts • An accessible complaints process with a timely response protocol.	Preconstruction Construction
Neighbours of the Dunedoo solar farm would be consulted and notified regarding the timing of major deliveries which may require traffic control and disruption to access.	Construction Decommissioning
Local businesses would be used to supply good and services during all phases of the Proposal wherever possible. The Proponent would actively liaise with local industry representatives to maximise and coordinate the use of local contractors, manufacturing facilities and goods and materials suppliers, and to minimise adverse impacts to local supplies, services and tourism.	Construction Operation Decommissioning

Mitigation measures	Phase
Large deliveries requiring traffic control would be scheduled to avoid festivals or other major tourism activities in Dunedoo. Local tourism industry representatives would be consulted to manage potential timing conflicts with local events.	Construction Decommissioning
Local representatives would be consulted regarding accommodation options for staff, to minimise adverse impacts on local services.	Construction Operation Decommissioning
Assess the feasibility to implement a program to open the solar farm for visits and education events.	Operation
Assess the feasibility to support local schools in science and engineering studies through a partnership.	Operation

9.6 TRAFFIC, TRANSPORT AND ROAD SAFETY

For the proposed solar farm, key traffic and transport impacts relate to haulage during construction. Increased vehicle numbers, particularly heavy vehicles, can equate to increased traffic collision risk, cause damage to roads and indirect impacts such as noise and dust to other motorists and nearby receivers.

TfNSW identified issues relating to traffic, transport and road safety as important during the development of the SEARs for the Proposal (refer to Section 1.4). Specific issues raised are addressed in this section and mitigation measures proposed.

9.6.1 Existing Environment

Regional Road Network

Castlereagh Highway is a regional state road under the care and management of TfNSW, which generally runs in a northwest-southeast alignment. Within the vicinity of the Development Site, it has a sealed road width of approximately 8 metres, with one (1) traffic lane of approximately 3.5 metres width and a 0.5-metre-wide shoulder in each direction.

Golden Highway is a regional state road under the care and management of TfNSW, and generally runs in an east-west alignment. Through Dunedoo township, it has a generous sealed road width of approximately 18 metres, accommodating one (1) traffic lane in each direction and angled parking on both sides of the road. Outside the Dunedoo township, Golden Highway has an approximate sealed carriageway width of 8 metres, with one (1) lane of traffic in each direction, approximately 3.5 metres wide with a 0.5-metre-wide shoulder.

Local Road Network

All Weather Road is a local road under the care and management of Warrumbungle Shire Council. It runs in a general east-west alignment, from its intersection with Castlereagh Highway in the west to its intersection with Digilah Road in the east. It has an unsealed road surface, with a width varying from 5 to 8 metres.

Digilah Road is a local road under the care and management of Warrumbungle Shire Council road which generally runs in a north-south alignment. It has a sealed road width of approximately 5.5 metres and forms an intersection with Golden Highway approximately 750 metres to the northeast of Dunedoo township. There is a low-level bridge crossing approximately 140 metres north of Golden Highway, providing access across the Talbragar River.

9.6.2 Potential Impacts

Construction and Decommissioning

The potential traffic, transport and road safety impacts associated with construction and decommissioning of the Proposal relate primarily to the increased numbers of large vehicles on the road network which may lead to:

- Increased collision risks accidents resulting from fatigue on both the daily commute and the weekend departure/return to the workers place of origin (other vehicles, pedestrians, stock and wildlife).
- Damage to road infrastructure.
- Associated noise and dust (where traffic is on unsealed roads) may adversely affect nearby receivers.

- Disruption to existing services (public transport and school buses).
- Reduction of the level of service on the road network caused by 'platooning' of vehicles.

Traffic Movements

Access requirements can be separated into the following categories:

- Cars –the largest proportion of vehicles that would be used by project management staff and site workers to access the site. Up to 12 cars on average are anticipated during construction. 3 to 10 cars are expected during normal operation.
- Utilities – would be required to transport equipment and materials around the site and for local pick up of materials. Approximately five (5) utilities would be used on a daily basis at the site during construction.
- Trucks – would also be used to transport equipment and materials around the site and for local pick up of materials. Larger sized deliveries would be undertaken by trucks as opposed to utilities. Approximately 16 trucks would be used on a daily basis at the site during construction.
- Standard articulated trucks – would be used to transport 12-metre-long containers from point of origin.
- Oversize and/or over-mass vehicles – may be required to deliver larger infrastructure components.

Vehicles would travel around the site via constructed access tracks to the following locations:

- Solar array module clusters
- Construction equipment laydown area
- Around the perimeter of the solar farm
- Along the TL corridor.

Haulage Programs

While a detailed haulage program has not yet been developed, it is expected that the project's components are most likely to be delivered from Sydney or arrive across the docks at Botany Bay. The majority of these materials would be transported by rail arriving into the rail yards at Dunedoo or Dubbo or Mudgee. From Dunedoo or Dubbo or Mudgee the materials would be transferred to trucks for road transport to the Development Site.

The remainder of construction materials, would be sourced locally, including from Dunedoo, Dubbo, Mudgee and Tamworth using the major road networks of Golden Highway and Castlereagh Highway. Gravel and concrete would be sourced from Dunedoo/Dubbo.

These roads are of sufficient capacity to accommodate the haulage of components required for the construction of the solar farm and TL.

A large proportion of Proposal components including solar panels, mounting and tracking systems, and fencing are expected to be assembled onsite within the Development Site.

Construction Traffic Generation

Construction activities would be undertaken during standard daytime construction hours (7:00am to 6:00pm Monday to Friday, and 7:00am to 1:00pm on Saturdays). Any construction outside of these normal working hours would only be undertaken with prior approval from relevant authorities.

It is anticipated that the delivery of PV panels will occur over an approximate 10 -12 -month construction period. The largest design vehicle expected to access the Development Site is a 30-metre-long heavy goods vehicle (HGV). The majority of HGVs are expected to be 19.5-metre-long Articulated Vehicles (AVs as defined in AS2890.2:2002) or smaller. Accordingly, during the peak construction period of the Proposal, it is assumed that the Proposal would generate:

- Approximately 40 HGV per day, or 80 movements. All of the HGV movements are proposed to arrive/depart to the south via the Castlereagh Highway / All Weather Road intersection.
- Approximately 12 light vehicles per day, or 24 light vehicle movements. All of the light vehicle movements are proposed to arrive/depart to the south via All Weather Road / Digilah Road intersection.

During non-peak periods approximately half as many light vehicles and HGVs would be expected.

Local vehicle movements could be reduced by organising carpooling. It is expected that a proportion of construction workers (skilled and technical workers) will utilise ride sharing commuting to/from the site, and it can be reasonably expected that these light vehicles will have an average of three people per vehicle.

Delivery times of components can be scheduled with the haulage contractors so that “platooning” of large vehicles on the highways does not occur. This outcome would be ensured by the preparation of a detailed Construction Traffic Management Plan (CTMP) to manage traffic and access in the local area throughout the construction phase.

Increased Collision Risks

The increased collision risk would be mainly limited to the construction period and relates primarily to traffic entering and exiting from the intersection of Castlereagh Highway / All Weather Road. This relates to both oncoming traffic and traffic following turning vehicles. Slowing vehicles may present a risk to through traffic.

Based on a 100 km/hr speed limit and a reaction time of 2 seconds, a safe intersection sight distance of 248 metres is required in accordance with the Austroads 2010 *Guide to Road Design Part 4A: Unsignalised and Signalised Intersections*. At the Castlereagh Higher/All Weather Road intersection, sufficient sight distance is affordable for turning vehicles. Accordingly, the sight distance at the access is considered acceptable.

Austroads’ *Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings* (Austroads Part 6) specifies the turning treatments required on major roads at unsignalised intersections. Refer to Figure 9-18 for the required turn treatments on major roads based on a 100 km/h design speed.

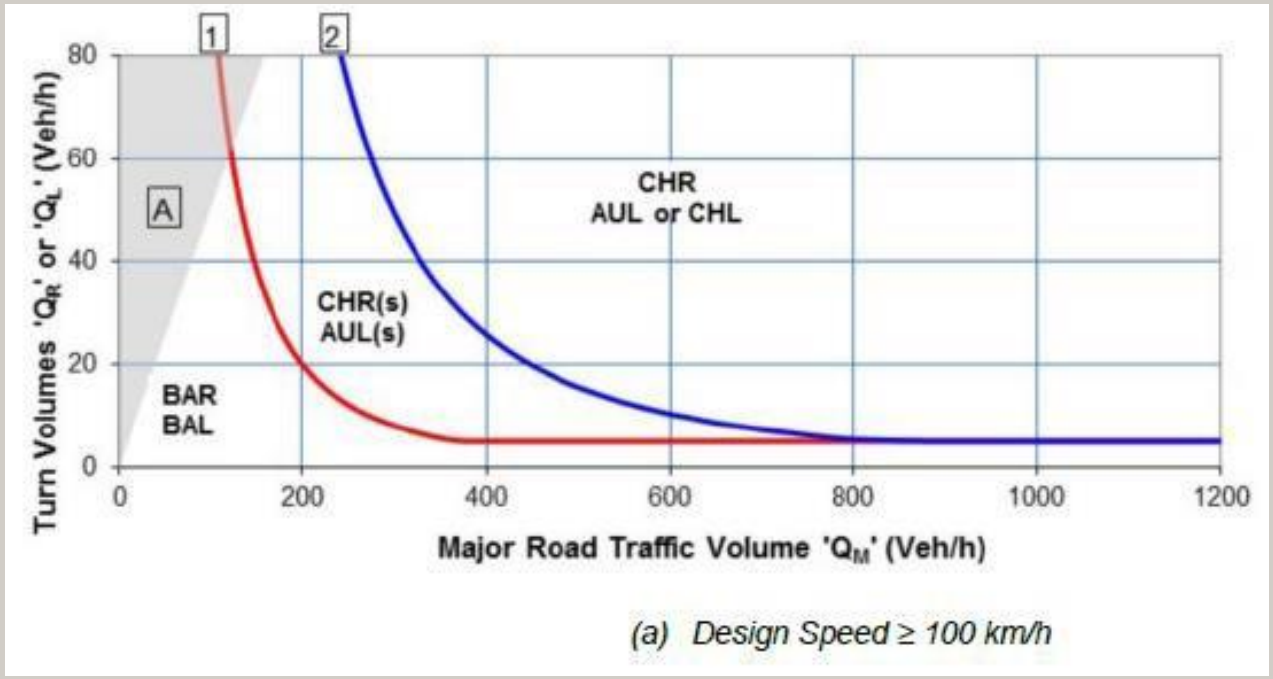

Figure 9-18 Required turn treatments on major roads at unsignalized intersections greater than or equal to 100 km/h (Austroads Part 6, 2010).

During the peak construction phase of the Proposal, Castlereagh Highway is expected to accommodate approximately 685 vehicle movements per day. All Weather Road is expected to accommodate approximately 100 vehicle movements a day along its western end, including 80 heavy vehicle movements associated with the construction of the Proposal.

Over a typical eight-hour construction vehicle delivery schedule, this equates to approximately 10 vehicle movements an hour through the Castlereagh Highway / All Weather Road intersection, at a 50:50 ratio. Therefore, the Q_R value is 5 vehicles per hour for the right turning movements onto All Weather Road.

Assuming 16% of daily trips occur during each peak hour, Castlereagh Highway is expected to have a two-way peak hour volume of 97 vehicles per hour (Q_M).

Accordingly, the intersection of Castlereagh Highway / All Weather Road would require a Basic Right Turn (BAR) turning treatment to be provided during construction of the Proposal. However, given the existing bridge crossing located approximately 40 metres south of the intersection, there is insufficient land available to provide a BAR turning treatment without requiring significant bridge reconstruction and widening. As such, it is considered an appropriate alternative to manage heavy vehicle movements through the intersection via on-site traffic management.

The preferred option to facilitate HGV movements via the Castlereagh Highway / All Weather Road intersection would be to widen the north-eastern corner of the junction to cater for the design vehicle swept paths (refer to Figure 4-16 and Figure 4-17).

The intersection allows for inbound HGVs to safely perform a BAR onto All Weather Road from Castlereagh Highway from Dunedoo, and a Basic Left Turn (BAL) from Castlereagh Highway from Dubbo. Similarly, the design caters for HGVs turning left onto Castlereagh Highway from All Weather Road. In the rare event that two (2) opposing HGVs approach the intersection simultaneously, outbound vehicles will be required to stop on All Weather Road in a position so as to allow inbound

HGVs safe access through the intersection. These events would be minimised through traffic management and communication between drivers and the Development Site.

Damage to Road Infrastructure

The increase in traffic and HGV movement could impact the condition of roads on the haulage network. Although the impact on Castlereagh Highway is expected to be negligible, due to the existing capacity of the road network, the impact of turning traffic at the intersection with All Weather Road would require monitoring to ensure it remains within the expected peak hourly volumes.

The *Unsealed Roads Manual: Guidelines to Good Practice (2009)* states that the average traffic volumes for gravel roads usually varies between 20 and 200 vehicles per day. All Weather Road is estimated to accommodate well under 200 vehicle movements per day, and it is expected that the condition will remain during peak construction periods. It is therefore considered that traffic volumes along All Weather Road will remain within acceptable levels for gravel roads throughout the construction period. As such, All Weather Road and the internal access tracks would remain unsealed but may be re sheeted with gravel to maintain their condition during the construction phase.

The road width of All Weather Road from its intersection with Castlereagh Highway to the first bend in the road prior to the proposed Access Point 1 location is considered to be of insufficient width to allow for simultaneous two-way HGV movements. A heavy vehicle passing bay would be provided along the south-eastern side of All Weather Road between Castlereagh Highway and Access Point 1 to allow for two (2) heavy vehicles passing each other, refer to Figure 4-13.

Once all new proposed road works (intersection upgrade and lane widening) are completed and prior to the start of the Proposal's construction, a pre-condition survey of the relevant sections of the existing road network would be undertaken, in consultation with Warrumbungle Shire Council. During construction, the road network would be monitored and maintained to ensure continued safe use by all road users, and any faults attributed to construction of the solar farm would be rectified. At the end of construction, a post-condition survey would be undertaken to ensure the road network is left in the same state as at the start of construction.

In the event of road closure due to flooding, particularly at the low-level bridge on Digilah Road, construction workers would leave their vehicles in Milling Park in Dunedoo (off the Golden Highway). They would be bused to the site via the Castlereagh Highway and All Weather Road, in order to minimise the number of vehicles using the Castlereagh Highway / All Weather Road intersection. The Flood Response Plan would include alternate modes of transportation to transport workers to/from the site.

Associated Noise and Dust

Construction of the Proposal may result in increased noise and dust, particularly on unsealed roads, though all such roads are within the Development Site. Impact from dust generated from the proposed activity, including that associated with increased traffic, is considered in Section 9.10. During construction, water would be used to minimise dust generation on the unsealed lanes and internal site tracks.

The DECCW (2011) *NSW Road Noise Policy* (NSW RNP) has been used to evaluate impacts from road traffic noise. This policy outlines a range of measures required to minimise road traffic noise and its impacts, including noise generated by developments that generate additional traffic on existing roads.

The criteria for various road categories and land uses are presented in section 2.3 of the NSW RNP. Those criteria are presented in Table 9-44.

Table 9-44 Applicable NSW Road Noise Policy (DECCW 2011) noise criteria

Type of project/land use	Assessment criteria – dB(A)	
	Day (7am – 10pm)	Night (7am – 10pm)
Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq, (15\ hour)}$ 60 (external)	$L_{Aeq, (9\ hour)}$ 50 (external)
Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq, (1\ hour)}$ 55 (external)	$L_{Aeq, (1\ hour)}$ 50 (external)

The nearest non-involved residence is 200 metres from the traffic access route to the Development Site. The area is flat with little vegetation screening. However, the residence is currently affected by the Castlereagh Highway traffic noise, exceedance of these levels is considered unlikely. The increase in traffic and HGV movement during construction would result in a minor increase in noise as a result of the proposed works. In the event a noise complaint is received during construction, mitigation including monitoring may be undertaken.

Disruption to Existing Services

Local traffic in Dubbo and Mudgee would be minimally affected by increased vehicles from staff seeking accommodation and services, and conducting commercial activities related to the solar farm. This would extend outside construction hours but would be insignificant in the context of traffic movements in these major regional centres.

Traffic impacts would largely be confined to standard hours of construction. Exceptions may occur as staff arrive and leave the site, before and after shifts. The objective of the TMP would be rationalise traffic movements for personnel and construction vehicles.

Large vehicles and oversized loads are likely to require temporary traffic controls at certain times during the construction phase, potentially at the intersection of Castlereagh Highway / All Weather Road. Where possible, large deliveries requiring stop/go traffic controls would not be scheduled during morning and evening commuting or school bus operating periods. However, given the long haulage distances, large deliveries within these periods, may be unavoidable. The Proponent would aim to restrict any traffic delays to a maximum of 10 minutes.

The increase in traffic volumes and slow turning vehicles may have a minimal effect on bus movements, including the school bus on Digilah Road, but would have no impact on scheduled services. Consultation with bus providers, to ensure there is no disruption to the bus schedule or to the location of stops would mitigate potential risk.

Subject to speed restrictions, safe intersections, rationalising staff travel, scheduling of deliveries and traffic controls and ongoing consultation with affected residents, the works are not considered likely to result in unacceptable delays or collision risks.

Local residents neighbouring the Development Site were consulted during the planning and assessment of the Proposal and would continue to be consulted during the construction phase (refer to Section 6).

Conclusion

Overall, the additional traffic would be a small component of the existing loads. No substantive increased collision risks, damage to road infrastructure, noise or dust impacts, disruption to existing services or reduced level of service is expected to accompany construction. This outcome would be ensured by the preparation of a TMP to manage the haulage process.

Operation

During operation, up to 3 full time equivalent staff would be based at the solar farm, primarily using standard light vehicles (4WD). Security personnel may also access the site. During major outages, up to 20 vehicles may be present at any one time.

Vehicles would use the designated road network to access the site and travel within the site during the operational phase (30-year period). Activities undertaken during the operation phase would include travelling to the site office or maintenance building and carrying out maintenance activities on the solar farm. Operational staff would be confined to designated parking areas and access roads/tracks within the solar farm.

The anticipated volume of workers (<6) would result in a very minimal increase in traffic flow on the Castlereagh Highway and Golden Highway. It is considered highly unlikely that operational traffic would obstruct public or private access, or negatively impact road conditions. Risks to road safety from operational traffic would be very minimal.

Decommissioning

Decommissioning impacts are likely to follow a similar pattern as construction, with components dismantled and removed, over a lesser time period.

9.6.3 Mitigation Measures

Traffic, transport and road safety impacts would be managed by implementing the mitigation measures provided in Table 9-45.

