Tenterfield Solar Farm

Statement of Environmental Effects

Prepared for
Enerparc Australia

13 May 2019

DOCUMENT TRACKING

Item	Detail
Project Name	Tenterfield Solar Farm – Statement of Environmental Effects
Project Number	11475
Project Manager	Alexandra Carynny T +61 2 4302 1225 Unit 1, Level 1, 79 Market St Mudgee NSW 2850
Prepared by	Alexandra Carynny, Robert Cawley, Eliza Biggs
Reviewed by	Rachel Murray, David Bonjer, Michelle Frolich, Tyler Beebe.
Approved by	Robert Cawley
Status	Final
Version Number	v3
Last saved on	13 May 2019
Cover photo	Tenterfield Solar Farm Site, taken by Andrew Crisp (ELA, 16/10/18)

This report should be cited as 'Eco Logical Australia 2019. *Tenterfield Solar Farm – Statement of Environmental Effects*. Prepared for Enerparc Australia.

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from Enerparc Australia (Enerparc).

Contents

List of figures

List of tables

Abbreviations

Abbreviation	Description
µT	Microtesla
AC	Alternating Current
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
ARPANSA	Australian Radiation Projection and Nuclear Safety Agency
BAM	Biodiversity Assessment Method
BC Act	*Biodiversity Conservation Act 2016*
BDAR	Biodiversity Development Assessment Report
BoM	Bureau of Meteorology
BOS	Biodiversity Offset Stratergy
BSAL	Biophysical Strategic Agricultural Land
CEMP	Construction Environmental Management Plan
CIV	Capital Investment Value
DC	Direct Current
DPI	Department of Primary Industries
DSM	Digital Surface Model
DTM	Digital Terrain Model
DMP	Decommissioning Management Plan
ELA	Eco Logical Australia Pty Ltd
EMF	Electromagnetic Field
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
EPA	Environmental Protection Agency
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection Licence
ESD	Ecologically Sustainable Development
FM Act	*Fisheries Management Act 1994*
GDE	Groundwater Dependent Ecosystems
GWh	Gigawatt hours
ICNG	Department of Environment and Climate Change's *Interim Construction Noise Guideline*

Abbreviation	Description
ISEPP	*State Environmental Planning Policy (Infrastructure) 2007*
JRPP	Joint Regional Planning Panel
KFH	Key Fish Habitat
kV	Kilovolt
Tenterfield LEP	*Tenterfield Local Environmental Plan 2013*
LCU	Landscape Character Unit
LGA	Local Government Area
MW	Megawatt
MNES	Matters of National Environmental Significance
NHMRC	National Health and Medical Research Council
NPW Act	*National Parks and Wildlife Act 1974*
NSR	Noise Sensitive Receiver
NSW	New South Wales
OEH	Office of Environment and Heritage
OEMP	Operation Environmental Management Plan
PBP 2018	*Planning for Bush Fire Protection 2018*
POEO Act	*Protection of the Environment Operations Act 1997*
PV	Photovoltaic
RBL	Rating Background Level
Roads Act	*Roads Act 1993*
RSD	Regionally Significant Development
RSWMP	Regional Strategic Weed Management Plan
RMS	Roads and Maritime Services
SEE	Statement of Environmental Effects
SEPP 44	*State Environmental Planning Policy No. 44 (Koala Habitat)*
SEPP 33	*State Environmental Planning Policy No. 33 – Hazardous and Offensive Development*
SEPP 55	*State Environmental Planning Policy No. 55 – Remediation of Land*
SRP	Spill Response Plan
TSF	Tenterfield Solar Farm
TTM	TTM Consulting Pty Ltd
WM Act	*Water Management Act 2000*
ZVI	Zone of Visual Impact

Executive summary

This Statement of Environmental Effects (SEE) has been prepared on behalf of Enerparc Australia Pty Ltd (Enerparc) for the proposed Tenterfield Solar Farm (TSF – the Proposed Development). The Proposed Development is a 25 MW_{AC} solar farm to be located within an area of approximately 60 ha (the Site), approximately 2 km east of the town of Tenterfield, New South Wales (NSW), within the Tenterfield Shire Local Government Area.

The Proposed Development will consist of infrastructure such as solar arrays, electrical cabling and connections, access tracks and security fencing, as well as underground transmission lines passing through a combination of road reserve and private property to a new 22 kV switchbay within the TransGrid Substation located approximately 1.5 km to the south west of the Site.

Under the *State Environmental Planning Policy (State and Regional Development) 2011*, electricity generating works (including solar) that are considered private infrastructure and have a Capital Investment Value greater than $5 million and less than $30 million are classified as “Regionally Significant Development” (RSD). RSD projects require approval under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The requirements of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* have also been considered during the preparation of this SEE.