Table 9-45 Mitigation measures for traffic, transport and road safety impacts

Mitigation measures	Phase
A Construction Traffic Management Plan (CTMP) would be developed as part of the CEMP and DEMP, in consultation with Warrumbungle Shire Council and TfNSW. The plan would include: • Confirmation of designated routes for construction and haulage traffic • Evaluation of any road or intersection upgrade requirements and associated traffic controls, in consultation with council and roads and maritime services (and consistent with Austroads guides and TfNSW supplements) • Scheduling of deliveries • Carpooling/shuttle bus arrangements changes required from Milling Park to site to minimise staff vehicle movements in the event of flooding • Consultation and notification arrangements regarding traffic impacts for nearby residents and local road users, particularly when traffic delays are expected • Arrangements and locations for traffic controls (speed limits, signage, stop/go) • Procedure to monitor traffic impacts and adapt controls (where required) to reduce the impacts	Preconstruction Construction Decommissioning

Mitigation measures	Phase
• Provision of a contact phone number for stakeholders and the public to obtain information and to enable rapid response to any issues or concerns • Assessment of road condition prior to construction on all local roads that would be utilised (All Weather Road and relevant section of Digilah Road),a road condition monitoring program, and process for rectifying road conditions should deterioration in road quality be attributable to the proposal. • Address the temporary increase in traffic across the low-level bridge crossing on Digilah Road to the north of Golden Highway • Reduce predicted impact (where possible) from transport during peak tourism periods (such as during local festivals), and morning and evening commuting or school bus operating periods • Link with the requirements of the Flood Response Plan	
Invite TfNSW education staff to provide information, guidance and discussion on fatigue management and road safety to site staff.	Preconstruction Construction Decommissioning
Consultation with stakeholders including TfNSW, Warrumbungle Shire Council, local landholders and emergency services would continue during construction and decommissioning to advise of any changes to road use and conditions.	Construction Decommissioning

9.7 HAZARDS

An environmental hazard is a thing or situation which can threaten the environment or human health. Hazards may be natural or artificial, or result from the interaction between human activity and the natural environment. Hazards relevant to the Proposal include risks associated with hazardous goods, electromagnetic fields, aviation impacts, and fire.

9.7.1 Hazardous Materials and Development

The SEARs relevant to this project required for the Battery Storage component that a Preliminary Hazard Assessment (PHA) 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).**

The SEARs also required that an assessment of potential hazards and risks be prepared, including but not limited to bushfires, spontaneous ignition, electromagnetic fields or the proposed grid connection infrastructure, against the International Commission on Non-Ionizing Radiation Protection (ICNIRP) *Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields.*

Notwithstanding, SEPP 33 Hazardous and Offensive Development also requires a PHA to be prepared for potentially hazardous or offensive development. Appendix 3 of the Applying SEPP 33 guidelines (DOP 2011) lists industries that may fall within SEPP 33; the guidelines do not include solar farms and energy storage facilities. Appendix 2 of the guidelines provides a risk screening procedure and a checklist to identify Hazardous and Offensive Development in instances where the applicability of SEPP 33 is not immediately apparent. Information relevant to the risk screening and the checklist is provided below.

Risk Screening

The SEPP 33 screening procedure is based on the quantity of dangerous goods stored or transported, the frequency of transportation movements and, in some cases, the distance of the materials from the site boundary. The guidelines require goods to be classified according the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code). The ADG Code lists 9 classes of dangerous goods:

- Class 1 Explosives
- Class 2 Gases
- Class 3 Flammable liquids
- Class 4 Flammable solids
- Class 5 Oxidising substances and organic peroxides
- Class 6 Toxic and infectious substances
- Class 7 Radioactive material
- Class 8 Corrosive substances
- Class 9 Miscellaneous dangerous substances and articles, including environmentally hazardous substances.

A development which exceeds screening thresholds in the guidelines would be considered potentially hazardous, and a PHA would need to be submitted with the development application. For quantities below the given thresholds, the SEPP indicates that there is unlikely to be a significant off-site risk, in the absence of other risk factors.

The dangerous goods that would require transportation and storage during construction or operation of the proposed solar farm are identified in Table 9-46, with ADG Code classification, relevant quantity and transportation thresholds, and storage arrangements. In terms of the class, transportation and storage of dangerous goods, the Proposal would not exceed SEPP 33 thresholds and would not be considered potentially hazardous.

Table 9-46 Dangerous goods and SEPP 33 thresholds relevant to the Proposal

Hazardous material	Storage threshold	Transport threshold		Storage arrangements	Exceeds thresholds?
		Movements	Quantities		
Class 2.1 Flammable gases					
LPG	10 tonnes or 16m^3 (above ground)	>500 cumulative >30/week	2-5 tonnes	Up to 45kg cylinders beside control building, at least 20 metres from boundary.	No
Class 2.2 Non-flammable, non-toxic gases					
Inert fire suppression gas	NA	NA	NA	Compressed in steel bottles in BS	No
Class 3 – Flammable liquids (PGII)					
Fuel (petrol)	5 tonnes	>750 cumulative >45/week	3-5 tonnes	Secure operations storage building	No (1 tonne)
Class 9 Miscellaneous dangerous substances and articles					
Li-on batteries	NA	>1000 cumulative >60/week	No limit	Housed across the site in up to 18 customised containers	No (18 x 21.99m^3 containers (total 396m^3)

Class 2.2 Non-flammable, Non-toxic Gases

The inert gas stored in compressed form in the proposed Battery Storage for fire suppression would belong to Class 2.2 Non-flammable, non-toxic gases. Gases within this class/division are excluded from the SEPP 33 risk screening process and are not considered to be potentially hazardous with respect to off-site risk. These materials have a Workcover notification threshold of 10,000 litres.

The use of inert gases for fire suppression in enclosed spaces carries asphyxiation risks for staff, site visitors and emergency personnel. Gases commonly used are blends of argon, nitrogen and carbon dioxide. Inert gases are used to reduce oxygen content to below 15% to extinguish fires. Levels below 18% are hazardous for humans, and levels below 10% are extremely dangerous. The risk of accidental asphyxiation can be minimised by:

- Proper installation and operation
- Regular equipment inspection maintenance
- Provision of warning signs and information to staff
- Staff and emergency responder training (including during maintenance and rescue/first aid)
- Fixed or personal oxygen monitoring equipment
- Activation of an audible and visible internal and external alarm prior to gas release
- Incorporation of an odour in the gas
- Effective ventilation and air exchange
- Safe and effective purging system.

Class 9 Miscellaneous Dangerous Substances and Articles

Class 9 represents miscellaneous dangerous goods, which pose little threat to people or property, although they may pose an environmental hazard (DOP 2011). Lithium-ion batteries are Class 9 Hazardous Goods (both new and waste batteries). Class 9 goods are also excluded from the SEPP 33 risk screening process. The major hazard offered by lithium-ion battery technologies is fire, as a result of the flammability of the substances used in the battery (Recharge 2013). Fire risks associated with lithium-ion batteries are discussed in Section 9.8. Class 9 materials have a Workcover notification threshold of 10,000 litres or kilograms.

Lithium-ion batteries are classified as hazardous waste under the Commonwealth *Hazardous Waste Act 1989*, and are classified as Dangerous Goods under the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code). The ADG Code requires dangerous goods to be carried in a secure, safe and environmentally controlled manner. The code specifies 'special provisions' and 'packing instructions' applying to the transportation of Li-ion batteries. The code listing also applies to waste Li-ion batteries. The National Environment Protection (Movement of Controlled Waste between States and Territories) Measure 1998 (the NEPM), which sets the regulatory framework for transporting 'controlled wastes' between Australian states and territories, does not currently cover Li-ion batteries. Waste Li-ion batteries are not currently regulated as a hazardous waste by state governments and hence transport within the state is not required to be tracked in hazardous waste tracking systems (Randell Consulting 2016).

Other Risk Factors

The Proposal would not involve the storage or transport of incompatible materials, generation of hazardous wastes, generation of dusts within confined areas, activities involving hazardous materials, incompatible, reactive or unstable materials and process conditions, storage or processing operations involving high (or extremely low) temperatures.

9.7.2 Electromagnetic Fields

Background

Electromagnetic fields (EMFs) consist of electric and magnetic fields and are produced whenever electricity is used. EMFs also occur naturally in the environment, such as the Earth's magnetic field and discharges during thunderstorms (WHO 2012).

Electric fields are produced by voltage and magnetic fields are produced by current. When electricity flows, EMFs exist close to the wires that carry electricity and close to operating electrical devices and appliances (WHO 2007). Electric and magnetic field strength reduces rapidly with distance from the source, and while electric fields are insulated by air and insulation material, magnetic fields are not.

Fields of different frequencies interact with the body in different ways. EMF field sources to which people may be exposed are predominantly in three frequency ranges. The Extremely Low Frequency (ELF) range of 0-300 Hz incorporates the 50 and 60 Hz frequencies of the electric power supply and of electric and magnetic fields generated by Transmission Lines and other electrical devices and infrastructure (Repacholi 2003).

Over decades of EMF research, no major public health risks have emerged, but uncertainties remain (WHO). While it is accepted that short-term exposure to very high levels of electromagnetic fields can be harmful to health, the International EMF Project, established by the World Health Organisation, has thus far concluded that there are no substantive health consequences from exposure to ELF *electric* fields at the low levels generally encountered by the public (WHO 2007). This includes ELF that would be produced by electricity generation at the proposed solar farm and along the Transmission Line.

Exposure to ELF magnetic fields is mostly considered to be harmless, however, a policy of prudent avoidance has been taken to account for any uncertainty. The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA 2015) advises that 'the scientific evidence does not establish that exposure to ELF EMF found near Transmission Lines is a hazard to human health', and that 'current science would suggest that if any risk exists, it is small'.

Australia does not currently have a standard regulating exposure to ELF electric or magnetic fields. The International Commission on Non-Ionizing Radiation Protection (ICNPR) published *Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300GHz)* in 1998. The guidelines were updated in 2010. The objective of the paper was to establish guidelines for limiting EMF exposure that would provide protection against known adverse health effects.

To prevent health-relevant interactions with Low Frequency fields, ICNIRP recommends limiting exposure to these fields so that the threshold at which the interactions between the body and the external electric and magnetic field causes adverse effects inside the body is never reached. The exposure limits, called basic restrictions, are related to the threshold showing adverse effects, with an additional reduction factor to consider scientific uncertainties pertaining to the determination of the threshold. They are expressed in terms of the induced internal electric field strength in V/m. The exposure limits outside the body, called reference levels, are derived from the basic restrictions using worst-case exposure assumptions, in such a way that remaining below the reference levels (in the air) implies that the basic restrictions would also be met (in the body) (ICNIRP 2010). Reference levels for occupational and general public exposure are shown in Table 9-47.

Table 9-47 ICNIRP reference levels (ICNIRP 2010)

Exposure characteristics	Electric field strength (kVolts per metre - kV/m)	Magnetic flux density (microteslas - μT)
Occupational	10	1000
General public	5	200

EMF Sources and Levels

Potential for EMF impacts occurs only during the operational phase of the solar farm when electrical infrastructure is capable of generating EMFs. In relation to potential occupational exposure for solar farm personnel, the electromagnetic fields would vary in different locations at the site. The Proposal includes the following components that could generate EMFs:

- Underground 22-33 kV cables
- Approximately 18 inverter/transformer containers
- A 66 kV facility connection substation and existing Essential Energy Dunedoo Substation
- The solar array (up to 1.5 kV DC).

Typical and maximum EMF levels for these types of infrastructure are discussed below. As noted above, strength attenuates with distance from the infrastructure.

Research into electric and magnetic fields undertaken at utility scale photovoltaic installations in California[1] by Chang and Jennings (1994), indicated that magnetic fields were significantly less for

[1] Note the U.S.A electricity supply operates at 60 Hz frequency.

solar arrays than for household applications. Chang and Jennings (1994) found magnetic fields from solar arrays were not distinguishable from background levels at the site boundary, suggesting the health risk of EMFs from solar arrays is minimal.

Potential Impacts

Construction and Decommissioning

There is low potential for EMF impacts during the construction and decommissioning phases of the project. The maximum magnetic field of the proposed Transmission Line is well under the 200 µT and 1000 µT limits respectively recommended for public and occupational exposure.

Staff would be exposed to EMF's over intermittent periods during works at and around the existing 132 kV overhead TL. Exposure to EMFs during the construction of the substation and its connection to the existing TL would be short term, therefore the effects are likely to be negligible.

The construction site would be fenced to protect the public from construction health and safety risks.

Operation

The assessment focuses on the potential for health impacts. The EMFs emitted by the solar farm would not be likely to interfere with local mobile phone, radio or television reception. These devices operate at a much higher frequency than the AC electrical equipment that would be used at the solar farm, and any EMFs produced would dissipate rapidly with distance from the source.

Overhead Transmission Lines

Figure 9-19 displays the typical electric fields emitted from different voltage overhead TLs. The locality has existing 132-kV TLs on the southern and eastern boundaries. Most cabling installed for the Proposal would be buried and located along the access tracks. A short section of overhead electrical cabling would be used to connect the substation to the existing Essential Energy 85A 66-kV TL. The existing and proposed overhead TLs are less than the recommended 5 kV/m and 10 kV/m limits.

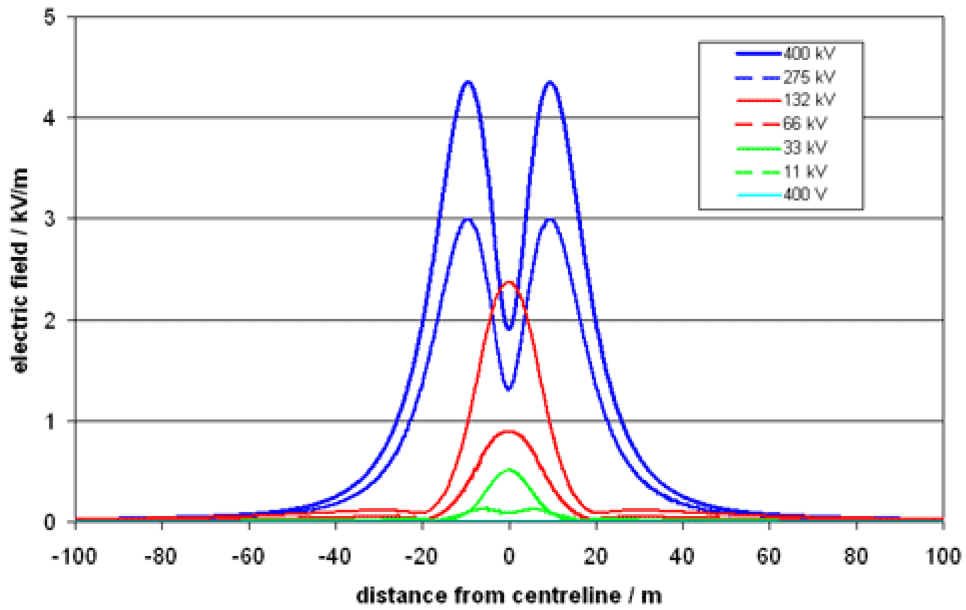

Figure 9-19 Typical electric fields from overhead transmission lines (EMFs.info 2017)

Figure 9-20 and Table 9-50 show a range of magnetic field levels measured by the ARPANSA around Transmission Line and substations. The existing and proposed overhead TL are less than the recommended 200 µT and 1000 µT limits, even if directly underneath the TL.

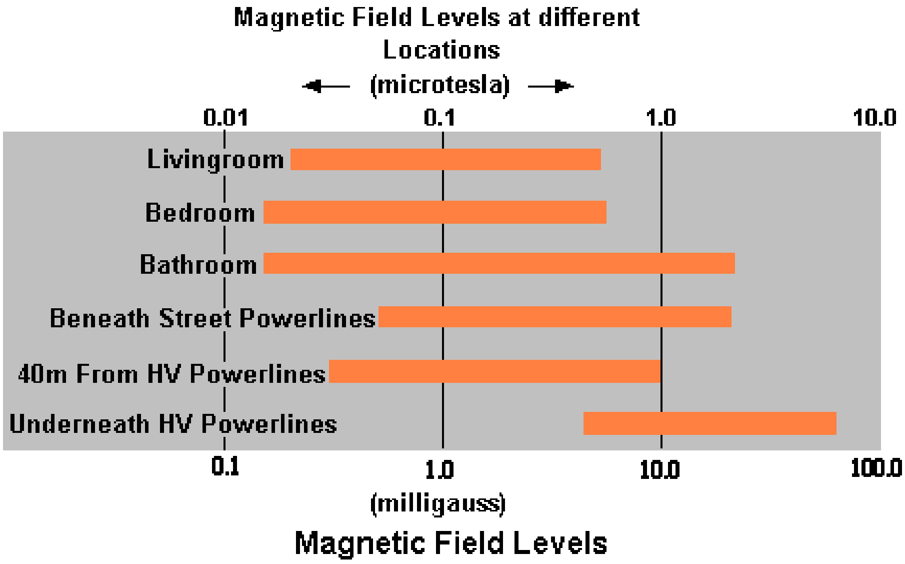

Figure 9-20 Magnetic field levels at different locations (ARPANSA 2015)

Table 9-48 Typical magnetic fields near overhead powerlines and substations

Source	Location of measurement	Range of measurement	
		(mG)	(µT)[2]
Transmission Line	Directly underneath	10 - 200	1 - 20
Transmission Line	At edge of easement	2 - 50	0.2 - 5
Substation	At substation fence	1 - 8	0.1 – 0.8

Underground Cabling

External electric fields from underground cables are shielded by the soil. EMFs.info (2016) provides typical magnetic field data for a single 33 kV underground cable at a 0.5-metre depth. Magnetic fields for this cabling would be under the recommended limits of 200 µT and 1000 µT.

[2] Converted from mG where 1 mG = 0.1 µT.

Table 9-49 Magnetic field levels from underground 33 kV cabling

Distance from 33 kV centreline (metres)	Magnetic Field (μT)
0	1.00
5	0.29
10	0.15
20	0.07

The Proposal would require the installation of internal reticulated 22 kV or 33 kV cabling. Cables used in the on-site reticulation cabling would typically contain three (3) core conductors in trefoil (three (3) lobed) arrangements to reduce the effects of magnetic fields from adjacent conductors. During detailed design and construction, the electric and magnetic fields produced by the cable would be maintained at much lower levels than the ICNIRP reference levels for the general public.

Inverters/Transformers

Based on current design, approximately 18 containerised Inverter/transformers, would be installed across the site. These containers would have a total output of up to around 70 MVA. The inverters would typically have an AC power frequency range between 47 and 63 Hz and fall into the Extremely Low Frequency (ELF) range of 0-300 Hz. Within this range, EMFs are not considered to be hazardous to human health. In addition, the Inverter/transformers would be located within the fenced solar farm site with no public access and would be producing power only during the daytime reducing the total time that EMFs are generated by the infrastructure.

Substation

For substations and transformers, the magnetic fields at distances of five to ten metres are generally indistinguishable from typical background levels in a home. The fenced exclusion area around the substation components is sufficient to reduce EMF to negligible levels.

Solar Arrays

The solar farm would require installation of DC wiring between panels and the Inverter/transformers. This cabling may be above ground or underground and would typically conduct less than 320A and 1500V. The potential for electromagnetic interference as a result of the aboveground and underground cable is considered to be negligible.

Battery Storage

Lithium-ion batteries are not associated with high levels of EMF and the EMF produced by the proposed BS would be well below ICNIRP reference levels.

9.7.3 Aviation

Existing Environment

No private airstrips are located within 1km of the Development Site. The two closest national airports are located in Dubbo (90 km west of the site) and Mudgee (77 km south of the site).

Potential Impacts

Glint and Glare

The identified potential risk to aviation from the solar farm is glint and glare. Glint is a quick reflection that occurs when the sun is reflected on a smooth surface. Glare is a longer, sustained reflection. Infrastructure at the site that may cause glint or glare depending on the sun angle, include:

- Solar panels
- Metal array mounting (steel or aluminium or other as supplied)
- Site buildings.

The potential for glint or glare associated with non-concentrating PV systems which do not involve mirrors or lenses is relatively limited. PV solar panels are designed to absorb as much solar energy as possible in order to maximise electricity generation. As such, they reflect only around 2% of the received light (Spaven Consulting 2011). The panels would also have an anti-reflective coating to further reduce the potential for glare and glint.

A comparative reflection analysis against other surfaces is shown in Figure 9-21. The figure shows that in relation to water and snow, a solar panel (with a reflectivity coating) reflects a much lower percentage of light. The Department of Planning (2010) discussion paper on planning for renewable energy generation confirmed that solar panels would not generally create noticeable glare compared with an existing roof or building surfaces.

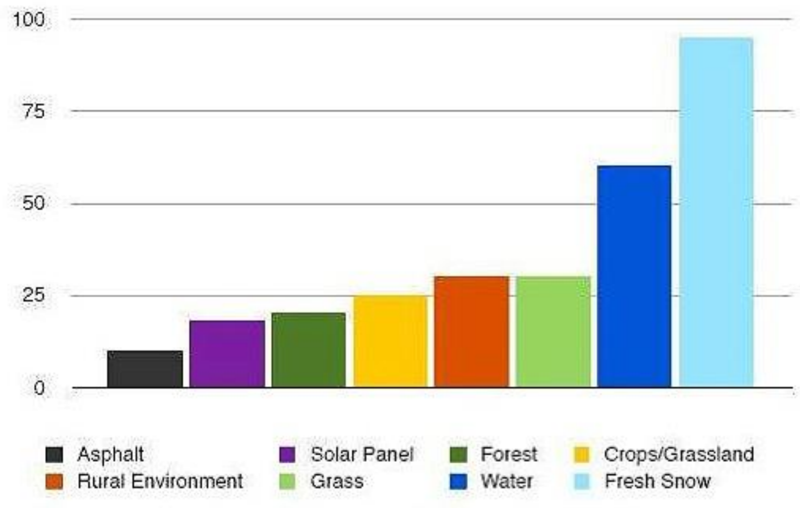

Figure 9-21 Comparative reflection analysis (Spaven 2011)

For other infrastructure such as the buildings and support posts, impacts from glint and glare is considered minor due to their small size and low surface area. Careful design and colour schemes can further reduce any potential reflection problems.

The visual assessment undertaken for the Proposal provided in Appendix F and summarised in Section 8.3 found that glint and glare impacts on aviation would be minor and can be effectively managed with the implementation of identified mitigation measures. The largest glare hazard for aviation remains the sun (Spaven 2011). The US Federal Aviation Administration (FAA) Technical Guidance for Evaluating Selected Solar Technologies on Airports (FAA 2010) cites several case studies of operating solar facilities at large airports, including Denver International, Fresno Yosemite International and Albuquerque International Sunport. In their review of the FAA policies, the US Department of Energy's National Renewable Energy Laboratory (NREL)) found that, with proper planning, solar can be successfully installed at airports with minimal or no impacts (Kandt and

Romero 2014. The report notes that successful solar systems have been installed at dozens of airports worldwide, noting examples in the United Kingdom, Greece, Italy and United States ranging between 45 kW and 12.5 MW capacity.

9.7.4 Mitigation Measures

Potential hazard risks would be managed via the mitigation strategies in Table 9-50.

Table 9-50 Mitigation measures for the management of hazards at the site

Mitigation measures	Phase
An Emergency Response Plan, incorporating an Evacuation Plan, Fire Response Plan, Flood Response Plan and Spill and Contamination Response Plan, would be developed prior to construction the solar farm. A copy of the plan would be kept on site. .	Preconstruction Construction Operation Decommissioning
Hazardous materials and development	
Dangerous or hazardous materials would be transported, stored and handled in accordance with AS1940-2004: *The storage and handling of flammable and combustible liquids* and the ADG Code where relevant. All potential pollutants kept on-site would be stored in accordance with relevant HAZMAT requirements and bunded.	Construction Operation Decommissioning
The transportation of new and waste lithium-ion batteries would comply with the requirements of the Dangerous Goods Code, including specific 'special provisions' and 'packing instructions' applying to the transportation of Li-ion batteries.	Construction Operation Decommissioning
EMF	
All electrical equipment would be designed in accordance with relevant codes and industry best practice standards in Australia.	Preconstruction Construction
All design and engineering would be undertaken by qualified and competent person/s with the support of specialists as required and would aim to minimise EMFs.	Preconstruction Construction
Aviation	
The materials and colour of on-site infrastructure would, where practical, be low reflectivity and in keeping with the colouring of the local landscape.	Preconstruction Construction

9.8 FIRE AND BUSHFIRE

Bush fire presents a threat to human life and assets and can deliver adverse ecological impacts. Bush fire risk can be considered in terms of environmental factors that increase the risk of fire:

- Fuel load and type
- Topography

- Weather patterns specific activities (such as hot works) or infrastructure that exacerbate combustion or ignition risks (such as Transmission Lines and other electrical components).

9.8.1 Existing Environment

The Development Site is generally flat, located 2 km from the Talbragar River and has been levelled for agricultural activities. The site has been cleared and cropped with little to no overstorey or shrub storey present, except for isolated remnants and tree clusters. Talbragar River comprises of a dense riparian habitat along the riverbanks, this river runs south and west of the boundary of the Development Site.

The proposed TLs runs south along the eastern border of the Development Site for 1.8 km, before heading southeast for approximately 350 metres to meet the Essential Energy Dunedoo substation via existing TLs proposed to be replaced (refer to Section 4.3.7 and Figure 4-11). It has been sighted in cleared areas with little to no overstorey or shrubs. The only exception is the crossing of the Talbragar River; however, the alignment has chosen a sparsely vegetated section. River crossing of Option 1 and Option 2 are approximately 320 metres apart. The Dunedoo substation is clear of any overstory vegetation.

The Development Site is within the area of operation of the Castlereagh Bushfire Risk Management Plan (Castlereagh BFMC 2008). The local bush fire season generally occurs between October and March and the largest fires typically occur from Mid-November to end of December. The climate in this area has low variability with warm to hot temperatures and winds coming from the west in summer. Winter periods are typically cooler and drier. Fire conditions are usually associated with severe electrical storms in the wet summer months, and dry lightning storms can occur in the dry months.

Historically, the Castlereagh BFMC area experiences 80 bush fires on average per year, of which three are major fires. The main ignition sources have been lightning, escape from legal burns, farm machinery, incendiaries and campfires. Lightening is mainly associated with spring and summer electrical storms, and the risk of fire increases with dry or low rain conditions. Escapes from legal burn occur in the rural farming and grazing lands spread across the Castlereagh BFMC.

The property is mapped as bush fire prone by Warrumbungle Shire Council. RFS brigades in the locality, are managed by the Castlereagh RFS Zone and include Dunedoo Brigade (30 Digilah Street), Laheys Creek and Uarbry. There is a designated Neighbourhood Safer Place at Dunedoo showground.

The Development Site comprises largely cleared cropping paddocks on level terrain with generally low fuel loads. Open woodland remnants are present at the site, and there are intermittent linear woodland remnants along roads in the Development Site. Transmission lines are present along the southern and eastern boundaries of the site and there are transmission lines to the dwelling on the property.

Water resources at the site include two (2) small farm dams. There is good all-weather access to the property from the public road network. The site is located within a broad scale agricultural area with a dispersed settlement pattern. There are up to seven (7) uninvolved residences within 2 km of the site.

The effect of anthropogenic climate change on extreme weather, increasing the number of hot days and heatwaves, is driving up the likelihood of very high fire danger weather (Climate Council 2016). This was evident during the 2019/2020 bushfire season that led to over 17 million ha of fire damage: the single largest recorded bushfire season for Australia (Parliament of Australia, 2020).

Planning for Bushfire Protection Guidelines

According to NSW RFS *Planning for Bush Fire Protection (PBP)* (RFS 2019), an acceptable level of protection from bushfires is achieved for developments through a combination of strategies which:

- *control the types of development permissible in bush fire prone areas;*
- *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 property preparedness, including emergency planning and property maintenance requirements; and*
- *facilitate the maintenance of Asset Protection Zones (APZs), fire trails, access for firefighting and on site equipment for fire suppression.*

The PBP guidelines provide six key Bush Fire Protection Measures for developments:

- *APZs;*
- *Access;*
- *Construction, siting and design;*
- *Landscaping;*
- *Services; and*
- *Emergency and evacuation planning.*

Planning for Bush Fire Protection 2019

PBP provides the following bushfire management objectives for National Construction Code Class 5 to 8 buildings (including commercial and industrial facilities):

- to provide safe access to/from the public road system for firefighters providing property protection during a bush fire and for occupant egress for evacuation;
- to provide suitable emergency and evacuation (and relocation) arrangements for occupants of the development;
- to provide adequate services of water for the protection of buildings during and after the passage of bush fire, and to locate gas and electricity so as not to contribute to the risk of fire to a building; and
- provide for the storage of hazardous materials away from the hazard wherever possible.

With regard to section 8.3.5 (of PBP) Solar Farms are identified and require the following measures to be incorporated into the design and operation of the Proposal,

- a 10-metre Asset Protection Zone (APZ) for the structures and associated buildings/infrastructure; and
- the APZ must be maintained to the standard of an inner protection area (IPA) for the life of the development.

PBP also requires a bush fire emergency management and operations plan, covering:

- work that should not be carried out during total fire bans;
- detailed measures to prevent or mitigate fires igniting;

- notification of the local NSW RFS Fire Control Centre for any works that have the potential to ignite surrounding vegetation, proposed to be carried out during a bush-fire fire danger period to ensure weather conditions are appropriate;
- appropriate bush fire emergency management planning and availability of fire-suppression equipment, access and water;
- storage and maintenance of fuels and other flammable materials., covering:
    - the suspension of work involving risk of ignition during total fire bans,
    - the availability of fire-suppression equipment, storage and maintenance of flammable materials,
    - notification of the local NSW RFS District Fire Control Centre for any works during the fire danger period that have the potential to ignite surrounding vegetation,
    - and bush fire emergency management planning.

A bush fire emergency management and operations plan would be prepared in consideration of the above for this project.

9.8.2 Potential Impacts

Construction and Decommissioning

Potential bushfire (including grass fire) hazards relate to the risk of the development causing a bushfire and the risk of any bushfires affecting the solar farm. Potential ignition sources associated with construction and decommissioning include:

- Earthworks and slashing machinery causing sparks
- Hot works activities such as welding, soldering, grinding and use of a blow torch
- Sparks and contact ignition from vehicles in long combustible vegetation
- Smoking and careless disposal of cigarettes
- Use of petrol-powered tools
- Operating plant fitted with power hydraulics on land containing combustible material
- Electrical faults during testing and commissioning
- Storage of chemicals and hazardous materials.

The construction works would take place on flat land in a low fuel environment, in cleared paddocks formerly used for cropping. Site access would be formalised at the beginning of the construction stage during civil works, which would increase the ability to access and suppress any fire onsite or on adjoining sites.

The bush fire hazard associated with the activities listed above is considered highly manageable. Risks would be minimised through the implementation of fire and bush fire mitigation measures outlined below.

Potential impacts from decommissioning activities would be similar to those for construction; and any bush fire risk associated with decommissioning of the project would be highly manageable.

Operation

The operation phase of the solar farm carries the following potential fire risks:

- Transmission Line failure or contact with vegetation within clearances
- Overheating in the battery banks
- Overheating in the substation
- Grass fire ignition from vehicles and maintenance machinery.

The solar farm buildings would be constructed of low combustibility or non-combustible materials suitable for buildings of class 5 to 8 and 10 of the Building Code of Australia (BCA), now the National

Construction Code (NCC). All electrical components would be designed and managed to minimise potential for ignition. The solar array, which would occupy the majority of the site, would likely be largely constructed of glass, silicon, steel and aluminium and would have very low flammability.

Ground cover beneath panels would be maintained and not permitted to accumulate to high fuel loads (access and solar input requirements are in line with this activity). Strategic grazing is one potential method for keeping fuel loads to a minimum around the solar farm infrastructure.

An APZ would be maintained around individual buildings and the entire Development Site including inverters, delivery station and solar substation. Internal access tracks are 5m wide allowing adequate access for emergency vehicles including fire trucks.

Bushfire and structural fire risks during operation of the solar farm are considered manageable subject to the control of grass fuels at the site, the appropriate maintenance of equipment, adoption of applicable best practice and technical standards and the implementation of safeguards provided below. Potential ignition sources not associated with the solar farm site would continue to present bushfire risks in the locality, including lightning, machinery, discarded cigarette butts from public road traffic, transmission lines and local stubble burn escapes.

In view of the likely fire hazards and risks, the Proposal is not considered likely to present a substantial bushfire ignition and structural fire threat, or to represent an unacceptable hazard in the event of a bushfire affecting the site.

Li-ion Batteries

The proposed Battery Storage (BS) would comprise up to 18 customised shipping containers, each housing multiple racks of approximately 85.88 MWh / 60.48 MW rated capacity battery units. The location and description of the BS unit is provided in Section 4.3.

All energy storage systems carry risks associated with the uncontrolled release of energy. While lithium-ion batteries offer significant advantages over competing commercialised storage technologies in terms of energy density, efficiency and charging times, these advantages also elevate the risk of fire. While a single Li-ion cell within a mobile phone poses a small fire hazard, a collection of many Li-ion cells in a container is a significant hazard, and the level of safety protection is correspondingly much higher. Consequently, the Li-ion based BS containers are designed with proper disconnects, relays, thermal management, enclosures, layout, monitoring and controls to mitigate the fire risk to the required level of safety.

Operating strategies spanning proper planning, risk assessment, storage methods, maintenance protocols, and response protocols are the other important factors in mitigating Li-ion fire risks (Butler 2013).

<u>Fire Risks</u>

Li-ion cells contain highly flammable electrolytes within a metal prismatic can or metalized pouch that have seals designed for 10 to 20-year service life. The ambient operating temperature range for Li-ion systems can span -10 to 50 degrees Celsius but the cells inside the containers are kept within a smaller range, 10 to 30 degrees Celsius, through the enclosure's thermal management system that is sized to keep the cells within the recommended operating temperature range under normal conditions. Excessive overcharging leads to heating within cells that can initiate 'thermal runaway' triggering new chemical reactions through breakdown of the electrolyte, additional heat generation and ultimately the venting of gases containing carbon monoxide, carbon dioxide and hydrogen.

Gas combustion occurs when the electrolyte vapours or combustible decomposition products come in contact with air and there is an ignition source, or the temperature reaches the autoignition point of 350-400°C (Recharge 2013). Monitoring of module temperature and voltage combined with a well-designed controls system prevents excessive overcharging and heating by taking the system offline before critical conditions are reached. Since thermal runaway in one (1) battery cell can initiate thermal runaway in adjacent cells it is important to design features that prevent propagation of fire among modules in the event that a fire is initiated.

There is potential for a fire event in the battery system which could initiate a bushfire in the surrounding grazed grasslands. Prevention measures to reduce the likelihood of a fire starting and effective mitigation measures to contain the fire reduces any risk.

Additionally, if the substation is oil-cooled, its bunding and drainage would be regularly inspected and cleaned to prevent oil seepage as per measures in Table 9-14.

<u>Fire Causes</u>

Battery overheating may be caused by a range of factors including electrical shorting, rapid discharge, overcharging, manufacturers defect, poor design, and mechanical damage (Butler 2013). Li-ion batteries do not produce any exhaust gases during normal operation, but they can produce flammable and toxic gases if there is a fault (Department of Commerce 2017). The main failure modes for these battery systems are either latent (manufacturing defects, operational heating, etc.) or abusive (mechanical, electrical, or thermal) (Blum and Long 2016).

A large majority of incidents involving Li-ion batteries have been due to failure to adhere to packing and transport requirements, use by non-professionals for innovative applications or use in non-controlled storage conditions (Recharge 2013).

Risk and Incident Management

Factors listed in Department of Commerce (2017) to avoid and mitigate battery fire impacts include:

- Building codes applicable to batteries (national and local), changes to floor loadings and National Construction Code requirements for battery installations
- Manufacturer's recommendations to protect the system from weather and extreme heat, light and temperature
- Adequate ventilation
- Containment of electrolyte spills
- Adequately fire-rated walls are used to avoid or delay the spread of fire
- Adequate access/egress for installation and maintenance
- Adequate mechanical protection.

Battery location and spatial design are also important safety factors.

Fire containment and suppression systems need to be employed to deal with a potential battery fire event, applying the Suppression through Cooling, Isolation, and Containment (SCIC) approach (Butler 2013). However, while most current systems have automated and manually triggered fire suppression systems, the technology is new and there is limited knowledge about the usefulness of the suppression systems in the event of fire (Blum and Long 2016).

Li-ion fires require specific training, planning, storage, and extinguishing interventions, catering for both progressive burn-off or explosive events (Butler 2013). The Proposal would manage the fire risks associated with the BS containers by:

- Spreading the BS over the site in smaller, discrete storage areas rather than in one large facility. Maintain an APZ around each BS unit.
- Locating the BS unit as far as practicable from any sensitive receivers (residences) or large stands of vegetation
- Installing reliable automated monitoring (voltage and temperature), alarm and shutdown response systems
- Installing reliable integrated fire detection and fire suppression systems (inert gas)
- Ensuring the BS unit are not vulnerable to external heat effects in the event of a bushfire

- Designing appropriate separation and isolation between individual battery containers and between batteries and other infrastructure, including gravel surfacing around the Proposal
- Compliance with all relevant guidelines and standards
- Preparation of a specific Battery Fire Response Plan, under the general Fire Response Plan, in consultation with fire authorities, fire suppression experts, RES' experienced storage team, and in reference to relevant standards and guidelines
- Facilitation (including funding) of first responder training in the management of Li-ion battery fires at the site for local brigades.

Though the specific battery manufacturer and model has not yet been determined, each battery module within the implemented solution would have its temperature and voltage monitored.

The fire suppression system within the BS unit would comprise the storage and release of inert gas within each battery container using either electrical detectors/ionisers, or a mechanical system in which the heat destroys a seal to release the gas.

There would be spare air-conditioning units in storage on site for replacement. In the event of failure of one of the units, the system would be able to maintain safe operating temperatures. If both air-conditioning units fail, the auto shutdown of the batteries would prevent overheating.

Standards and Guidelines

The installation of Li-ion batteries has been identified as in need of relevant standards and Standards Australia is developing a new standard (AS/NZS 5139) for smaller scale battery installations (Standards Australia 2017). The Clean Energy Council provides requirements for accredited installers, the Australian Energy Storage Council has produced a Guide for Energy Storage Systems and the WA Department of Commerce has released a guide for electrical contractors in relation to battery storage systems (Department of Commerce 2017).

Asset Protection Zone

Appendix 4 of the PBP guidelines provides minimum Asset Protection Zone (APZ) requirements for developments located in designated bush fire prone land. These APZ prescriptions would be applied to the solar farm infrastructure to provide defendable space and to manage heat intensities at the infrastructure interface.

In accordance with section 8.3.5 of PBP, an APZ of a minimum width of 10 metres would be provided around the solar farm buildings, substation and BS, and around the outside perimeter of the solar array. The 10-metre APZ setback requirement would also be applied to any woody vegetation plantings undertaken around the perimeter of the solar farm. All of the APZ would be managed as an Inner Protection Area.

The APZ surrounding the proposed BS unit and substation would include gravel surfacing to minimise the risk of fire escaping from the facilities and the risk of external fire affecting the facilities.

Fuel Hazard Management

According to the PBP guidelines, the APZ should provide a tree canopy cover of less than 15% located greater than 2 metres from any part of the roofline of a building, and should not overhang any building. Trees should have lower limbs removed up to a height of 2 metres above the ground. The understorey should be managed (mowed) to treat all shrubs and grasses on an annual basis in advance of the fire season.

There would be no trees or shrubs within the APZ established for the solar farm, or within the solar array area. Grassland Fuel Hazard is a function of grass height and cover, with variation according to curing and species fuel characteristics. Grass fuel would be monitored and managed using stock grazing or mowing to maintain safe fuel levels. Grass height within the APZ would be maintained at or below five centimetres throughout the October-March fire season. Grass height outside the APZ, including beneath the solar array, would be maintained at or below 10 centimetres outside the fire season.

The overhead TL at the site would be managed by maintaining appropriate vegetation clearances to minimise potential ignition risks, in accordance with the *ISSC 3 Guideline for Managing Vegetation Near Transmission Lines*.