The TSF requires consent from NSW Roads and Maritime Services (RMS) under section 138 of the *Roads Act 1993* to underbore the Bruxner Highway road reserve for the installation of the transmission line cabling. A controlled activity approval under section 91(2) of the *Water Management Act 2000* will also be required for cable and vehicular crossings of waterfront land (bed, bank or land within 40 m of a watercourse regardless of Strahler order). Due to the need for this consent, Division 4.8 of the EP&A Act categorises the works as Integrated Development. Enerparc are seeking approval for the Integrated Development through the Northern Joint Regional Planning Panel (JRPP) with assessment through the Tenterfield Shire Council.

Community consultation on the Proposed Development has been undertaken progressively since October 2018 in the form of letters, meetings with local landowners, an informational open day and consultation with Council and RMS. In addition, a project specific website (www.tenterfieldsolarfarm.com.au) has been established. Community consultation has identified the concerns of local residents and as a result, the design of the module layout and impact screening has been progressively modified to minimise adverse impacts.

Biodiversity

The proponent has committed to avoid, in the first instance, potential impacts to native vegetation, fauna and ecological communities by prioritising development in areas of exotic and cleared vegetation over areas of native vegetation. An initial review of environmental contraints and a comprehensive vegetation survey was undertaken across the Site for the Proposed Development. The results of the survey and plot data determined that there was not enough native vegetation present to warrant a full Biodiversity Development Assessment Report, and a Biodiversity Assessment was considered to be more appropriate for the Site. The Biodiversity Assessment did not identify any threatened species or ecological communities within the Site.A small (0.49 ha), linear strip of remnant grassland vegetation occurs on a mapped road reserve, adjacent to the Site.. This small area was classified as a variant of Plant Community Type 510 (*Blakely’s Red Gum – Yellow Box grassy woodland of the New England Tableland Bioregion*) which meets the criteria of the *White Box Yellow Box Blakely’s Red Gum woodland* listed as a Threatened Ecological Comminity under the EPBC Act, however following an assessment of site constraints, this area will not be impacted by the proposed development. Anticipated clearing of native vegetation will not exceed 1 ha and no old-growth or hollow-bearing remnant trees will be cleared as part of the proposal. The environment to be impacted by the Proposed Development is already highly disturbed and contains no significant habitat features. Mitigation measures including weed management and hygine protocols are recommended to further minimise any impact of the TSF on biodiversity. Following the completion of construction and restoration works, no long-term or residual impacts are considered likely to occur.

Heritage

Following an analysis of the desktop assessment (review of previously undertaken Aboriginal studies and database searches) and observations made during the archaeological field survey, the Site and proposed transmission line routes were considered to represent an area of low archaeological potential as a result of physical impacts caused by pastoral activities including vegetation clearing, ploughing, vehicle movement and dam/fence construction. The Proposed Development will not have any direct or indirect impacts on known historic heritage items. It is unlikely any items of historic significance remain unidentified within the Site, however, an unexpected archaeological finds procedure will be adopted and included in site induction processes and toolbox talks.

Land

The Site lies within the Tenterfield Plateau sub-region of the New England Tableland bioregion and is located in a rolling landscape, where elevation ranges around 880 - 890 m above sea level. Land within the Site has been historically cleared for grazing and most has been sown with improved pastures. There are small patches of native vegetation along roadsides, paddock edges, lower lying areas along drainage lines and scattered throughout paddocks. The Site and surrounding land, is zoned RU1 - Primary Production under the provisions of the *Tenterfield Local Environmental Plan 2013*. Solar energy systems are permitted with consent in this zoning. No critical industry clusters or Biophysical Strategic Agricultural Land have been mapped within or in vicinity of the Site. The Proposed Development involves a temporary diversification in land use of up to 60 ha for the duration of the project life (30 years). This changed land use may temporarily reduce production; however, once constructed, sheep grazing may continue within the Site to control vegetation beneath the solar array. Furthermore, the Proposed Development would not compromise the capacity for immediate neighbours to conduct existing or proposed primary production and, following the end of the Proposed Development's life span, the land can be returned to its pre-development use. This SEE identifies a series of environmental controls and measures to ensure that land resources are protected from adverse impacts.