Access

Safe and efficient access (suitable for firefighting appliances) would be established and maintained over the solar farm site. The APZ around the perimeter of the site would incorporate a 4-metre-wide gravel access track. The perimeter track would comply with the requirements for in-fill development in section 7.4a of the PBP guidelines, including:

- A minimum carriageway width of four metres
- Minimum vertical clearance of 4 metres
- Capacity for passing using reversing bays and/or passing bays every 200 metres suitable for fire tankers
- Property access roads are two-wheel drive, all-weather roads
- Property access must provide a suitable turning area in accordance with Appendix 3 (of PBP)

The turn radius and swept path clearance on access roads would be suitable for Category 1 Tankers (Medium Rigid Vehicle).

Fire-fighting Resources and Preparedness

A water storage tank would be installed adjoining the main internal access road for fire-fighting and other non-potable water uses, with a 65 mm Storz outlet, a metal valve and a minimum of 20,000 litres reserved for fire-fighting purposes. Rainwater tanks installed beside site buildings for staff amenities would also enable RFS connectivity of Storz outlets. Suitable fire extinguishers and PPE would be maintained at site buildings.

A Fire Response Plan would be developed prior to commissioning in consultation with the local NSW RFS District Fire Control Centre to manage fire risks, resources and preparedness. Following commissioning of the solar farm, the preparedness of local RFS and Fire and Rescue brigades would be enhanced through site orientation and information events and the facilitation of training in the management of Li-ion battery fires. An Emergency Response Plan, including an Evacuation Plan, Fire Response Plan (with a specific battery fire response section) Flood Response Plan and Spill and Contamination Response Plan would also be developed to enable rapid, safe and effective incident response.

9.8.3 Mitigation Measures

Potential hazard risks would be managed via the mitigation strategies in Table 9-58.

Table 9-51 Mitigation measures for the management of hazards at the site

Mitigation measures	Phase
The Fire Response Plan would be developed in consultation with the local RFS District Fire Control Centre, and include: • 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	Preconstruction Construction Operation Decommissioning

Mitigation measures	Phase
• Specific management of activities with a risk of fire ignition (hot works, vehicle use, smoking, use of flammable materials, blasting) • Appropriate risk control measures 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 system (either in its entirety or partially, as determined by risk assessment). • Incorporation of fire safety and response in staff and contractor induction, training, OHS procedures and work method statements • Dedicated staff training on the use and maintenance of fire-fighting equipment and resources • Designation of a staff safety officer tasked with ensuring implementation of the plan and regular liaison with firefighting agencies • Document all firefighting resources maintained at the site with an inspection and maintenance schedule • Monitoring and management of vegetation fuel loads • Identification of Asset Protection Zones (APZs) and key access routes • A communications strategy incorporating use of mobile phones, radio use (type, channels and call-signs), Fire Danger Warning signs located at the entrance to the site compounds, emergency services agency contacts • Activation triggers for the Emergency Response Plan and Fire Response Plan.	
Fire risks associated with the BS (if installed) would be managed by: • Locating the BS unit as far as practicable from any sensitive receivers (residences) or large stands of vegetation • Installing reliable automated monitoring (voltage and temperature), alarm and shutdown response systems • Installing reliable integrated fire detection and fire suppression systems (inert gas) as required by relevant standards • Ensuring the battery buildings/containers are not vulnerable to external heat effects in the event of a bushfire • Designing appropriate separation and isolation between individual battery containers and between batteries and other infrastructure • Compliance with all relevant guidelines and standards • Preparation of a specific Battery Fire Response Plan under the general Fire Response Plan, in consultation with fire authorities, fire suppression experts, RES' experienced storage team, and with reference to relevant standards and guidelines • Facilitation of first responder training in the management of Li-ion battery fires at the site for local brigades.	Preconstruction Construction Operation Decommissioning

Mitigation measures	Phase
In developing the Fire Response Plan, NSW RFS would be consulted on the location of water supplies (20,000 litre tank), fire-fighting equipment maintained on-site, fire truck connectivity requirements, proposed APZ and access arrangements, communications, vegetation fuel levels and hazard reduction measures.	Preconstruction
Two (2) copies of the FRP will be stored in a prominent 'Emergency Information Cabinet' which is located in a position directly adjacent to the site's main entry point/s.	Construction Operation
An APZ of minimum 10 metres would be maintained between remnant or planted woody vegetation and solar farm infrastructure. The APZ around the perimeter of the site would incorporate a 4-metre-wide gravel access track.	Construction Operation
Average grass height within the APZ would be maintained at or below 5 cm throughout the October-March fire season. Average grass height outside the APZ, including beneath the solar array, would be maintained at or below 15 cm throughout the fire season.	Construction Operation
The overhead Transmission Line at the site would be managed by maintaining appropriate vegetation clearance limits to minimise potential ignition risks, in accordance with the ISSC 3 Guideline for Managing Vegetation Near Transmission Lines.	Operation
Landscaping around buildings at the site would comply with Appendix 4 Asset Protection Zone Requirements in the PBP guidelines.	Construction Operation
Appropriate fire-fighting equipment would be held on site to respond to any fires that may occur at the site during construction. This equipment will include fire extinguishers, a 1,000-litre water cart retained on site on a precautionary basis, particularly during any hot works operations. Equipment lists would be detailed in Work Method Statements.	Construction
Once constructed and prior to operation, the solar farm operator will contact the relevant local emergency management committee (LEMC). The LEMC is a committee established by virtue of 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 particular Local Government Area. The contact details of members of the LEMC can be obtained from the relevant local council.	
The NSW RFS, Fire and Rescue NSW and local emergency management committee (LEMC) would be provided with a contact point for the solar farm, during construction and operation.	Construction Operation
Following commissioning of the solar farm, the local RFS and Fire and Rescue brigades would be invited to an information and orientation day covering access, infrastructure, firefighting resources on-site, fire control strategies and risks/hazards at the site.	Operation

Mitigation measures	Phase
The perimeter access track would comply with the requirements for in-fill development property access roads in the PBP guidelines. All access and egress tracks on the site would be maintained and kept free of parked vehicles to enable rapid response for firefighting crews and to avoid entrapment of staff in the case of bush fire emergencies. Access tracks would be constructed as through roads as far as possible. Dead end tracks would be signposted and include provision for turning fire trucks.	Construction Operation Decommissioning
A Hot Works Permit system would be applied to ensure that adequate safety measures are in place. A risk assessment would be undertaken to determine the appropriate firefighting equipment required for the specific task. Where possible hot works would be carried out in specific safe areas (such as the Construction Compound temporary workshop areas).	Construction Operation Decommissioning

9.9 HISTORIC HERITAGE

9.9.1 Existing Environment

Historic Land Use

When part of the Talbragar River was surveyed by Mortimer William Lewis in 1832 the only farms on the river were Robert Martin's 'Cobbora', James Willard Lowe's 'Bolaro', William Bowman's 'Merotherie' and upstream, Richard Fitzgerald's 'Tongay' (Cameron 1993, p.247).

The present site of Dunedoo was on the 'Bolaro' Run held in the 1840's by brothers Robert Lowe Jnr and William Willard Lowe. As with most runs, its area was 16,000 acres (i.e. 25 square miles).

As the number of settlers increased, the settlement at Dunedoo, then called 'Redbank', grew. In 1867 local representations were made to the State Government for an official township at Dunedoo. Surveyor William Jacomb Conder completed the survey for the town of Dunedoo in October 1868, siting it closer to the river than the present.

The first allotments in the town plan were put up for auction at Dubbo on 30th May 1870. No bids were received. A second sale of the town lands was held at Cobbora on 30th March 1875 and 10 lots were sold ranging in price from 4-5 pounds. However, the town made little progress until it was officially announced that the railway would pass through Dunedoo, which was completed in 1910.

To avoid the railway line running through the middle of the settlement the town area was redesigned and moved further away from the river in 1908. Several owners of lots in the path of the railway had to surrender this land. The first sale of new blocks was held at Cobbora on 4th August 1909 (Cameron 1993, p.258).

The northern area surrounding the Talbragar River at Dunedoo (including the Subject land) consists of low-lying alluvial paddocks which have been subject to historical flooding, with historic floods recorded in both 1920 and 1955.

The Subject land has been cleared and utilised for grazing since European settlement in the mid 1800's. It has therefore been subject to impacts from farming for many decades. Overall, the area would be categorised as disturbed through consistent farming practices over many decades through ploughing and tree clearing.

Database Searches

The following databases were searched on 9 March 2020 for heritage items which may be impacted by the Proposal:

- Warrumbungle LEP 2013 Schedule 5 Environmental Heritage
- State Heritage Inventory (SHI)
- Australian Heritage Database.

The results of the NSW SHI database search indicated that there is three (3) previously recorded Aboriginal Places listed under the *National Parks and Wildlife Act* within the Warrumbungle LGA. None of these recorded Aboriginal Places are within Dunedoo or in close proximity to the Subject land. Refer to Section 8.2 for details regarding Aboriginal heritage.

The results of the NSW SHI database search indicated that one (1) previously recorded heritage site, the Dunedoo Railway Station and yard group, is listed under the *NSW Heritage Act* within Dunedoo in the Warrumbungle Shire LGA. This site is not located within the Subject land and will not be impacted by the Dunedoo Solar Farm.

The results of the NSW SHI database search indicated that four (4) previously recorded heritage sites are listed by the Local and State Agencies within Dunedoo in Warrumbungle Shire LGA however none are located within or in close proximity to the Subject land.

The results of the Australian Heritage Database search indicated that two (2) sites are located within Dunedoo in the Warrumbungle Shire LGA which include the Dunedoo Railway Station and Yard Group and an Indigenous Place in Dunedoo. No other information is provided about the Indigenous Place in Dunedoo so its location to the Subject land is unable to be ascertained.

No other known previously recorded heritage sites are located within or adjacent to the Subject land.

9.9.2 Potential Impacts

In view of the distance of the Development Site from the listed heritage items identified in the database searches, and the results of the field inspection, there is considered to be a low risk of direct or indirect impacts to heritage items. Contingency measures would be applied if items suspected of having heritage value are uncovered during the works.

9.9.3 Mitigation Measures

Measures to avoid and minimise impacts to historic heritage items which may be present at the Development Site are provided in Table 9-52.

Table 9-52 Mitigation measures for historic heritage values

Mitigation measures	Phase
If an item of potential historic heritage is uncovered during the works, works in the immediate vicinity would cease and the Heritage Division (OEH) would be contacted for advice.	Construction

9.10 AIR QUALITY AND CLIMATE

The impacts of poor air quality can adversely affect plant growth, degrade ecosystems, represent human health risks, and contribute to GHG emissions and anthropogenic climate change.

Air quality impacts would arise during the ground-preparation activities, construction activities and to a lesser degree, throughout the lifetime operation of the proposed solar farm. The duration, frequency and severity of these impacts and their significance would vary in accordance with the phases of the proposed development. In Australia's rural agricultural landscape dust and dirt are a major influence on air quality.

This section describes the existing air quality conditions in the Proposal's locality and the potential impacts that may occur as a result of the construction and operation of the proposed solar farm. This section also identifies the measures that would be implemented in order to mitigate these impacts.

9.10.1 Existing Environment

Air Quality

Air quality for the locality is generally expected to be good and typical of that found in rural settings in NSW. Existing sources of air pollution include vehicle emissions (particularly along major roads such as the Castlereagh Highway during high-use periods), dust from agricultural activities during dry periods and smoke from seasonal stubble burning. During colder months, there would be a minimal increase in air contaminants due to smoke from the operation of solid fuel heating.

Settlement within proximity of the site is considered sparse (refer to Section 9.5). The closest non-involved receiver is approximately 1.7 km to the west of the Development Site. Several other residences are located to the west and northwest within 5 km of the Development Site. Topography of the Development Site is relatively flat. No heavy industries are found within a 15-km radius of the site, as a result, no point sources of emissions from industries are located within the project's air shed. The closest non-point source are the vehicles travelling along All Weather Road, Castlereagh Highway and Digilah Road.

A search of the National Pollutant Inventory (NPI) indicated no facility air pollution sources for the Warrumbungle LGA (NPI 2017).

Climate

The Proposal is located within the South Western Slopes Bioregion. The South Western Slopes is dominated by a sub-humid climate with hot summers and no dry season (NSW National Parks and Wildlife Service, 2003). The closest Bureau of Meteorology Automatic Weather Station (AWS) to the site is Dunedoo Post Office, approximately 2 km south of the Development Site. The average annual minimum temperature is 9.7˚C and the maximum annual average temperature is 24.1 ˚C. The average annual rainfall is 609.4 mm, with most rain falling in December, January, and February (BOM, 2020).

Winds speeds are greatest during spring and summer. During these warmer months the strong winds (>40 km per hour) come from the east. In the coolers months winds >20 km per hour originate from the east and west. The highest periods of air quality are during spring and summer where drier periods of high temperatures are associated with strong winds.

Sensitive Receivers

In accordance with good international practice, the assessment of sensitive receptors should consider up to 500 metres from the site boundary for both human and ecological receptors (Holman et al, 2014), due to the typical distance of dust dispersion. The assessment of other pollutants (e.g.

gaseous exhaust fumes) would require a smaller area of assessment (~200 metres) as suggested by Bignal, K. et al, 2004, before emissions are indistinguishable from background concentrations. Refer to Figure 9-16 for the locations of sensitive receivers.

Table 9-53 Air quality sensitive receivers

Receiver	Justification
Up to seven uninvolved residences are located within 2 km of the proposed solar farm (including the TL). Specifically, one residence is located within 400 metres. The next closest non-involved receiver to the solar farm site is 680 metres north.	Construction and operational vehicles would use the available roads from Dubbo, Mudgee and other supply centres, which go through several residential areas as there are no bypass roads. This would likely lead to increased localised air pollution and dust from unsealed roads. Human exposure to air pollutants can lead to health effects, principally in the respiratory system.
One residential dwelling is located within the Development Site, within Lot 137 DP754309. The dwelling is the homestead of the landowner selling the land to the Proponent.	
Proposal construction and operation workers and staff.	Workers would experience emissions from heavy machinery and generators, and increased dust conditions. Human exposure to air pollutants can lead to health effects, principally in the respiratory system.
Air Quality (Gaseous and Particulate)	The proposed location is within a non-degraded air shed as no significant polluting sources are found in the Proposal's locality.

Criteria

The POEO Act requires that no vehicle shall have continuous smoky emissions for more than ten seconds. Limits on dust emission of less than 4 mg/m/m^2 are also specified.

Climate Change

Climate change refers to the warming temperatures and altered climatic conditions associated with the increased concentration of GHG in the atmosphere. Climate change projections for Australia includes more frequent and hotter hot days and fewer frost days, rainfall declines in southern Australia and more extreme weather events including intense rainfall, severe drought and harsher fires (CSIRO, 2015). 2019 was the warmest year on record in Australia and all of Australia's warmest years have occurred since 2013 (BOM 2020). At the global level, temperature averaged over the last five years (2015, 2016, 2017, 2018, 2019) has been confirmed as the highest ever on record for any five-year period. The annual mean air temperature in Australia is projected to increase by 2.6-4.8°C by 2090 (above the 1986-2005 period) (CSIRO 2015).

Up to and including 2020, seasonal weather patterns have continued to break trends and records. Australia's climate in 2019 was found to be the nation's driest and warmest on record, where both mean annual maximum and minimum temperatures above average for all states and territories.

Temperatures have been increasing since about 1950, with the largest increase in temperature experienced in recent decades (OEH 2014). The projected climate change impacts for the far west region of NSW are summarised in Figure 9-22 below.

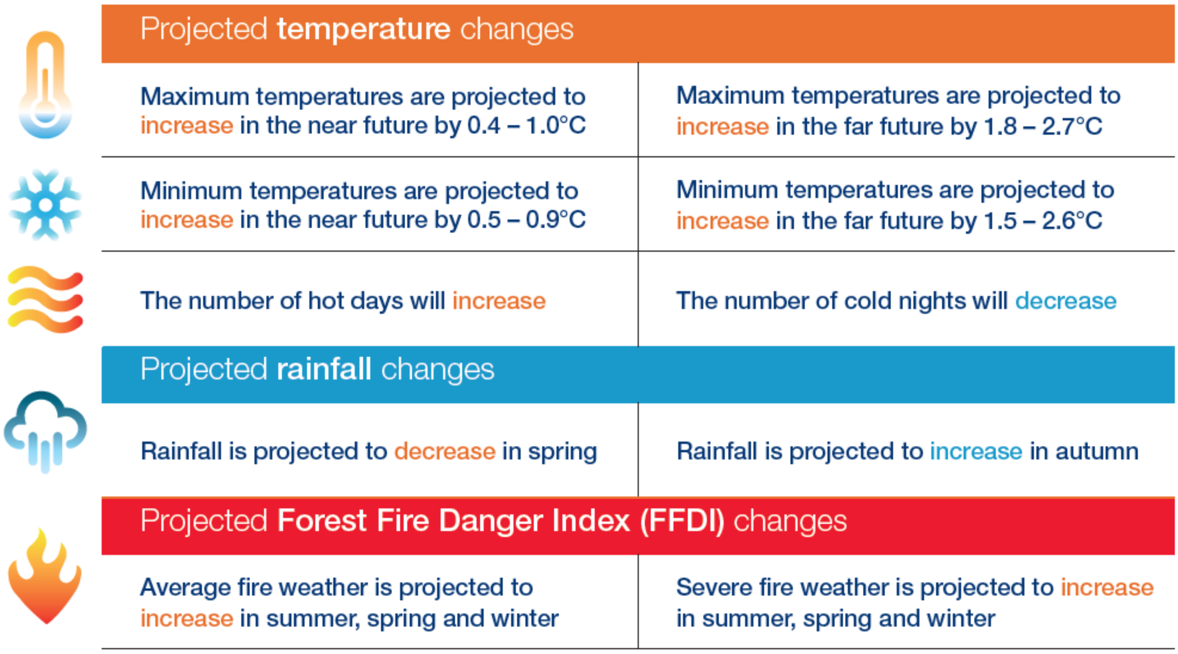

Figure 9-22 Projected climate change impacts for the central west region of NSW (OEH 2014)

Rural and regional communities are disproportionately affected by the impacts of climate change, through worsening extreme weather events and impacts to capacity, productivity and resilience in some rural industries (Climate Council 2016). The NSW government provided a $1Billion Emergency Drought Relief Package to drought-stricken farmers in the year 2018. A significant proportion of Australian exports are agricultural products that are sensitive to global warming impacts (AGO 2003). Some incremental adaptations in agricultural enterprises would be straightforward, but the more transformational adaptive changes may be risky and expensive, especially for individual farmers (Climate Council 2016).

It is now generally accepted that the release of certain gases including, most notably carbon dioxide, contribute to global climate change. These gases are collectively referred to as ‘greenhouse gasses. Construction and maintenance activities where plant and equipment use diesel, gasoline and other hydrocarbons, result in greenhouse gas emissions and are likely to contribute to climate change. The construction, operation and decommission of the proposed solar farm assessed in this EIS would produce minimal CO_2 emissions. This is compared to conventional coal and gas fired powered stations outlined in Table 9-54.

Table 9-54 Comparison of CO_2 equivalent emissions produced per kilowatt hour

Generation method	Emissions produced (grams CO2 equivalent per kWh)	Source
Solar farm	19-59	Wright and Hearps (2010)
Coal-fired power station	800-1000	Wright and Hearps (2010)
Combined cycle gas turbine	400	Alsema *et al*. (2006)

The operation of the Proposal would help reduce greenhouse gas emissions and move towards cleaner electricity generation. Based on 144,540 MWh, the Proposal would offset the equivalent of 47 kilotonnes per annum of CO_2 emissions for Brown Coal, 101 kilotonnes per annum of CO_2 emissions for Black Coal and power the equivalent of 24,415 NSW homes (emission calculation based on 2013 NTNDP emission intensity values averaged across the power stations).

9.10.2 Potential Impacts

Construction and Decommissioning

The assessment of the construction impacts on air quality has been undertaken qualitatively considering the likely construction equipment, processes and materials expected for the Proposal.

The principle sources of dust and emissions at the Proposal during construction would be:

- Excavation and earthwork, such as ground-breaking, levelling (cutting and filling), preparation of pipe trenches, etc.
- Vehicle movement over unpaved surfaces
- Movement of vehicles to and from the site (e.g. for deliveries)
- Dust from uncovered stockpiled powdery materials or truckloads
- Emissions (e.g. NO_x, SO_x and CO) and particulates from vehicles, diesel generators, heavy plant and other mechanical equipment; and
- Stored VOCs and other volatile hazardous materials.

During construction, the ambient air quality at the Proposal may potentially be affected by increased dust, particularly during the earthworks phase and by gaseous exhaust fumes from construction activities, equipment and additional vehicle movements to and from the site.

Vehicle Emissions

The Development Site is located within a rural zone with sparsely distributed residences usually located some distance from roads. The construction phase is expected to last 10 – 12 months with a peak period lasting approximately 3 months. During this time, emissions would be generated from earth-moving equipment, diesel generators, trucks, cranes, pile driving equipment and hand-held equipment.

Vehicles accessing the site would include the labour force (approximately 100 construction personnel during the peak period), carpooling of 2-3 skilled workers and haulage traffic delivering construction components (detailed further in Section 9.5). The major haulage routes to the Proposal are Castlereagh Highway and Golden Highway. The access to the site would be from All Weather road, an unsealed Council managed roadway.

Digilah Road (also an unsealed Council managed roadway), connects to All Weather Road from the east, this road would only be used by light construction vehicles and not HGV.

Construction vehicle emissions would impact local air quality, local residents, crops, pastures, surface water bodies and road users along these roads. Site workers would also be impacted by localised vehicle emissions at the Development Site.

Air quality impacts relating to the use of the above are generally small. Equally, the equipment used on site should be well maintained, as such the significance of impacts is assessed to be minor.

Where there are multiple vehicles or equipment in use, the potential for cumulative impacts from the combination of these emissions would however increase to moderate negative impacts.

Dust Due to Site Preparation and Road Upgrades

During construction, dust is likely to be generated from the following:

- Excavation activities
- Intersection upgrades, road widening, and other earthworks
- Movement of trucks and vehicles along All Weather Road and Digilah Road (both unsealed roads) and the onsite access tracks which would be unsealed in the construction phase.

Earthworks associated with construction would be relatively minor and mostly involve levelling the ground to upgrade/widen existing roads, construct the access road and laydown areas, and trenching work for cable installation. Posts for the module frames would either be pile driven or screwed which would generate little dust. The impact area for the piles would be less than 1% of the site area.

One (1) 66-kV overhead TL would be constructed to connect the solar farm to the existing Dunedoo substation located approximately 2.1 km from the Development Site. As such, a temporary access track would be established along the TL alignment to facilitate access for equipment, plant and construction vehicles.

Traffic using the unsealed roads and tracks during the decommissioning phase would also have the potential to generate dust impacts.

Factors such as the meteorology and particle mass would influence the dispersion of dust, and the significance of dust impacts from construction works would be largely based on the direction of the wind and the proximity of sensitive receivers.

Dust resulting from construction activities typically comprises large diameter particles, which settle rapidly and close to the generation source, e.g. within 500 metres under low/calm conditions. Studies by the US EPA (1995) show that particles larger than 100 μm would likely settle out within 6 to 9 metres from the point of emission at wind speeds of 16 km/h. The closest sensitive receiver is within 400 metres of the site, whilst the remaining receivers are well 700 metres. Consequently, far field dust impacts from construction works are not considered significant

The prevailing wind direction in the Proposal's area may vary between seasons and could therefore disperse dust in almost any direction. Existing vegetation screening at several of the sensitive receivers and the riparian habitat along the Talbragar River act as a barrier between the work areas and receivers, trapping dust and reducing potential for dust to affect the receivers. As such, substantive air quality impacts are not anticipated.

The southern-most portion of the TL construction works would be close to Dunedoo Town receivers, but this stage of works would be much shorter in duration and works would be carried out progressively such that there would not be any sustained close proximity works. These works also involve mainly piling equipment as such minimal earthmoving is required.

Dust risks would be mitigated by wetting roads, tracks and worked surfaces as required. Specifically, work carried out during long periods of dry weather and high winds have a greater potential to generate dust which can impact air quality. As such, construction work during summer months may require greater dust suppression measures to manage any increased impacts.

Dust due to Movement of Trucks and Material Transportation

Except for vehicle movements on unpaved surfaces, dust due to the movement of trucks and material transportation should only occur where mitigation measures are not effectively implemented at the site or in the access road being used by the construction vehicles.

Uncontained and/or un-sheeted trucks may be subject to losses of material where the containment is not effective (i.e. spills), or where wind or other air turbulence may disturb the contents and result in dispersion of material. Such impacts have the potential to degrade local air quality in the immediate area of such movements if particles become suspended.

Greenhouse gas emissions would be generated during construction. These emissions would contribute to climate change at a global level but are offset many times over by the benefits of carbon reduction delivered from the electricity produced by the Proposal over its operational life. Construction related emissions would not impact materially on the local climate.

Mitigation strategies also include a formal community consultation and engagement system, and complaints mechanisms, whereby the sources of complaints are promptly identified and addressed, and appropriate application of a suite of dust and emission reduction measures. Subject to mitigation measures, any dust or other air quality impacts are likely to be minor, temporary and highly localised.

No air quality impacts in addition to those mentioned for construction are anticipated during the decommissioning phase. Impacts during decommissioning would be less in extent and traffic requirements would be similar in type but of shorter duration than that required for the construction phase.

Due to the existing surrounding agricultural activities and the minimal impacts on air quality during construction and decommissioning, the cumulative impact is expected to be not significant.

Operation

Unlike fossil fuel power generation, solar farms are by nature zero emission facilities since they use renewable and clean sources to generate power.

Emissions of pollutants including sulfur dioxide, nitrogen oxides, carbon monoxide and carbon dioxide are indirectly related to the operational and maintenance process of the solar farm and would result in some localised, intermittent negative impacts to air quality. Some generation of dust from vehicles travelling on the unsealed access roads and tracks would also be expected. Two to three vehicles are expected to be required at the site during normal operation. During major maintenance operations, this number could increase to 10 vehicles at any one time for a limited period. Limited amounts of fuel would also be required for temporary power generation in the event of an unplanned outage. As such impacts on local and regional air quality are expected to be negligible during the lifetime operation of the solar farm.

A groundcover management plan would be implemented to reduce dust production from disturbed areas and planting of the site would provide screening to sensitive receivers located along the northern boundary of the Development Site (Section 8.3).

Negative impacts to air quality during operation are likely to be negligible. Additionally, the Proposal would have a positive impact on global climate change by assisting to reduce Australia’s reliance on fossil fuels for electricity generation and reducing the amount of GHG emissions (discussed in Section 2.1.1).

The Proposal would also reduce local exhaust emissions from farm machinery, as a result of the change in land use.

Due to the existing activities surrounding the site and the minimal impacts on air quality during operation, the cumulative impact is expected to be not significant. Cumulative impacts are discussed further in Section 9.12.

Climate and Climate Change

The Proposal would not affect local weather or climate patterns. The Proposal would provide a new less polluting form of electricity generation, as it represents a transition to renewable energy sources. The Proposal would be a part of the positive contribution to reducing greenhouse gas emissions and help mitigate the negative effects of climate change. On an annual basis, the Proposal would provide enough clean, renewable energy for about 24,415 average NSW homes. At the same time, it would displace approximately 47,000 metric tonnes of carbon dioxide – the equivalent of taking about 12,490 cars off the road.

9.10.3 Mitigation Measures

Mitigation measures for air quality and climate impacts are identified in Table 9-55.

Table 9-55 Mitigation measures for air quality and climate impacts

Mitigation measures	Phase
The Community Consultation Plan will be implemented to promote information sharing for air quality and include a complaints process: • Notification of relevant stakeholders defined • An accessible complaints process with a timely response protocol.	Preconstruction Construction Decommissioning
Dust control measures, including on site access roads, will be specified in the CEMP and DEMP and may include water applications or other means as required.	Construction Decommissioning
Idling for more than 5 minutes is prohibited. Lorries and trucks engines would be turned off.	Construction Decommissioning
Vehicle loads of material which may create dust or litter would be covered while using the public road system.	Construction Decommissioning
All vehicles and machinery used at the site would be in good condition, fitted with appropriate emission controls and comply with the requirements of the POEO Act, relevant Australian standards and manufacturer's operating recommendations. Plant would be operated efficiently and turned off when not in use.	Construction Decommissioning
Fires and material burning is prohibited in the Development Site.	Construction Decommissioning

9.11 WASTE

Waste is an undesired by-product of all industrial development and is generated at both the construction and operation stages of a project. If not properly managed and contained, direct environmental impacts to the soil, surface water and groundwater may occur. Equally, secondary impacts to sensitive receivers is likely. The development and implementation of a waste management plan ensures that any discarded non-hazardous wastes can be recovered and re-used directly or recycled. Hazardous materials would be appropriately handled in order to prevent direct and indirect contamination events.

This chapter provides an assessment of the environmental impacts of waste generation from construction and operational activities at the proposed solar farm. Activity specific mitigation measures are recommended to address the identified potential impacts.

9.11.1 Existing Environment

The National Waste Policy: Less Waste, More Resources (DEE 2018) sets out the objectives, principles, outcomes and strategies for waste management. The policy aims to:

- Avoid the generation of waste, reduce the amount of waste (including hazardous waste) for disposal, manage waste as a resource and ensure that waste treatment, disposal, recovery and re-use is undertaken in a safe, scientific and environmentally sound manner, and
- Contribute to the reduction in greenhouse gas emissions, energy conservation and production, water efficiency and the productivity of the land.

In NSW, waste management and pollution are regulated under the *Protection of the Environment Operations Act 1997* (POEO Act) and the *Protection of the Environment Operations (Waste) Regulation 2005.* Unlawful transportation and deposition of waste is an offence under section 134 of the Act. Littering is an offence under section 145 of the Act.

The NSW *Waste Avoidance and Resource Recovery Act 2001* contains waste minimisation and management objectives, including:

- Encourage the most efficient use of resources and to reduce environmental harm in accordance with the principles of ecologically sustainable development
- 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.

The NSW Waste Avoidance and Resource Recovery Strategy (EPA 2014), the 'WARR Strategy', provides a framework for achieving these statutory objectives, focusing on the following key result areas:

- Avoid and reduce waste generation
- Increase recycling
- Divert more waste from landfill
- Manage problem wastes better
- Reduce litter
- Reduce illegal dumping.

Adopting the above principles would encourage the most efficient use of resources and reduce costs and environmental harm in accordance with the principles of ecologically sustainable development.

The Central West Regional Organisation of Councils (CENTROC) and Orana Regional Organisation of Councils (OROC) have collaborated to prepare the NetWaste Strategic Waste Plan 2017-2021, which was developed in line with EPA guidelines and aims to achieve a coordinated approach to waste management based on the WARR Strategy key result areas. Warrumbungle Shire Council is a member of the regional voluntary Netwaste Group.

The Warrumbungle Shire Council has a recycling centre at the Materials Handling Centre at Coonabarabran, 4202 Baradine Road. The Dunedoo Waste Transfer Station is located on 128 Avonside Road.

In order to facilitate the logistics of waste disposal for remote areas of the NetWaste region, specific contracts have been set up with member councils to provide access services that overcome the economic and geographic constraints for these remote areas. The following regional contracts are currently in place (source: www.netwaste.org.au/projects/existing-regional-contracts):

Table 9-56 Potential waste streams and associated recycling services

Waste Stream	Recycling Service
Processing of Garden Organics and Wood and Timber Contract	17 member NetWaste Councils participate in this regional contract which serves to chip garden organic material and produce a mulch product for Councils. The existing contract is with Ausshredding Pty Ltd and is a 2-year initial contract with possible extension options available. Since 2006, 667,825 m^3 of garden organic and wood timber material has been chipped and diverted from landfill.
Dubbo – Narromine Joint Recycling Contract	Dubbo City and Narromine Shire Councils commenced a joint recycling contract with JR Richards and Sons in 2010 for a 10-year term. The product is collected and delivered to a large Transfer Station in Dubbo, where it is transported to Sydney facility for sorting and recycling. Since the contract commenced, 17,905 tonnes of material has been recycled.
Collection of Scrap Metal	Scrap metal is a prominent waste type received by Councils to their landfills and waste transfer stations, which has significant reuse and recycling opportunities. 22 of the NetWaste Councils are part of a regional contract which sees a regular collection service for this material while receiving a price for the commodity. This was the first regional contract established by the group back in 2004. Since its commencement, 127,659 tonnes of scrap metal have been collected.
Collection of Used Motor Oil	Following the installation of used oil collection units at a number of landfills and waste facilities across the region, NetWaste worked to establish a regional contract for the collection and recycling of this material. The current service contract is held by Cleanaway Pty Ltd. Since 2009 when the first contract was established, over 1,181 KL has been collected and recycled.

9.11.2 Resource Use and Payback

Estimated Resource Use

Key resources and estimated quantities (pending the completion of the detailed Proposal design) required to construct the proposed solar farm are listed in Table 9-33.

Table 9-57 Resource requirements for the Proposal

Resource	Quantity
Gravel (access tracks)	5,000 m^3
Sand (bedding for cables)	900 m^3
Concrete	350 m^3
Water during construction	41,760 KL

The majority of the required resources would be used during the construction of the proposed solar farm. During operation and decommissioning, resource requirements would relate to maintenance activities including the use of machinery, vehicles and water resources. Water resources would be required throughout construction, operation and decommissioning. Water use is considered in Section 9.3 of this EIS.

Life Cycle Analysis

Life cycle analysis (LCA) assesses and quantifies the energy and material flows associated with a given process to identify the resource impacts of that process and potential for resource recovery. LCA estimates of energy and emissions based on the total life cycle of materials used for a project, i.e. the total amount of energy consumed in procuring, processing, working up, transporting and disposing of the respective materials (Schleisner, 2000).

A life cycle inventory of polycrystalline PV panels has been undertaken by the International Energy Agency Photovoltaic Power System Program. In their report, Life Cycle Inventories and Life Cycle Assessments of Photovoltaic Systems (IEA-PVPS-T12-04:2015) the ‘energy payback time’ for thin film modules has been estimated at less than 1 year for a solar installation in Southern Europe. This is consistent with the estimation that the Proposal would have an energy payback period of approximately 1.5 years. Over the panel’s 30-year lifetime, they are expected to produce less than 18 grams of GHG per kWh generated, almost 50% lower than for Csi (Fthenakis *et al.,* 2015).

The production of the frames and other system components including cabling would also produce emissions and waste but less than the production of modules. The carbon footprint of PV systems - assuming a location in southern Europe - ranges from 16 to 32 grams CO_2 eq. per kWh compared to between 300 and 1,000 g CO_2 eq. per kWh when produced from fossil fuels (Solar Power Europe 2017b). In terms of the water footprint, PV consumes 0.1 l/kWh(VI), mainly during manufacturing and recycling, compared to 0.75 to 75 l/kWh for typical fossil fuel electricity production in a southern Europe location (Solar Power Europe 2017c).

As such, solar farms are favourable in a number of aspects when compared to the major electricity generating methods employed in Australia:

- CO_2 emissions generated per kilowatt hour of energy produced.
- short energy payback time in comparison to the life span of the Proposal.

- potential to reuse and recycle component parts such as metals and glass from frames and panels.

9.11.3 Potential Impacts

Construction

Waste

The management of waste during the construction phase would observe the objectives of the *Waste Avoidance and Resource Recovery Act 2001* and the relevant key result areas of the WARR Strategy and the Net Waste Strategic Waste Plan.

Solid waste is one of the major pollutants caused by construction. A number of different construction activities associated with the Proposal would produce solid wastes, including:

- Packaging materials
- Excess building materials
- Scrap metal and cabling materials
- Plastic and masonry products, including concrete wash
- Excavation of topsoils and vegetation clearing
- Bio wastes, from on-site septic and greywater systems.

In accordance with the definitions in 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). Ancillary facilities in the site compound would also produce sanitary wastes classified as *general solid waste* (putrescibles) in accordance with the POEO Act. Waste produced during construction would be disposed of at an appropriately licensed waste facility. Green waste from tree clearing would be mulched for use in rehabilitation at the site or removed from the site.

The impact from waste generation, on regional waste facilities is assessed to be moderate without the implementation of any recycling or re-use measures. However, with the implementation of a Waste Management Plan, identification of recycling waste facilities in the LGA and Orana region and consulting with the NetWaste Strategic Waste Plan, the impacts from construction waste disposal on regional landfills, the biological environment and social environment is assessed to be minor.

Operation

During operation, the solid waste streams would be associated with maintenance activities and presence of employees. Some materials, such as fuels and lubricants, and metals may require replacement over the operational life of the solar farm. These materials would be reused or recycled wherever possible. Given the minimal amount of moving parts and limited wear tear of equipment, the operational waste streams generated by the solar farm would be very low and impacts to regional waste disposal facilities would be minor.

Li-ion Batteries

The average life of the Li-ion PV solar batteries is assumed to be 10 years (Randell Environmental Consulting 2016) and the batteries may require replacement 1-2 times during the life of the solar farm.

Li-ion batteries are classified as hazardous waste under the Commonwealth *Hazardous Waste Act 1989*, and Dangerous Goods under the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code). The code has a special provisions and packaging instructions for Li-ion batteries transported for disposal or recycling.

Presently, there are few facilities to recycle Li-ion batteries in Australia. Li-ion batteries that are recovered are typically collected with other e-wastes (Randell Environmental Consulting 2016). The Australian Battery Recycling Initiative (ABRI) website indicates four companies which provide a collection and recycling service for used Li-ion batteries.

Any spent batteries that would be exported would require an export permit under section 40 of the *Hazardous Waste Act*. The Proponent would coordinate this activity and the associated commercial arrangements with the selected battery supplier.

Given the rapid rise of Li-ion battery use in Australia, including in renewable energy projects and electric cars, cost-effective local recycling may be available at the time of battery replacement or decommissioning. AEMO (2015) predict strong growth in the consumption of Li-ion batteries for both electric vehicles and PV solar over the next 20 years. This growth would begin to significantly affect the waste stream from 2025 (Randell Environmental Consulting 2016).

Decommissioning

As during the construction phase, waste during decommissioning would be handled in line with the objectives of the relevant legislation, policies and strategies. Decommissioning of the solar farm would involve the recycling or reuse of materials including:

- Solar panels and mounting system
- Metals from posts, cabling, fencing
- Buildings and equipment such as the inverters, transformers and similar components.

Buildings and major electrical equipment would be removed for resale or reuse, or for recycling as scrap. The Li-ion PV solar batteries would be disposed in accordance with the hazardous waste policies active at the time of decommissioning.

Items that cannot be recycled or reused, would be disposed of at appropriate facilities in accordance with applicable regulations. All above ground infrastructure would be removed from the site during decommissioning.

The majority of the Proposal components are recyclable and mitigation measures are in place to maximise reuse and recycling in accordance with resource management hierarchy principles.

9.9.3 Mitigation Measures

Mitigation measures to avoid and minimise waste impacts are identified in Table 9-58.