Visual amenity

The overall impact of the Proposed Development on the rural landscape character is assessed as Low. It is due to the rolling to hilly nature of the Site and surrounding land that the solar infrastructure should be largely obscured and/or screened from direct views. Zone of Visual Impact analysis using a digital surface model that incorporated screening effects of the existing vegetation and built structures outside of the Development Footprint indicates that some part of the Proposed Development was potentially visible from 33 of the 1,725 identified receptors within 5 km of the preliminary Development Footprint. Of these 33, seventeen are located within 2 km of the preliminary Development Footprint and sixteen between 2 km and 5 km of the preliminary Development Footprint. Public viewpoints within 5 km of the Site are restricted to public roads. Mitigation measures including ongoing stakeholder consultation and landscaping strategies (including visual setbacks and identification of vegetative screening opportunities) have been developed, where necessary, to provide low or insignificant visual impacts at all identified receptors. Post-decommissioning, the continuation of agricultural production and removal of all above-ground infrastructure results in an insignificant residual visual impact.

Noise

The Proposed Development is located within a rural landscape and, background noise sources and levels are considered to be low, typical of the rural setting. Thirty-five residences are located within 1 km of the assessed preliminary Development Footprint. Acoustic modelling uses a worst-case prediction scenario to assess the maximum possible noise impact where it is assumed that all noise-generating construction machinery are being operated concurrently at the nearest part of the Development Footprint to each respective receiver. While maximum impact will only be for a short duration until the activities move to a different location, assessing the maximum impact ensures the right mitigation methods are implemented. The worst-case modelling indicates that the ICNG Noise Management Level of 50 dB(A) would be exceeded during the noisiest construction tasks (under worst-case atmospheric, meteorological and ground attenuation conditions) for residences located within 550 m of the Development Footprint. The period of time during which the exceedance could occur at any particular receiver will be a very small proportion of the overall 6-month construction period, when the construction activities are at the edge of the Development Footprint closest to that particular receiver. The ICNG highly noise affected limit of 75 dB(A) is not exceeded at any residences even during the noisiest construction tasks. Impact from operational activities is predicted to be insignificant. Mitigation measures are provided to further reduce potential impacts during all project phases.

Transport

The Site is located to the north of Old Racecourse Road in Tenterfield. The Proposed Development will be accessed via a new access point off Old Racecourse Road. Most construction trucks and staff vehicles will come via New England Highway, Bruxner Highway, Bellevue Road, and Old Racecourse Road. The local roads (other than the Bruxner Highway) are used by the residents to access their farms and houses. Traffic flows on the local roads are low. The Proposed Development is forecast to generate around five heavy vehicles and up to 40 light vehicles a day during the seven month construction period. The existing road network will not be significantly affected by the additional traffic. The Road Safety Audit identified potential sight distance issues and recommended roadworks to be addressed prior to commencement of construction activities.

Water

The Site lays within the upper reaches of the Border Rivers Catchment area. The Site drains generally in a northerly direction via first order streams and a second order stream (Strahler, 1957) to Pitkins Swamp Creek, a fourth order stream which forms the northern boundary. The second order stream is a gentle sloping area that extends into a low lying floodplain adjacent to Pitkins Swamp Creek. Pitkins Swamp Creek is a shallow, narrow winding creek with a mostly mud or fine sand substrate that is impacted by historical land management activities including livestock access. Aquatic vegetation was sparsely distributed in the creek, and biodiversity was low. Riparian vegetation and the riparian zone generally throughout the Site are cleared and/or highly degraded to support agricultural activities and comprise exotic species. There are also a number of farm dams present. Background searches of threatened species that may occur in the locality had indicated potential impact for two aquatic species within Pitkins Swamp Creek. However, field survey has concluded that it is unlikely that Purple-Spotted Gudgeon or Tusked Frog occur in the area, so the potential for impact to either species is negligible.

The Proposed Development has been assessed as having no direct impacts on water resources. There is low potential for indirect impacts to occur during the construction, operation and decommissioning stages through the process of erosion and sedimentation. Solar panels will be located away from the waterway, and there is no construction planned for inside the riparian corridor, so impacts to Pitkins Swamp Creek from the proposed solar farm will be negligible or minor. If the creek is fenced off from stock, and stocking rates lowered, the ecological condition of Pitkins Swamp Creek may potentially improve.

As a result of a design philosophy that, in the first instance seeks to avoid impacts, the following environmental protections are adopted:

- Exclusion from the Development Footprint of Pitkins Swamp Creek (4^{th} order stream) and associated riparian zone (a buffer distance of at least 40 m from the creek bank);
- Avoidance of footings and pilings, where practicable, from 1^{st} and 2^{nd} order riparian zones;
- Avoidance of creek crossings for internal access and cabling;
- Sourcing of non-potable water from onsite dams and/or existing water licenced sources offsite; and
- Sourcing all potable water requirements from offsite.