Table 9-58 Mitigation measures for waste impacts

Mitigation measures	Phase
A Waste Management Plan (WMP) would be developed to minimise waste, including: • Identification of opportunities to avoid, reuse and recycle, in accordance with the waste hierarchy • Quantification and classification of all waste streams • Provision for recycling management on-site • Provision of toilet facilities for on-site workers and identify that sullage would be disposed of (i.e. pump out to local sewage treatment plant) • Tracking of all waste leaving the site • Disposal of waste at facilities permitted to accept the waste	Construction Operation Decommissioning

Mitigation measures	Phase
• Requirements for hauling waste (such as covered loads).	
A septic system would be installed and operated according to the Warrumbungle Shire Council regulations.	Construction Operation

9.12 CUMULATIVE IMPACTS

9.9.4 Existing Environment

Cumulative impacts relate to the combined effect of similar or different impacts on a particular value or receiver, and may occur concurrently or sequentially. For these purposes, cumulative impacts are associated with other known or foreseeable developments occurring in proximity to the Proposal. The preceding assessment sections take into account the potential for the Proposal to interact with existing conditions in the Development Site.

The DPIE Major Project Register, Warrumbungle Shire Council, Dubbo Regional Council and Mid-Western Regional Council websites were searched for nearby developments which may be relevant to the assessment of cumulative impacts. Other proposed solar farm developments which may contribute to the cumulative impacts of the Proposal are summarised in the table below.

Table 9-59 Other proposed developments in the vicinity of the Proposal

Project Name	Description	LGA	Distance to Proposal
Mumbil Solar	• 134 MW solar farm • Development Site 280 ha	Dubbo	77 km southwest of Dubbo
Maryvale Solar	• 196 MW solar farm • Development Site 230 ha	Dubbo	71 km southwest of Dubbo
Suntop Solar	• 260 MW solar farm • Development Site 280 ha	Dubbo	82 km southwest of Dubbo
Suntop 2 Solar	• 230 MW solar farm • Development Site 530 ha	Dubbo	10 km west of the Central West township of Wellington
Wellington Solar	• 180 MW solar farm • Development Site 490 ha	Dubbo	72 km southwest of Dunedoo
Wellington North Solar	• 300 MW solar farm • Development Site 970 ha	Dubbo	72 km southwest of Dunedoo

Beryl Solar	• 95 MW solar farm • Development Site 332 ha	Mid-Western	64 km southeast of Dunedoo
Wollar Solar	• 400 MW solar farm • Development Site 800 ha	Mid-Western	118 km southeast of Dunedoo

Other infrastructure projects in the region which may be concurrent with the Proposal include the Cowal Gold Mine, Northparkes Gold/Copper Mine, Tomingley Gold Mine, Dubbo Zirconia Mine, Wellington Gas fired power station, Parkes Intermodal Terminal, and Moolarben Coal Mine.

9.12.1 Potential Impacts

Considering the distance of the above-mentioned solar farms to this Proposal, there is unlikely to be significant cumulative impacts during construction or operation. The only potential cumulative impacts that could result are socio-economic impacts caused by additional pressure on availability of accommodation for the labour force to be employed. However, Dubbo is a large city with a population exceeding 36,000 as of the 2016 census and there are also a number of towns in proximity to the Proposals such that pressures on local communities, housing and public services would be minimal. Other potential cumulative impacts are discussed below.

Construction and Decommissioning

Biodiversity Impacts

The clearing of native vegetation, which is a key threatening process at both State and Commonwealth level, is considered a major factor in the loss of biological diversity. At least 61% of the native vegetation in NSW has been cleared or highly modified since European settlement (NSW Scientific Committee 2001).

The Proposal would be developed over land that has been historically cleared and used for intensive agricultural purposes. Additionally, the proposed design and layout of the solar farm ensures that the remnant woodlands located within the Development Site would be avoided. With regards to the TL alignment, this has been selected to minimise the removal of any trees, as such it has targeted an area that is sparely treed as it crosses the Talbragar River.

Consequently, the Proposal's design aims to minimise the clearing of native vegetation in the Development Site, and the minimal clearing impacts proposed would be minor and not likely to add substantially to cumulative impacts of native vegetation removal.

Cumulative impacts are considered best addressed by avoiding and minimising. This has been achieved via site selection, and construction of the solar farm in a cleared and levelled agricultural field. Where avoidance is not possible, the impacts of each contributing project has been assessed on a case by case basis.

The proposed removal of paddock trees and impacts to artificial aquatic habitats would combine with any similar impacts at the Cobbora Coal Mine site. In view of the limited impacts at the Dunedoo Development Site (refer to Section 8.1), the distance between the sites and the abundance of similar land and habitats throughout the locality, this cumulative impact is not likely to significantly affect biodiversity at the local or regional scales.

The proposed layout has been designed to avoid impacts to paddock trees and remnant woodland where possible (refer to Section 8.1). Where tree clearing has been unavoidable, the losses would be offset using the Biodiversity Assessment Method and the Biodiversity Offsets Policy for Major Projects, further mitigating cumulative impacts on biodiversity.

Land and Resource Use Impacts

The footprint of the solar farm and extent of land and soil disturbance resulting from the construction of the solar farm is insignificant in comparison to the total availability of land in the region. The volume and quantities of resources used in the construction of the solar farm is a fraction in comparison to the resources used for the operation of other commercial industries in the region.

With regards to agricultural productivity, the Proposal would not permanently alter the productivity or land use potential of the Development Site and no long-term cumulative impacts would be produced. The likely impact of the suspension of agricultural production at the Development Site has been quantified in Section 9.2.

Given the limited scale of impact at this site, the potential for increased production on other landowner properties and the abundance of similar land and agricultural enterprises in the region, the cumulative land, resource and agricultural productivity impacts are not likely to be significant. As such the cumulative impacts to land use, resources and agricultural productivity are not likely to be significant.

Traffic Impacts

Cumulative traffic impacts may occur on common construction access and freight transport routes, primarily on the Castlereagh Highway and other major State roads. These are high capacity roads designed for heavy vehicle traffic which are likely to be able to absorb any cumulative impacts of the Proposals. Potential cumulative impacts would be confined to the period of any overlap in the construction phases of the Proposals.

A TMP would be prepared to take into account other road users including freight from other projects that may generate additional traffic impacts.

Socio-economic Impacts

The construction of the proposed solar farm would generate a number of jobs for construction workers and skilled labourers. During peak construction, the Proposal would directly employ approximately 100 workers. Positive impacts would therefore occur as a result of increased local employment, dissemination of skills to the local workforce and purchase of local good and services which would generate income for local business suppliers.

The concurrent or sequential construction of several solar farms in the region would ensure a sustained demand for local employment over an extended period, and sustained support for local businesses and service suppliers. The cumulative impacts are therefore positive.

Visual and Landscape Character Impacts

Considering the distance between the Proposal and other solar farms, the cumulative visual and landscape impact of the Proposal is not likely to be significant.

Decommissioning

Cumulative construction impacts are considered to be best managed by managing each component (dust, noise etc.) individually. Cumulative decommissioning impacts would be minor. Cumulative impacts would be managed at the time of decommissioning. Infrastructure developed during construction (e.g., access tracks) would be utilised during decommissioning.

Operation

During operation, cumulative impacts would be minimal. Impacts are identified as follows:

The Proposal would result in additional staff being employed within the locality resulting in positive employment impacts.

Agricultural production from the Development Site would be affected during the operation of the solar farm. Following decommissioning, the existing forms of agricultural production (grazing and cropping) could resume. Existing land used for grazing and cropping could continue under the proposed TL during operation. Sheep grazing could potentially continue within the solar farm area but would occur at reduced levels of production. A temporary reduction in agricultural production at the Development Site is not expected to have a major impact on the overall agricultural production from the Warrumbungle Shire area.

GHG Emissions and Air Quality Impacts

The cumulative impact of additional renewable energy generator in the region would have positive impacts for NSW in terms of provision of electricity to meet increasing demand as well as the reduction of coal fired electricity generation with the associated environmental benefits.

9.9.5 Mitigation Measures

Mitigation measures to avoid and minimise cumulative impacts are identified in Table 9-60.

Table 9-60 Mitigation measures for cumulative impacts

Mitigation measures	Phase
Traffic Management Plan prepared for the Proposal would take into account the cumulative impacts of any council or TfNSW road works, should these activities occur concurrently.	Preconstruction Construction

10 ENVIRONMENT MANAGEMENT

10.10 ENVIRONMENTAL MANAGEMENT FRAMEWORK

10.10.1 Environmental Management Plans

Environmental protection and management measures would be implemented via a Construction Environmental Management Plan (CEMP), Operation Environmental Management Plan (OEMP) and a Decommissioning Environmental Management Plan (DEMP). These plans would be prepared sequentially, prior to each stage of works.

The EMPs would include performance indicators, timeframes, implementation and reporting responsibilities, communications protocols, a monitoring program, auditing and review arrangements, emergency responses, induction and training and complaint/dispute resolution procedures. The monitoring and auditing program would clearly identify any residual impacts after mitigation. Adaptive management would be used to ensure that improvements are consolidated in updated EMPs.

The EMP framework including CEMP and OEMP, is illustrated in Figure 10-1. The EMPs would incorporate all of the specific mitigation measures contained in this EIS.

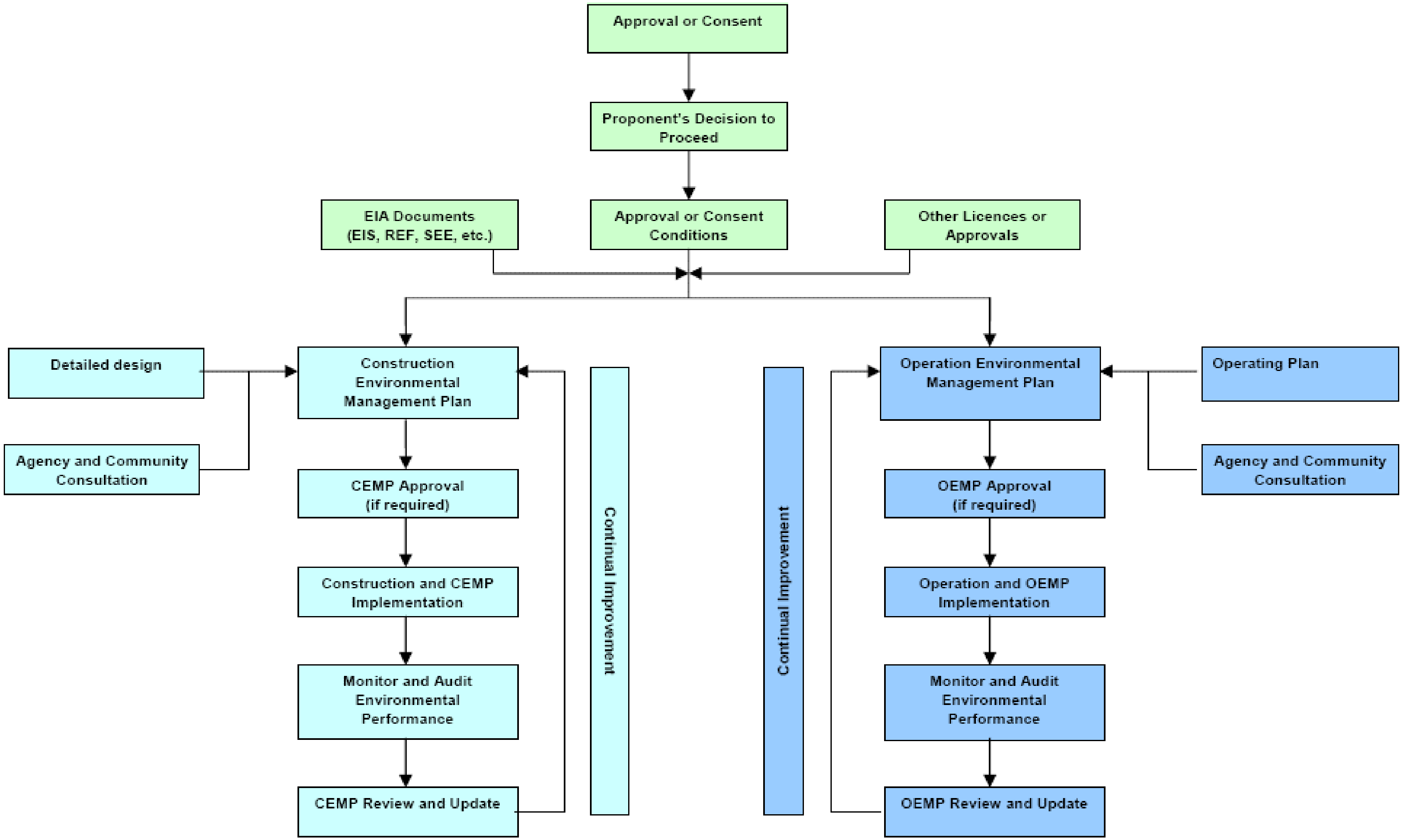

Figure 10-1 Post-approval Environmental Management Plan (EMP) process (DIPNR 2004).

10.10.2 Sub-plan Structure

The Construction Environmental Management Plan (CEMP) would incorporate the following sub-plans:

- Soil and Water Management Plan, incorporating an Erosion and Sediment Control Plan and Site Drainage Plan (Section 9.1)
- Construction Noise Management Plan (Section 9.4)
- Traffic Management Plan (Section 9.6)
- Biodiversity Management Plan (Section 8.1).

The following plans would be developed prior to construction and implemented at all stages of the Proposal via the CEMP and the OEMP:

- Emergency Response Plan, incorporating an Evacuation Plan (Section 9.7), Fire Response Plan (Section 9.7), Flood Response Plan (Section 8.4) and Spill and Contamination Response Plan (Section 9.1)Landscape Management Plan (Section 8.1)
- Waste Management Plan (Section 9.11).

The Decommissioning Environmental Management Plan (DEMP) would also incorporate a Site Rehabilitation Plan (Section 9.2).

10.11 CONSOLIDATED MITIGATION MEASURES

The mitigation measures contained in this report comprise Proposal -specific safeguards, recommendations from specialist assessment reports and reference to a range of best practice guidelines and regulatory requirements. The measures are to be incorporated in Proposal plans and designs, contract specifications and the Construction Environmental Management Plan, Operation Environmental Management Plan and Decommissioning Environmental Management Plan as appropriate. The mitigation measures are consolidated below. Where measures are relevant to more than one environmental aspect, they are cited only once under the most relevant aspect, to avoid duplication.

Table 10-1 Consolidated list of mitigation measures

Mitigation measure		Phase
BIODIVERSITY		
Displacement of resident fauna through vegetation clearing and habitat removal		
Time works to avoid critical life cycle events	• Hollow-bearing trees would not be removed during spring to summer • If clearing outside of this period cannot be achieved, pre-clearing surveys would be undertaken to ensure no impacts to fauna would occur	Construction
Implement clearing protocols during tree clearing works, including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological or wildlife handler	• Pre-clearing checklist • Tree clearing procedure	Construction
Relocate habitat features (fallen timber, hollow logs) from within the development site	• Tree-clearing procedure including relocation of habitat features to adjacent area for habitat enhancement	Construction

Mitigation measure		Phase
Indirect impacts on native vegetation and habitat		
Clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance; for example, removal of native vegetation by chainsaw, rather than heavy machinery, is preferable in situations where partial clearing is proposed	• Approved clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing. • No stockpiling or storage within dripline of any mature trees • In areas to clear adjacent to areas to be retained, chainsaws would be used rather than heavy machinery to minimise risk of unauthorised disturbance	Construction
Noise barriers or daily/seasonal timing of construction and operational activities to reduce impacts of noise	• Construction Environmental Management Plan will include measures to avoid noise encroachment on adjacent habitats such as avoiding night works as much as possible.	Construction
Temporary fencing to protect significant environmental features such as riparian zones	• Prior to construction commencing, exclusion fencing, and signage would be installed around habitat to be retained	Construction
Hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas	• A Weed Management procedure would be developed for the proposal to prevent and minimise the spread of weeds. This would include: – Management protocol for declared priority weeds under the *Biosecurity Act 2015* during and after construction – Weed hygiene protocol in relation to plant, machinery, and fill – Any occurrences of pathogens such as Myrtle Rust and Phytophthora would be monitored, treated, and reported	Construction, Operation

Mitigation measure		Phase
	• The weed management procedure would be incorporated into the Biodiversity Management Plan.	
Staff training and site briefing to communicate environmental features to be protected and measures to be implemented	• Site induction • Toolbox talks	Construction
Preparation of a vegetation management plan to regulate activity in vegetation and habitat adjacent to the proposed development	• Preparation of a Biodiversity management plan that would include protocols for: • Protection of native vegetation to be retained • Best practice removal and disposal of vegetation • Staged removal of hollow-bearing trees and other habitat features such as fallen logs with attendance by an ecologist • Weed management • Unexpected threatened species finds • Rehabilitation of disturbed areas	Construction
Erosion and sediment controls	• An erosion and sediment control plan would be prepared in conjunction with the final design and implemented	Construction
Making provision for the ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on or adjacent to the development site.	• Retained native vegetation would be considered as an offset site	Operation

Mitigation measure		Phase
Light shields or daily/seasonal timing of construction and operational activities to reduce impacts of light spill	• Avoid Night Works • Direct lights away from vegetation	Construction /Operation
Adaptive dust monitoring programs to control air quality	• Daily monitoring of dust generated by construction activities • Construction would cease if dust observed being blown from site until control measures were implemented • All activities relating to the proposal would be undertaken with the objective of preventing visible dust emissions from the development site	Construction
Prescribed biodiversity impacts		
Sediment barriers and spill management procedures to control the quality of water runoff released from the site into the receiving environment	• An erosion and sediment control plan would be prepared in conjunction with the final design and implemented • Spill management procedures would be implemented.	Construction
Appropriate landscape plantings of local indigenous species to replace loss of planted vegetation	• Landscape plantings will be comprised of local indigenous species.	Operation
Staff training and site briefing to communicate impacts of traffic strikes on native fauna.	• Awareness training during site inductions regarding enforcing site speed limits. • Site speed limits to be enforced to minimise fauna strike.	Construction and Operation
ABORIGINAL HERITAGE		

Mitigation measure	Phase
The sites Dunedoo Solar AFT 1 to Dunedoo Solar AFT 14 which are located within the Development Footprint for the Dunedoo Solar Farm must be salvaged via surface collection prior to construction works commencing for the Dunedoo Solar Farm. Until surface collection salvage has occurred at the sites a minimum 5-metre buffer must be observed to ensure no inadvertent impacts occur.	Pre-construction
The collection and relocation of the surface artefacts within the Dunedoo Solar Farm Subject land should be undertaken by an archaeologist with representatives of the registered Aboriginal parties and be consistent with Requirement 26 of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales.* The salvage of Aboriginal objects can only occur following development consent that is issued for State Significant Developments and must occur prior to any construction works commencing.	Pre-construction
No mitigation is required prior to impacts to the previously recorded site AHIMS# 36-2-0049/ DTG/OC27 - Dunedoo 1. Following development consent that is issued for State Significant Development to allow impacts to the Aboriginal site AHIMS# 36-2-0049 an *Aboriginal Site Impact Recording Form* must be completed to list the site as destroyed.	Pre-construction
The sites Dunedoo Solar AFT 15 to Dunedoo Solar AFT 23 which are located outside the Dunedoo Solar Farm Subject land must not be impacted. Any future activities that may potentially pose a risk of impacts to these sites by this project would need to be assessed by an archaeologist and additional consultation with the registered Aboriginal parties would be required.	Pre-construction
An *Aboriginal Site Impact Recording Form* must be completed and submitted to AHIMS following harm for each site collected or destroyed from salvage and/or construction works as approved for impacts in line the development consent for this State Significant Development.	Pre-construction
For any additional impacts to sites and areas outside the Subject land, as assessed in this report a modification application would need to be submitted to the to the Department of Planning, Industry and Environment (DPIE) for this State Significant Development which includes consideration of impacts on Aboriginal Heritage as determined by an archaeologist, additional Aboriginal consultation and survey may be required.	Pre-construction

Mitigation measure	Phase
The Proponent should prepare a Cultural Heritage Management Plan (CHMP) to address the potential for finding additional Aboriginal artefacts during the construction of the Dunedoo Solar Farm and for the management of known sites and artefacts within the Subject land. The Plan should include the unexpected finds procedure to deal with construction activity. Preparation of the CHMP should be undertaken in consultation with the registered Aboriginal parties.	Pre-construction
In the unlikely event that human remains are discovered during the construction of the Dunedoo Solar Farm, all work must cease in the immediate vicinity. The appropriate heritage team within the Department of Planning, Industry and Environment (DPIE) and the local police should be notified. Further assessment would be undertaken to determine if the remains were Aboriginal or non-Aboriginal. If the remains are deemed to be Aboriginal in origin the Registered Aboriginal Parties should be advised of the find as directed by the appropriate heritage team within DPIE.	Construction
Further archaeological assessment would be required if the proposal activity extends beyond the area assessed in this report. This would include consultation with the registered Aboriginal parties and may include further field survey.	Pre-construction
VISUAL AMENITY AND LANDSCAPE CHARACTER	

A Landscape Management Plan is recommended to address the 'as built' visual impacts of the proposed solar farm. The plan should include:
• **On-site vegetation screening generally in accordance with Figure 8-21). This would include details of:**
    ○ **selected species aimed at 'breaking up' not blocking views of onsite infrastructure. These should generally be native to the area, fast growing small trees and bushes and low lying vegetation**
    ○ **Location of planting locations, generally expected to be between the security fencing and the property boundary**
    ○ **Band width, generally expected to be approximately 6m with three (3) rows of vegetation in high visual impact areas and two (2) rows in low / moderate visual impact areas**
    ○ **Maintenance schedule for a period of 24 months. Maintenance should generally include the removal of weeds and replacement of dead or non-performing plants**
• **General methods to reduce visual impact of buildings. This would centre on the colour and materials of infrastructure, to reduce the overall visual contrast and reflectivity of the project.**
	Construction

Mitigation measure	Phase
The plan would be implemented nearing completion of construction.	
HYDROLOGY AND FLOODING	
The design of buildings and equipment foundations would consider the potential for flooding at the site including designing locations, footings for buildings and other infrastructure to cater for or avoid predicted flood depths and are to be consistent with relevant standards.	Design/ Pre-Construction
A Soil and Water Management Plan will be implemented including provisions for sediment and erosion control and site drainage.	Construction
An Emergency Response Plan will be implemented, including provisions for response to spills and contamination for chemical and fuel use, storage and in case of spills or other incidents.	Construction
The design and construction of the internal access tracks will include soil erosion and sediment control measures.	Design Construction
The Flood Response Plan covering all phases of the Proposal would: • **Detail who would be responsible for monitoring the flood threat and how this is to be done** • **Detail specific response measures to ensure site safety and environmental protection** • **Outline a process for removing any necessary equipment and materials offsite and out of flood risk areas** • **Consideration of site access in the event that some tracks or site access points (such as Digilah Rd) become flooded** • **Establish an evacuation point** • **Define communications protocols with emergency services agencies.** • **Be prepared in consultation with the State Emergency Services (SES and WSC)**	Preconstruction Construction Operation Decommissioning
SOILS AND LANDFORMS	

Mitigation measure	Phase
The solar array would be designed and installed to allow sufficient space between panels to establish and maintain perennial groundcover (subject to climatic conditions). Groundcover management details (including stocking levels etc) and rehabilitation of civil work completed during construction are to be included in the Construction Environmental Management Plan and Operational Environmental Management Plan.	Preconstruction Construction Operation
A Construction Environmental Management Plan (CEMP) would be implemented to manage runoff, soil erosion and sedimentation and pollution risks at the site. The CEMP would be prepared in accordance with the 'Blue Book' Volume 1 Managing Urban Stormwater: Soils and Construction (Landcom 2004), Volume 2A Installation of Services (DECC 2008a) and Volume 2C Unsealed Roads (DECC 2008b).	Pre-construction Construction
As part of the CEMP, a Soil and Water Management Plan (incorporating a Site Drainage Plan and Erosion and Sediment Control Plan) would be prepared, implemented and monitored during the Proposal to minimise soil and water impacts. These plans would include provisions to: • **Install, monitor and maintain erosion controls** • **Identify and protect sensitive features such as native vegetation, dams and Talbragar River** • **Ensure that machinery leaves the site in a clean condition to avoid tracking of sediment onto public roads** • **Manage topsoil: in all excavation activities, separate subsoils and topsoils to restore natural soil profiles and assist revegetation, guided by the findings of the pre-works soil survey. Topsoils stockpiled for extended periods would be managed to avoid contact with overland runoff, minimise weed risks, and maintain soil organic matter, soil structure and microbial activity** • **Minimise the area of disturbance from excavation and compaction and rationalise vehicle movements to minimise soil impacts** • **Ensure any discharge of water from the site is managed to ensure ANZECC (2000) water quality criteria are met as far as practicable, ensure excavations are not scheduled when heavy rainfall events are predicted, or soils are saturated.**	Pre-construction Construction
The Spill and Contamination Response Plan prepared as part of the Emergency Response Plan would include measures to:	Construction Operation

Mitigation measure	Phase
• **Respond to the discovery of existing contaminants at the site (e.g. Pesticide containers or asbestos), including stop work protocols and remediation and disposal requirements** • **Manage the storage of any potential contaminants on-site** • **Mitigate the effects of soil and water contamination by fuels or other chemicals (including emergency response and EPA notification procedures)** • **Ensure that machinery and materials arrive on site in a clean and secure condition** • **Prevent contaminants affecting adjacent pastures, irrigation channels, dams and native vegetation** • **Monitor and maintain spill equipment including spill kits in relevant machinery** • **Induct and train site staff.** • **Detail fuels, chemicals, and liquids storage locations that are at least 50 metres from any waterways or drainage lines, in an appropriate bunded area** • **Disposal process for contaminated materials.**	Decommissioning
The site design and, if required the CEMP, OEMP and DEMP and relevant sub-plans should incorporate where possible the management recommendations in the site soil survey report (Soil Management Designs 2018), including: • **Maintain protective ground cover in the north-western corner (3%-slope) where possible** • **Maintain protection with perennial ground cover on Brown Chromosols in the vicinity of Pit 4** • **Consider engineering and design solutions for the installation of the piles in all Vertosol areas, which have a high shrink-swell potential in top and sub soils** • **Apply Gypsum (6t/ha) in areas with Grey and Brown Vertosols, to improve drainage and avoid trafficability issues following heavy rain events.** • **Apply Gypsum (3t/ha) for the remainder of the area** • **Apply lime at a rate of 2t/ha to help overcome a slight acidity issue that will be difficult to treat once the solar panels have been installed** • **Apply fertilizer produce rich in nitrogen and zinc for the Vertosol zone represented by Pit 5** • **Moderate salinity in the depth interval 60-100 cm was observed at Pits 2 and 3; this may have an impact on susceptibility to corrosion of piles.**	Preconstruction Construction Operation Decommissioning
LAND USE	

Mitigation measure	Phase
Essential Energy would be consulted prior to commencement of works to ensure that the works do not adversely affect electricity transmission or impede access for inspection and maintenance.	Pre-construction
Consultation with relevant landholders would be ongoing to manage interactions between the solar farm and other properties.	Construction Operation Decommissioning
Underground cabling and other works to remain in situ following decommissioning of the solar farm would be installed deeper than 500mm to allow cultivated cropping to resume following decommissioning.	Construction
A Decommissioning Environmental Management Plan (DEMP) would be prepared and submitted to DPIE for approval prior to decommissioning. The DEMP would include a Site Rehabilitation Plan covering: • **Criteria and indicators for the restoration of land capability and agricultural potential based on pre-works soil survey results** • **Details of rehabilitation actions such as removal of infrastructure, remediation of soils, reinstatement of dams and irrigation/drainage channels as required and establishment of suitable groundcover vegetation on bare areas** • **A monitoring and assessment process to demonstrate that the target state has been achieved** • **An expected timeline for the rehabilitation program.**	Decommissioning
Essential Energy would be consulted prior to commencement of works to ensure that the works do not adversely affect electricity transmission or impede access for inspection and maintenance.	Pre-construction
The following landholders and residents would be consulted and notified to minimise, where possible, the noise, dust, traffic and other disturbance impacts: • **Those adjacent to the Development Site,** • **Those located on All Weather Rd between the junction of Castlereagh Highway and All Weather Road and the Development Site; and** • **Those located on Digilah Road or All Weather Road between the junction of Golden Highway/Bolaro Road and Digilah Road and the Development Site.**	Construction Decommissioning

Mitigation measure	Phase
WATER USE AND WATER QUALITY	
The Spill and Contamination Response Plan prepared as part of the Emergency Response Plan would include measures to: • **Respond to the discovery of existing contaminants at the site (e.g. Pesticide containers or asbestos), including stop work protocols and remediation and disposal requirements** • **Manage the storage of any potential contaminants on-site** • **Mitigate the effects of soil and water contamination by fuels or other chemicals (including emergency response and EPA notification procedures)** • **Ensure that machinery and materials arrive on site in a clean and secure condition** • **Prevent contaminants affecting adjacent pastures, irrigation channels, dams and native vegetation** • **Monitor and maintain spill equipment including spill kits in relevant machinery** • **Induct and train site staff.** • **Detail fuels, chemicals, and liquids storage locations that are at least 50 metres from any waterways or drainage lines, in an appropriate bunded area** • **Disposal process for contaminated materials.**	Construction Operation Decommissioning
If the substation is oil-cooled, the layout, design, size etc of the oil containment bunding and drainage would comply with the relevant standards and guidelines. The bund would be regularly inspected and cleaned, including removal of rainwater.	Pre-construction Construction Operation
A Soil and Water Management Plan will be developed to incorporate the following: • **That no detergents or other chemicals would be added to the solar panel cleaning water** • **Specify concrete washout process and location** • **Specify the procedures for testing, treatment and discharge of construction wastewater** • **Detail staff training required**	Construction Operation
If ground water is to be used, A Groundwater Management Plan would be incorporated into the CEMP to manage impacts on groundwater. This would be informed by onsite survey by an appropriately trained expert and include:	Pre-Construction

Mitigation measure	Phase
• **Pollution controls** • **Management of dewatering.**	
If a new bore is to be constructed, the construction and maintenance of the groundwater extraction bore will be in accordance with the *Minimum Construction Requirements for Water Bores in Australia (3rd edition*) produced by the National Uniform Drillers Licencing Committee (NUDLC). The minimum requirements for consideration include: • **Only a licensed driller shall carry out the bore installation works and shall be present at all times during bore construction activities.** • **The bore design should aim to ensure the protection of the groundwater resource from surface contamination. The headworks and casing are sealed so that there is no potential for flow outside the casing.** • **To minimise the possibility of contaminating the bore and any surrounding bores, the new bore should be located away from existing bores, surface water sources and any sources of pollution (e.g. dairies, septic tanks and absorption trenches, refuse dumps, landfill, effluent discharges from drainage ditches, cattle/stock dips).** • **Chemicals and other drilling fluid additives that could leave a residual toxicity should not be added to any drilling fluids or cement slurries (i.e. grouts) used to drill and complete any water bore.**	Pre-Construction Construction Operation Decommissioning
NOISE AND VIBRATION	
Works should be undertaken during standard working hours only (except for works that can be performed without noise nuisance): **Construction** • **Monday – Friday 7am to 6pm.** • **Saturday 7am to 1pm.** • **No work on Sundays or public holidays.** **Operation** • **Monday – Friday 7am to 6pm.** • **Saturday 8am to 1pm.**	Construction Operation Decommissioning

Mitigation measure	Phase
No work on Sundays or public holidays.	
All staff on-site should be informed of procedures to operate plant and equipment in a quiet and efficient manner where possible.	Construction Operation Decommissioning
Endeavour to establish good relations with people living and working in the vicinity of the construction. This could include regular communication of the proposed works including timing and duration.	Construction Operation Decommissioning
If required, implement noise control measures, that are suggested in Appendix C (Table C1, C2 and C3) of Australian Standard 2436-2010 "Guide to Noise Control on Construction, Demolition and Maintenance Sites".	Construction Decommissioning
In addition to physical noise controls that may be required, the following general noise management measures should be followed: • **Plant and equipment should be properly maintained.** • **Provide special attention to the use and maintenance of 'noise control' or 'silencing' kits fitted to machines to ensure they perform as intended.** • **Strategically position plant on site to reduce the emission of noise to the surrounding neighbourhood and to site personnel.** • **Avoid any unnecessary noise when carrying out manual operations and when operating plant.** • **Any equipment not in use for extended periods during construction work should be switched off.**	Construction Decommissioning
Establish a procedure to deal with complaints. Each complaint would need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences if exceedances to relevant requirements is established.	Construction Operation Decommissioning

Mitigation measure	Phase
Where noise level exceedances cannot be avoided, then time restrictions and/or providing periods of repose for residents, must be considered where feasible and reasonable. That is, daily periods of respite from noisy activities may also be scheduled for building occupants during construction hours.	Construction Decommissioning
SOCIAL AND ECONOMIC IMPACTS	
The Community Consultation Plan would continue to be implemented throughout the planning, assessment and construction phases of the project, and would include: • **Regular community updates about the progress of the Proposal and findings of the assessments** • **Consultation and notification of local residents and other relevant stakeholders regarding the timing of major deliveries and other activities which may produce particular social and economic impacts** • **An accessible complaints process with a timely response protocol.**	Preconstruction Construction
Neighbours of the Dunedoo solar farm would be consulted and notified regarding the timing of major deliveries which may require traffic control and disruption to access.	Construction Decommissioning
Local businesses would be used to supply good and services during all phases of the Proposal wherever possible. The Proponent would actively liaise with local industry representatives to maximise and coordinate the use of local contractors, manufacturing facilities and goods and materials suppliers, and to minimise adverse impacts to local supplies, services and tourism.	Construction Operation Decommissioning
Large deliveries requiring traffic control would be scheduled to avoid festivals or other major tourism activities in Dunedoo. Local tourism industry representatives would be consulted to manage potential timing conflicts with local events.	Construction Decommissioning
Local representatives would be consulted regarding accommodation options for staff, to minimise adverse impacts on local services.	Construction Operation Decommissioning
Assess the feasibility to implement a program to open the solar farm for visits and education events.	Operation

Mitigation measure	Phase
Assess the feasibility to support local schools in science and engineering studies through a partnership.	Operation
TRAFFIC AND TRANSPORT	
A Construction Traffic Management Plan (CTMP) would be developed as part of the CEMP and DEMP, in consultation with Warrumbungle Shire Council and TfNSW. The plan would include: • **Confirmation of designated routes for construction and haulage traffic** • **Evaluation of any road or intersection upgrade requirements and associated traffic controls, in consultation with council and roads and maritime services (and consistent with Austroads guides and TfNSW supplements)** • **Scheduling of deliveries** • **Carpooling/shuttle bus arrangements changes required from Milling Park to site to minimise staff vehicle movements in the event of flooding** • **Consultation and notification arrangements regarding traffic impacts for nearby residents and local road users, particularly when traffic delays are expected** • **Arrangements and locations for traffic controls (speed limits, signage, stop/go)** • **Procedure to monitor traffic impacts and adapt controls (where required) to reduce the impacts** • **Provision of a contact phone number for stakeholders and the public to obtain information and to enable rapid response to any issues or concerns** • **Assessment of road condition prior to construction on all local roads that would be utilised (All Weather Road and relevant section of Digilah Road),a road condition monitoring program, and process for rectifying road conditions should deterioration in road quality be attributable to the proposal.** • **Address the temporary increase in traffic across the low-level bridge crossing on Digilah Road to the north of Golden Highway** • **Reduce predicted impact (where possible) from transport during peak tourism periods (such as during local festivals), and morning and evening commuting or school bus operating periods** • **Link with the requirements of the Flood Response Plan**	Preconstruction Construction Decommissioning

Mitigation measure	Phase
Invite TfNSW education staff to provide information, guidance and discussion on fatigue management and road safety to site staff.	Preconstruction Construction Decommissioning
Consultation with stakeholders including TfNSW, Warrumbungle Shire Council, local landholders and emergency services would continue during construction and decommissioning to advise of any changes to road use and conditions.	Construction Decommissioning
HAZARDS	
An Emergency Response Plan, incorporating an Evacuation Plan, Fire Response Plan, Flood Response Plan and Spill and Contamination Response Plan, would be developed prior to construction the solar farm. A copy of the plan would be kept on site.	Preconstruction Construction Operation Decommissioning
Hazardous materials and development	
Dangerous or hazardous materials would be transported, stored and handled in accordance with AS1940-2004: *The storage and handling of flammable and combustible liquids* and the ADG Code where relevant. All potential pollutants kept on-site would be stored in accordance with relevant HAZMAT requirements and bunded.	Construction Operation Decommissioning
The transportation of new and waste lithium-ion batteries would comply with the requirements of the Dangerous Goods Code, including specific 'special provisions' and 'packing instructions' applying to the transportation of Li-ion batteries.	Construction Operation Decommissioning
EMF	
All electrical equipment would be designed in accordance with relevant codes and industry best practice standards in Australia.	Preconstruction Construction

<table>
<tr><th>Mitigation measure</th><th>Phase</th></tr>
<tr><td>All design and engineering would be undertaken by qualified and competent person/s with the support of specialists as required and would aim to minimise EMFs.</td><td>Preconstruction
Construction</td></tr>
<tr><td colspan="2">Aviation</td></tr>
<tr><td>The materials and colour of on-site infrastructure would, where practical, be low reflectivity and in keeping with the colouring of the local landscape.</td><td>Preconstruction
Construction</td></tr>
<tr><td colspan="2">FIRE AND BUSHFIRE</td></tr>
<tr><td>The Fire Response Plan would be developed in consultation with the local RFS District Fire Control Centre, and include:
• 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
• Specific management of activities with a risk of fire ignition (hot works, vehicle use, smoking, use of flammable materials, blasting)
• Appropriate risk control measures 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 system (either in its entirety or partially, as determined by risk assessment).
• Incorporation of fire safety and response in staff and contractor induction, training, OHS procedures and work method statements
• Dedicated staff training on the use and maintenance of fire-fighting equipment and resources
• Designation of a staff safety officer tasked with ensuring implementation of the plan and regular liaison with firefighting agencies
• Document all firefighting resources maintained at the site with an inspection and maintenance schedule
• Monitoring and management of vegetation fuel loads
• Identification of Asset Protection Zones (APZs) and key access routes</td><td>Preconstruction
Construction
Operation
Decommissioning</td></tr>
</table>

Mitigation measure	Phase
• A communications strategy incorporating use of mobile phones, radio use (type, channels and call-signs), Fire Danger Warning signs located at the entrance to the site compounds, emergency services agency contacts • Activation triggers for the Emergency Response Plan and Fire Response Plan.	
Fire risks associated with the BS (if installed) would be managed by: • Locating the BS unit as far as practicable from any sensitive receivers (residences) or large stands of vegetation • Installing reliable automated monitoring (voltage and temperature), alarm and shutdown response systems • Installing reliable integrated fire detection and fire suppression systems (inert gas) as required by relevant standards • Ensuring the battery buildings/containers are not vulnerable to external heat effects in the event of a bushfire • Designing appropriate separation and isolation between individual battery containers and between batteries and other infrastructure • Compliance with all relevant guidelines and standards • Preparation of a specific Battery Fire Response Plan under the general Fire Response Plan, in consultation with fire authorities, fire suppression experts, RES' experienced storage team, and with reference to relevant standards and guidelines • Facilitation of first responder training in the management of Li-ion battery fires at the site for local brigades.	Preconstruction Construction Operation Decommissioning
In developing the Fire Response Plan, NSW RFS would be consulted on the location of water supplies (20,000 litre tank), fire-fighting equipment maintained on-site, fire truck connectivity requirements, proposed APZ and access arrangements, communications, vegetation fuel levels and hazard reduction measures.	Preconstruction
Two (2) copies of the FRP will be stored in a prominent 'Emergency Information Cabinet' which is located in a position directly adjacent to the site's main entry point/s.	Construction Operation
An APZ of minimum 10 metres would be maintained between remnant or planted woody vegetation and solar farm infrastructure. The APZ around the perimeter of the site would incorporate a 4-metre-wide gravel access track.	Construction Operation