Management plans shall be developed to assess and identify appropriate operational protocols to ensure the protection of surface and groundwater quality, maintenance of water supplies and rights of access, and the protection of riparian, aquatic and groundwater dependent ecosystems.

Hazards and Risks

Hazards and risk assessments considered bushfire, electrical fire and electromagnetic interference. Small portions of the transmission line route, the Site, and its surrounds are mapped as Bushfire Prone Land on the Tenterfield LGA Bushfire Prone Land Map (NSW RFS, 2018). The Proposed Development is located within cleared areas, away from infrastructure, residences and Pitkins Swamp Creek. In terms of onsite resources, the Site is well serviced by multiple sealed roads (Old Racecourse Road and Bellevue Road). There will also be internal access tracks created for the Proposed Development. These roads can provide emergency evacuation routes and emergency vehicle entry. The flammability of solar farms is very low as they are predominantly constructed of glass, silicon, steel and aluminium. While fires (such as grassland fires) have the potential to occur, the risk of fire originating from the Site is very low. With appropriate mitigation strategies in place, bushfire and electrical fire risks during the operation of the solar farm are considered highly manageable.

Potential electromagnetic field (EMF) impacts would occur only during the operational phase, when the solar farm infrastructure is capable of generating EMFs. EMFs produced by the PV solar array would be significantly less than those produced for household applications (Chang & Jennings, 1994). The EMFs produced by the underground (up to)22 kV cables connecting the solar array with the adjacent existing TransGrid 132/22 kV substation will be insignificant due to the insulative effect of burial and in built cable shielding. Any EMFs produced by the existing substation would already comply with exposure limits (EMFs Info, 2017). Given the distance of residences from the highest EMF emitter (the substation), the low EMFs emitted from the PV solar arrays, the existing 11 and 22 kV distribution network, and two TransGrid 132 kV transmission lines located near these residences, EMFs from the Proposed Development are likely to be indistinguishable from background levels at the boundary fence.

Socioeconomic

Tenterfield provides essential retail, commercial and community services to local communities, as the northern gateway to New England adjoining the Queensland border (NSW DPE, 2017). Tenterfield has a strong economy based on agriculture, as well as construction, retail trade, health, education and tourist accommodation.

The Proposed Development would have an overall positive impact on the local and wider economy during the construction and decommissioning stages which will generate the largest economic gain for the greatest number of people and businesses. This is due to the hiring of a large temporary work force over these periods. Employment opportunities would involve landscaping for vegetative screening, concreting, earthworks, steel works and electrical cabling during construction, with demolition and removal during decommissioning. Where practicable, Enerparc will source from local companies. Indirect employment opportunities would involve food industries, fuel, accommodation and other services that contractors coming to the area would require. Local employment opportunities will be generated, while additional workers from outside the region would stimulate the local economy through demand for accommodation, hospitality and retail services. A temporary influx of staff may lead to a small, but temporary, increase in pressure on local services, including accommodation. Enerparc will liaise with relevant local representatives to maximise the benefits to the local economy, by recruiting contractors from the local area and implementing an informal ‘buy local’ practice where goods and services are purchased from local businesses, provided that they are competitive in terms of quality and price.

The Proposed Development would provide a number of employment opportunities and benefits to the local economy, while reducing carbon emissions and providing progress towards national and international environmental commitments.

Electricity produced from the Site provides a clean power source for local and regional consumers in a cost-effective manner. With a 25 MW_{AC} and up to 32,180 kWp the solar farm will produce 52.45 GWh of clean renewable energy per year to the local electricity transmission network, providing enough energy to power up to 9,530 average homes each year. This would reduce up to 42,930 tonnes of CO^2 per annum through the displacement of conventional electricity supply.

A Community Consultation Plan will be prepared and implemented outlining the measures that will be taken during the construction phase to increase positive benefits to the Tenterfield community and to reduce any adverse impacts. It will note protocols to keep the community updated on project progress during the construction phase, how relevant stakeholders will be informed of potential impacts, and the resolution process, for any complaints received.

Environmental Management

Environmental Management Plans would be prepared following final design and prior to each respective development stage to provide an overall framework for the management of environmental impacts that could potentially arise during the construction, operation and decommissioning of the Proposed Development. These plans will also include an Emergency Response Plan, Erosion and Sediment Control Plan, a Spill Response Plan, a Waste Management Plan, a Bushfire Management Plan, and a Community Consultation Plan.

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

- Relevant legislation;
- Conditions of consent; and
- Commitments provided in this SEE.