Mitigation measure	Phase
Average grass height within the APZ would be maintained at or below 5 cm throughout the October-March fire season. Average grass height outside the APZ, including beneath the solar array, would be maintained at or below 15 cm throughout the fire season.	Construction Operation
The overhead Transmission Line at the site would be managed by maintaining appropriate vegetation clearance limits to minimise potential ignition risks, in accordance with the ISSC 3 Guideline for Managing Vegetation Near Transmission Lines.	Operation
Landscaping around buildings at the site would comply with Appendix 4 Asset Protection Zone Requirements in the PBP guidelines.	Construction Operation
Appropriate fire-fighting equipment would be held on site to respond to any fires that may occur at the site during construction. This equipment will include fire extinguishers, a 1,000-litre water cart retained on site on a precautionary basis, particularly during any hot works operations. Equipment lists would be detailed in Work Method Statements.	Construction
Once constructed and prior to operation, the solar farm operator will contact the relevant local emergency management committee (LEMC). The LEMC is a committee established by virtue of 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 particular Local Government Area. The contact details of members of the LEMC can be obtained from the relevant local council.	
The NSW RFS, Fire and Rescue NSW and local emergency management committee (LEMC) would be provided with a contact point for the solar farm, during construction and operation.	Construction Operation
Following commissioning of the solar farm, the local RFS and Fire and Rescue brigades would be invited to an information and orientation day covering access, infrastructure, firefighting resources on-site, fire control strategies and risks/hazards at the site.	Operation

Mitigation measure	Phase
The perimeter access track would comply with the requirements for in-fill development property access roads in the PBP guidelines. All access and egress tracks on the site would be maintained and kept free of parked vehicles to enable rapid response for firefighting crews and to avoid entrapment of staff in the case of bush fire emergencies. Access tracks would be constructed as through roads as far as possible. Dead end tracks would be signposted and include provision for turning fire trucks.	Construction Operation Decommissioning
A Hot Works Permit system would be applied to ensure that adequate safety measures are in place. A risk assessment would be undertaken to determine the appropriate firefighting equipment required for the specific task. Where possible hot works would be carried out in specific safe areas (such as the Construction Compound temporary workshop areas).	Construction Operation Decommissioning
HISTORIC HERITAGE	
If an item of potential historic heritage is uncovered during the works, works in the immediate vicinity would cease and the Heritage Division (OEH) would be contacted for advice.	Construction
AIR QUALITY AND CLIMATE	
The Community Consultation Plan will be implemented to promote information sharing for air quality and include a complaints process: • Notification of relevant stakeholders defined • An accessible complaints process with a timely response protocol.	Preconstruction Construction Decommissioning
Dust control measures, including on site access roads, will be specified in the CEMP and DEMP and may include water applications or other means as required.	Construction Decommissioning
Idling for more than 5 minutes is prohibited. Lorries and trucks engines would be turned off.	Construction Decommissioning
Vehicle loads of material which may create dust or litter would be covered while using the public road system.	Construction Decommissioning

Mitigation measure	Phase
All vehicles and machinery used at the site would be in good condition, fitted with appropriate emission controls and comply with the requirements of the POEO Act, relevant Australian standards and manufacturer's operating recommendations. Plant would be operated efficiently and turned off when not in use.	Construction Decommissioning
Fires and material burning is prohibited in the Development Site.	Construction Decommissioning
WASTE	
A Waste Management Plan (WMP) would be developed to minimise waste, including: • **Identification of opportunities to avoid, reuse and recycle, in accordance with the waste hierarchy** • **Quantification and classification of all waste streams** • **Provision for recycling management on-site** • **Provision of toilet facilities for on-site workers and identify that sullage would be disposed of (i.e. pump out to local sewage treatment plant)** • **Tracking of all waste leaving the site** • **Disposal of waste at facilities permitted to accept the waste** • **Requirements for hauling waste (such as covered loads).**	Construction Operation Decommissioning
A septic system would be installed and operated according to the Warrumbungle Shire Council regulations.	Construction Operation
CUMULATIVE IMPACTS	
Traffic Management Plan prepared for the Proposal would take into account the cumulative impacts of any council or TfNSW road works, should these activities occur concurrently.	Preconstruction Construction

11 JUSTIFICATION

The Secretary's Environmental Assessment Requirements for the Proposal state that the EIS must provide:

- A strategic justification of the development focusing on site selection and suitability, and
- The reasons why the development should be approved having regard to relevant matters for consideration under the EP&A Act, ESD principles, site suitability with respect to potential land use conflict and feasible alternatives to the development.

In this section, the Proposal is justified in terms of reasons for approval, site suitability, matters for consideration under the EP&A Act and ESD principles. The impacts on existing and potential land uses are assessed in detail in Section 9.2 and summarised below. A discussion of alternative locations, technologies and designs, including the 'do-nothing' option, is provided in Section 2.

11.10 SUMMARY OF REASONS FOR APPROVAL

The assessments presented in the EIS indicate that the proposed Dunedoo solar farm should be approved, subject to the identified mitigation measures, principally because:

- The Proposal is permissible and meets planning requirements, including those pertaining to the EP&A Act and Regulation, State and Regional Development SEPP, Infrastructure SEPP, and the Warrumbungle LEP
- The identified environmental impacts are generally minor, highly localised, capable of mitigation or offsetting and often confined to the construction phase
- The environmental risks associated with the Proposal are manageable and uncertainty can be addressed through mitigation measures and with the environmental management plants.
- The site is highly suited to utility scale solar electricity generation
- The Proposal reflects the technology best suited to the site and network requirements
- The Proposal provides an important contribution to the urgent need to abate carbon emissions in the electricity sector to meet government commitments and policy objectives and avoid dangerous climate change
- The Proposal offers a range of community benefits relating to electricity supply, economic activity, and local employment opportunities
- The Proposal is reversible and would not result in any permanent loss of land use potential or reduce future land and resource use options
- The Proposal incorporates Battery Storage, which would regulate inputs to the network and help overcome limitations associated with intermittent solar generation.

11.11 SITE SUITABILITY

Selecting the best site for the Proposal reduces construction and operating costs, reduces environmental impacts and risks, and maximises benefits in terms of generation performance that leads into assisting in the carbon emission abatement. The criteria used to select the proposed solar farm site include:

- Low environmental constraints (predominantly cleared cropping land) ensuring minimal loss of native vegetation
- Level terrain for cost effective construction, minimal shading between panels and a straightforward ongoing maintenance process
- High quality solar resource (estimated to be approximately 18 MJ/m^2 annually)

- Negligible impact on heritage
- Low density population and limited close neighbouring properties
- Suitable planning context
- Road access
- On-site access to the transmission network
- High levels of available capacity on the grid transmission system.

The Development Site is flat and predominantly clear of vegetation, and highly suited to efficient, high-output utility scale solar generation. The Proposal is located in a sparsely populated rural area where the dominant land use is broad scale agriculture. The land uses surrounding the solar farm site and along the construction access route are described in Sections 9.1 and 9.2. The solar farm is not likely to restrict or negatively impact any surrounding land uses.

The Development Site comprises several large paddocks, which have been used for cropping over a long period. The crops grown at the site are characteristic of agriculture in the Warrumbungle LGA. The Proposal would affect a very small proportion of the land used for cropping in the LGA. The reduction in crop production would be offset by increased productivity on other properties held by the landowner (refer to Section 9.2). The Proposal would not impose requirements for additional Council or State Government services or facilities.

The Essential Energy network passes alongside the property, allowing connection to the transmission network and the substation to be sited on the property. This connection method means there are no off-site overhead grid works. Preliminary electrical system studies show there is sufficient capacity on the 66 and 132 kV Essential Energy system to accept electrical generation into the network from the Dunedoo Proposal. The studies also show the level of generation is commensurate with demand in the Central West area, leading to low electrical losses.

The solar farm would be permissible under the Infrastructure SEPP (refer to Section 5.6). The use of the Development Site would be based on a lease and purchase agreement between the Proponent and the landowners. The Proposal would not affect long term agricultural capability or future use or land use planning options for the property.

11.12 MATTERS FOR CONSIDERATION

The consent authority for SSD Development Applications is required to take into consideration matters listed in section 4.15 of the EP&A Act. An evaluation of the Proposal against the relevant objects of the Act and section 4.15 matters is provided in Table 11-1.

Table 11-1 Evaluation of the Proposal against sections 4.15 matters for consideration

Relevant objects of the Act
To encourage: • the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment • the promotion and co-ordination of the orderly and economic use and development of land • the protection, provision and co-ordination of communication and utility services

Relevant objects of the Act
• the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats • ecologically sustainable development. The Proposal would involve a site-appropriate harvesting of solar resources for the purposes of electricity generation. The development would not affect land use capability or reduce future land and resource use options. The Proposal demonstrates clear economic and social benefits for the community, and negative impacts are shown to be localised, capable of mitigation and often confined to the construction phase. The Proposal would not adversely affect local communications or utilities infrastructure or services. The Proposal has been sited and designed to minimise impacts to threatened species, populations and ecological communities. Any residual impacts would be limited and offset according to State Government requirements. The Proposal is considered to be sustainable within the context of ESD principles; refer to Section 11.13.
Environmental planning instruments
Environmental planning instruments relevant to the Proposal are identified in Section 5. The Proposal and this report are consistent with the objectives and assessment requirements of these instruments.
The regulations (to the extent that they prescribe matters for consideration)
Clause 228 of the *EP&A Regulation 2000* lists factors that must be taken into account concerning the impact of an activity on the environment. Relevant factors and corresponding sections within this EIS include: (a) any environmental impact on a community (Sections 8.2 and 9.5) (b) any transformation of a locality (Sections 8.1, 8.3, 9.2) (c) any environmental impact on the ecosystems of the locality (Section 8.1) (d) any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality (Sections 8.3, 9.3) (e) any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations (Sections 8.1, 8.2, 8.3, 9.2, 9.5, 9.9) (f) any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974) (Section 8.1) (g) any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air (Section 8.1) (h) any long-term effects on the environment (Sections 8 and 9) (i) any degradation of the quality of the environment (Sections 8 and 9) (j) any risk to the safety of the environment (Sections 8 and 9) (k) any reduction in the range of beneficial uses of the environment (Sections 9.2, 9.5) (l) any pollution of the environment (Sections 9.1, 9.3, 9.7, 9.10) (m) any environmental problems associated with the disposal of waste (Section 9.11) (n) any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply (Section 8.4) (o) any cumulative environmental effect with other existing or likely future activities (Section 9.12).

Relevant objects of the Act
The Proposal has been assessed against each of these factors in this EIS. The report concludes that the Proposal would not result in significant impacts to any aspect of the environment, including the above factors, subject to the mitigation measures and offsetting provisions identified in the report.
The likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality
The likely impacts of the Proposal , including environmental impacts on both the natural and built environments, and the social and economic impacts in the locality, have been identified and quantified where possible in Sections 8 and 9 of this report. The assessments conclude that the Proposal would not result in significant impacts to the natural or built environment, or social and economic values in the locality, subject to the relevant mitigation measures and offsetting provisions identified in the report.
The suitability of the site for the development
The Development Site has been selected according to criteria relating to solar resources, network connection, hazard potential, planning requirements and likely environmental impacts. The suitability of the site for the proposed solar farm development is addressed in Section 11.11. The site is considered highly suitable for a utility scale solar farm development.
Any submissions made in accordance with this Act or the regulations
This EIS has been prepared in response to agency input to the SEARs, and the results of consultations involving a wide range of government and non-government stakeholders; refer to Section 6. Submissions received during the exhibition period of the EIS would also be taken into account in the planning and implementation of the Proposal.
The public interest
The needs and benefits associated with the Proposal are described in Section 2. The Proposal is considered to be demonstrably in the public interest because it would: • assist with the abatement of greenhouse gas emissions and the avoidance of dangerous climate change by displacing approximately 48,236 tonnes of carbon dioxide per year • benefit network reliability and security by providing embedded electricity generation close to local consumption, by providing a more diverse mix of energy sources, and potentially by providing stabilisation services to the grid using Battery Storage • support 100 direct and 160 indirect jobs over the construction period, and 3 direct and 9 indirect jobs during operation • provide an economic boost to the local economy through the purchase of local goods and services

11.13 ECOLOGICALLY SUSTAINABLE DEVELOPMENT

Ecologically Sustainable Development (ESD) involves the effective integration of social, economic and environmental considerations in decision-making processes. In NSW, the concept has been incorporated into legislation including the *Environmental Planning and Assessment Act 1979* and Regulation and the *Protection of the Environment Administration Act 1991*.

Based on the likely costs and benefits of the proposed solar farm, the Proposal is considered to comply with the principles of Ecologically Sustainable Development. ESD principles and their relationship to the design, construction and ongoing operations of the Proposal are identified in Table 11-2.

Table 11-2 Assessment of the Proposal against the principles of Ecologically Sustainable Development

(a) The precautionary principle—namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by: ***(i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and*** ***(ii) an assessment of the risk-weighted consequences of various options.***
The impacts of the construction of the solar farm at the site are likely to be reasonably predictable and carry low levels of uncertainty and risk. Based on field surveys and assessments, the works would be unlikely to result in irreversible environmental damage. The development would have an operational life of around 30 years and would be highly reversible. The precautionary principle has been observed in the assessment of impacts; all potential impacts have been considered and avoided or mitigated wherever possible where a risk is identified.
(b) inter-generational equity—namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.
The Proposal would not diminish long term ecological or agricultural productivity, biological resources or future land use options at the site. At the end of the operating life of the solar farm, the above-ground infrastructure would be removed (to a depth of 500 mm) to restore former land use potential, agricultural productivity and land use and planning options at the site. Soil values would be restored with reference to the results of a pre-works baseline soil survey. The Proposal would provide a significant environmental benefit by producing sustainable energy, reducing the reliance on fossil fuels which threatens the well-being of current and future generations through climate change. In contrast to non-renewable energy sources, the solar farm would not emit carbon dioxide, airborne particulates or other pollutants. At the end of its operational life, the Proposal would not require expensive and difficult land remediation or leave a legacy of toxic waste to be stabilised and stored.
(c) conservation of biological diversity and ecological integrity— namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration.
Layout planning and mitigation measures have been adopted to avoid or mitigate any impacts which would affect the long-term viability of populations of all native species at and around the site, particularly threatened species and communities. These measures include avoiding and protecting natural areas and habitats on the site. It is noted that climate change is a key global threat to many species and communities, and that the Proposal would contribute to the abatement of carbon emissions from the electricity sector in Australia.
(d) improved valuation, pricing and incentive mechanisms— namely, that environmental factors should be included in the valuation of assets and services, such as:

(i) ***polluter pays—that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement, and***
(ii) ***the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste, and***
(iii) ***environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.***

The Proposal would provide for the increased penetration of renewable energy into the energy market. The Battery Storage would use the market to regulate the storage and release of energy based on prevailing demand. To date the environmental and social costs of electricity generation have not been fully measured or incorporated into wholesale or retail electricity pricing. The long-term external costs of carbon-intensive energy sources in terms of climate change in particular have not been factored into prices. Photovoltaic solar farms produce approximately 40 grams CO_2eq/kWh, while coal produces approximately 1,000 grams CO_2eq/kWh (NREL 2012). This external cost differential is not reflected in electricity market prices.

External costs are similarly not included in calculations of Levelised Cost of Electricity (LCOE) - the discounted lifetime cost of ownership and use of a generation asset expressed in cost per MWh.

In terms life cycle energy consumption, the ‘energy payback time’ for polycrystalline PV modules has been estimated at two (2) years for a solar installation in Southern Europe (refer to Section 9.11).

12 CONCLUSION

The proposed 55 MW AC Dunedoo solar farm would be located approximately 2 km north of Dunedoo in the Central Western region of NSW, on approximately 79 ha of rural freehold land currently used for irrigated cropping and grazing.

The main impacts of the Proposal would be:

Construction phase (10 - 12 months)

- Clearing of 0.91 ha of native vegetation
- Intermittent construction noise and traffic from vehicles and machinery during standard work hours, which may affect local residents and road users.
- 100 direct and 160 indirect jobs over the construction period, and up to 3 direct and 9 indirect jobs during operation. Local business transactions are expected to represent at least 50% of the Proposal 's procurement spend.

Approximately $11.4 million injected into the local region during construction and additional monies during the operational life. **Operation phase (30 years)**

- Visual and landscape character impacts, which may affect local residents and road users
- Temporary suspension of agriculture at the site, offset by continued grazing at the site and increased production on other properties held by the landowner.

The key benefits likely to flow from the Proposal are:

- Substantial contribution to climate change objectives, including the Paris Agreement commitments, Renewable Energy Target, NSW Climate Change Policy Framework and NSW Renewable Energy Action Plan
- Improved electricity reliability and security by providing embedded generation closer to local consumption centres, contributing to a more diverse mix of energy sources and grid stabilisation using Battery Storage

The Proposal has been designed iteratively to avoid and minimise impacts, such as by excluding and protecting higher density paddock tree patches and remnant woodland areas. Mitigation measures have been identified in the EIS to address risks and impacts, including:

- Accessible and responsive consultation and notification process throughout the construction phase involving affected stakeholders, particularly neighbouring landholders and local road users
- Indigenous tree and shrub plantings along the property boundary where required to provide visual screening
- Soil protection throughout the life of the solar farm by maintaining perennial groundcover across the site (subject to climatic conditions)
- Comprehensive preparation and planning to account for potential hazards including hazardous materials and fire risks.

Residual biodiversity impacts would be offset in accordance with the NSW Biodiversity Offsets Scheme and will be achieved by making payments into the Biodiversity Conservation Fund using the offsets payment calculator.

The Proposal would not affect unique or significant agricultural land. Following decommissioning, solar farm infrastructure would be removed and the site would be restored to full agricultural and land use potential.

The EIS concludes that the Proposal would not result in significant impacts to environmental, cultural, social and economic values at the locality or region scales. The selected site is highly suitable for a utility scale solar development. On the whole, the impacts of the Proposal are localised, minor and reversible, and risks are manageable.

The Proposal would form an important part of Australia's response to climate change and government commitments in the abatement of carbon emissions in the electricity sector. The Proposal is consistent with the principles of Ecologically Sustainable Development, particularly in relation to climate change abatement and intergenerational equity. In view of the demonstrated need for, and benefits of, the Proposal, the Dunedoo solar farm is considered to be justified and clearly in the public interest.

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APPENDIX A SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

APPENDIX B PROPOSAL PLANS

APPENDIX C CONSULTATION

APPENDIX D BIODIVERSITY DEVELOPMENT ASESSMENT REPORT

APPENDIX E ABORIGINAL CULTURAL HERITAGE ASSESSMENT

APPENDIX F VISUAL IMPACT ASSESSMENT

APPENDIX G FLOOD IMPACT ASSESSMENT

APPENDIX H NOISE AND VIBRATION ASSESSMENT

APPENDIX I SOIL REPORT

APPENDIX J ECONOMIC IMPACT ASSESSMENT

APPENDIX K TRAFFIC ASSESSMENT

APPENDIX L COMMUNITY CONSULTATION PLAN

APPENDIX M TBD