Residual risks following the application of mitigation strategies identified in this SEE are shown to be generally low or medium, and can be reasonably managed. The reasons for justifying the Proposed

Development are demonstrated within this Statement of Environmental Effects and accord with environmental, social and economic considerations, as well as the principles of Ecologically Sustainable Development.

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

1 Introduction

1.1 Tenterfield Solar Farm Overview

The proposed Tenterfield Solar Farm (TSF – the Proposed Development), located within the Tenterfield Shire Local Government Area (LGA), proposes to generate electricity through the conversion of solar radiation to electricity using Photovoltaic (PV) panels laid out across the solar farm site (the Site) in a series of fixed modules, mounted on steel racks with piled, screwed or ballasted supports. Other infrastructure that is proposed to be present on site includes electrical power conversion units, underground electrical cabling, telecommunications equipment, storage facilities, vehicular access, security fencing and gates.

Electricity shall be fed from the TSF to the TransGrid Substation, located approximately 1.5 km south-west of the Site. The proposed route for the grid connection generally follows private property and road reserves associated with Old Racecourse Road, with an underbored crossing of the Bruxner Highway road reserve. The proposed route of the connection infrastructure is included within the studied area.

The Proposed Development has an estimated Capital Investment Value (CIV) of more than $5 million, but less than $30 million. Under the *State Environmental Planning Policy (State and Regional Development) 2011*, electricity generating works (including solar) that are considered private infrastructure and have a CIV greater than $5 million, but less than $30 million, are classified as “Regionally Significant Development” (RSD).

In addition, the Proposed Development requires consent from Roads and Maritime Services (RMS) under section 138 of the *Roads Act 1993* (Roads Act) to underbore the Bruxner Highway for the installation of the transmission line cabling and controlled activity approval under section 91(2) of the *Water Management Act 2000* will also be required for cable and vehicular crossings of waterfront land (bed, bank or land within 40 m of a watercourse). As such, TSF is considered to be Integrated Development in accordance with Division 4.8 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This Statement of Environmental Effects (SEE) has been prepared to assist Enerparc Australia Pty Ltd (the Proponent) gain development approval for the Integrated Development through the Northern Joint Regional Planning Panel (JRPP), with assessment through the Tenterfield Shire Council.

1.2 Tenterfield Solar Farm Setting

The Proposed Development is located on land within the Tenterfield Shire LGA approximately 2 km east of the town of Tenterfield, New South Wales (NSW), (Figure 1) and accommodated within four (4) parcels of land. Additional to the four parcels of land allocated for the solar panel array area, there is also a transmission line route that forms part of the Proposed Development. This transmission line route heads along Old Racecourse Road, before passing through private property and under the Bruxner Highway to arrive at the current substation on Bellevue Road. Table 1 identifies all lots associated with the TSF.

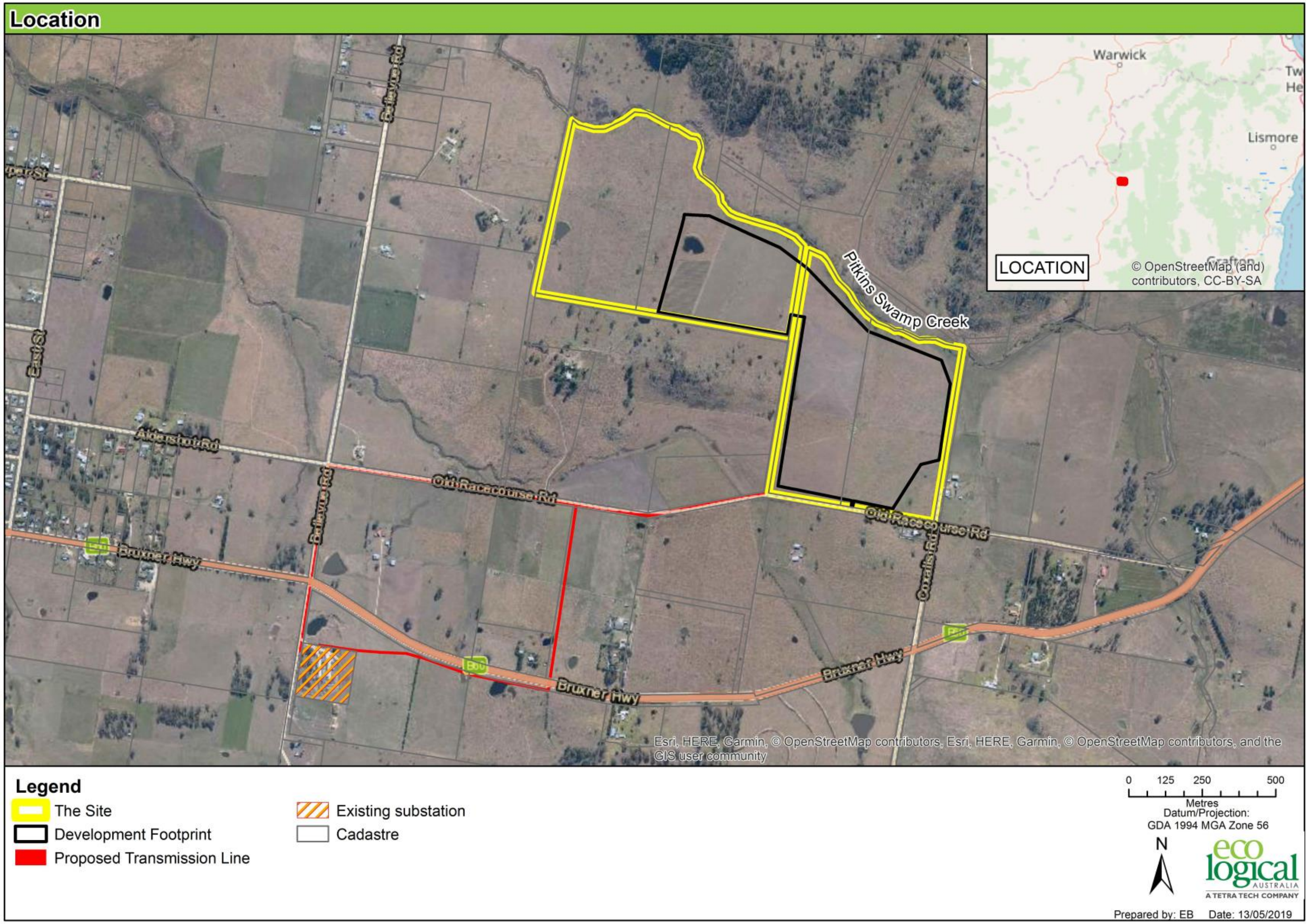


Figure 1: Tenterfield Solar Farm setting and study area

Table 1: Landholdings associated with the Site and transmission line route

Lot//Deposited Plan	Size (ha)	Proposed Use	Lot//Deposited Plan	Size (ha)	Proposed Use
Lot 85 // DP 751540	21.2	Site	Lot 89 // DP 751540	18.7	Site
Lot 87 // DP 751540	23.3	Site	Lot 90 // DP 751540	19.9	Site
Lot 1 // DP 779055	6.0	Transmission line	Lot 1 // DP 782041	18.7	Transmission line
Lot 528 // DP 751540	15.3	Transmission line	Lot 862 // DP 1218118	38.3	Transmission line
Lot 437 // DP 751540	13.8	Transmission line	Lot 1 // DP 529125	3.4	Substation link

The Site and adjoining land is zoned RU1 – Primary Production and is comprised of previously cleared and improved agricultural land that is currently used for cattle grazing. For each of the parcels of land that are proposed to be used for the TSF, a 3-year land lease agreement has been negotiated between the landowner and the Proponent. Following the 3-year lease, an option of an additional 25 year lease will follow.

The land surrounding the Proposed Development is primarily used for agricultural activities, with associated rural dwellings comprising a mix of involved and non-involved residences, totalling 35 within one kilometre of the Site. A Travelling Stock Reserve (TSR) is located to the north of the Site. The closest residence is located approximately 35 m from the eastern boundary of the Site and the closest residentially zoned land is approximately 1.3 km to the west of the Site.

General access to the Site will be via a new access point off Old Racecourse Road. Construction vehicles will arrive via the New England Highway, Brunxer Highway, Bellevue Road and Old Racecourse Road. An alternative entry point shall be via Coxalls Road.

1.3 The Proponent

Enerparc is a global expert in developing, engineering, building, and operating large-scale PV systems. As an Engineering Procurement Construction (EPC) contractor, Enerpac has connected over 2,000 MW (Megawatts) of solar systems to electricity grids, a knowledge base that was drawn upon to combine speed, flexibility, and high quality in delivering projects. With a local presence in active solar markets including Europe, North America, Middle East and Asia, Enerparc are one of the largest Independent Power Producers in solar energy with more than 200 discrete solar projects in their portfolio, with an installed capacity of over 1,100 MW and are a long-established renewable energy developer, owner and asset manager.

2 Description of Development

2.1 Details of construction, operation and decommissioning

It is anticipated that the Proposed Development would take approximately 7 months to construct and would be operational for approximately 28 years. Following the operational period, all above ground infrastructure would be removed from Site which would take approximately 6 months. As such, development consent for the Proposed Development is sought for 30 years.

The solar array includes fixed PV modules which comprise of approximately 107,268 pieces, with 10 inverter stations expected to be in operation. The combined electricity generation capacity is approximately 25 MW_{AC}.

The solar panels would be fitted to fixed frames (i.e. non-tracking) which would be orientated so that the panels face upwards at approximately 25 to 30^{0} in a northerly direction. The solar array will be supported by approximately 750 piles which would be mechanically driven or screwed into the ground. Figure 2 shows a typical module table landscape.

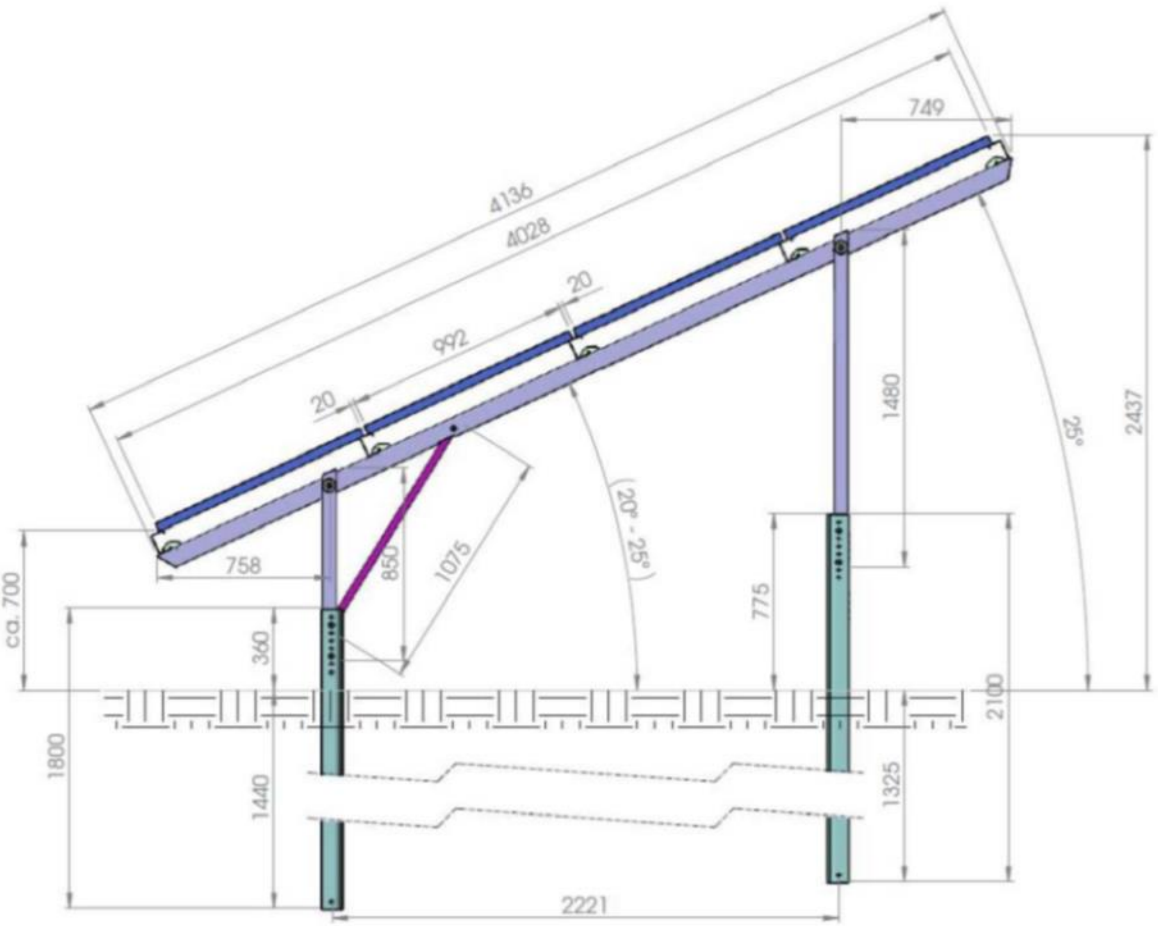


Figure 2: Module table landscape

The solar array would be wired in 'blocks' that would be connected to inverter stations located throughout the Proposed Development. Blocks would not necessarily appear as discrete entities but would appear as a series of continuous rows running in an east-west alignment. The solar array would connect to the substation through a 22kV line that would be installed below ground.

Inverter stationstations

PV panels produce Direct Current (DC) electricity which would be converted to Alternating Current (AC) at 10 inverter stations of approximately 3MVA capacity, each. Inverter stations are typically housed in containers, or located on platforms, either singularly the size of a 20 ft container, measuring approximately 6.1 m (l) x 2.9 m (h) x 2.5 m (w), or doubly the size of a 40 ft container measuring approximately 12.2 m (l) x 2.9 m (h) x 2.5 m (w). Each inverter station would also have:

- Circuit breakers;
- Transformer; and
- Communication equipment.

Inverter stations will be transported to the Site ready-made and require little in the way of foundations, either attached to steel or concrete pilings approximately 1.6 m deep depending on ground conditions.

Onsite building

A support building and/or storage shed with fire-fighting water tank and associated parking would take a maximum additional area of 50 m by 50 m

Onsite buildings will be designed to support operational requirements during the operational life of the Proposed Development and will comply with all relevant Australian building standards and regulations. Water will be supplied to the Site by commercial contactors and stored onsite in water tanks.

Cables and cable trenching

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

- Below ground warning tapes;
- Below ground Polymeric cover strips;
- Electrical cables to export power;
- Electrical supply cables where necessary;
- Earthing cable;
- Communications and Supervisory Control and Data Acquisition links; and
- Above ground warning signs.

Where possible, trenches will be located alongside/underneath internal access tracks to minimise ground disturbance.

2.1.1 Construction Phase

It is anticipated that the Proposed Development would take approximately 7 months to construct.

Primary Construction Activities

Primary construction activities include:

- Installation of erosion and sedimaent control measures;
- Establishment of temporary construction compound and laydown areas;
- Vegetation screen planting;

- Construction of internal tracks and culverts;
- Assessment for the need to upgrade access roads;
- Construction of perimeter fence and establishment of firebreak;
- Establishment support buildings;
- Preparation of array area;
- Removal of farm dam/s (if required);
- Installation of piles and mounting system;
- Securing panels to the mounting system;
- Installation and connection of inverter stations;
- Trench digging, cable laying and/or cable stringing;
- On Site grid connection;
- 22kV switchbay at TransGrid substation;
- Removal of temporary construction compound and facilities;
- Rehabilitation of disturbed areas of Site; and
- Solar Farm Commissioning.

Overall, solar farms sit lightly on the land. Ground disturbance is low and will be principally associated with the installation of framing to support the panels and trenching for cables. Other components that would impact directly on the Site include access tracks, support buildings, the temporary construction compound and the perimeter fence.

Construction hours

Construction work will be undertaken within standard construction hours:

- Monday to Friday, 7 am to 6 pm; and
- Saturday, 8 am to 1 pm.

Any construction activities outside these hours would only be undertaken following consultation with relevant authorities and notification of immediate neighbours.

Construction resource requirements

Resource requirements and their likely sources are shown in Table 2. As far as possible local resources and/or suppliers will be used for the construction of the Proposed Development.

Table 2: Resource requirements and sources for the Proposed Development

Resource	Detail	Likely Source
Plant and Machinery	Pile drivers, mobile crane, earth moving equipment, diesel generators, concreting equipment	Wider NSW for larger equipment; local where possible
Materials and equipment	Steel, gravel, sand, cables, trees for landscaping, solar panels, inverter stations	Gravel, sand, and landscaping equipment will be sourced locally; some materials and equipment, for example solar panels and inverter stations are manufactured overseas
Labour	Variety of positions required depending on construction activity	National and local contracting staff
Accommodation	Accommodation for workers	Tenterfield and wider New England region

2.1.2 Operational Activities

The operational period is anticipated to commence immediately following construction. Operational activities include:

- Monitoring of solar production – analysis of Supervisory Control and Data Acquisition data;
- Export of solar energy to the National Electricity Grid;
- Maintenance of all plant and equipment – visual inspections; engineering work and replacement of equipment as required;
- Security – remotely and through routine site inspections;
- Vegetation monitoring and management – routine vegetation management and monitoring in panel areas (sheep may be permitted to graze within panel areas) and the vegetation buffer areas;
- Erosion monitoring – routine monitoring for scarring beneath the panels and along access tracks and waterways.

During the operational period there would be approximately 8 to 12 full time staff who may routinely visit the solar farm to carry out activities as listed above. Travel would be in standard 4x4 vehicles; however, should there be a requirement for major maintenance work, larger trucks and equipment may need to be deployed.

2.1.3 Decommissioning

During decommissioning all above ground infrastructure would be removed to a level of at least 0.5 m below the surface and the Site restored to its pre-development state.

Key activities shall include:

- Disconnection from the substation;
- Dismantling of the support buildings;
- Removal of the solar arrays, piles and cabling;
- Removal of onsite tracks and fences unless agreed otherwise with the landowner; and
- Disturbed groundcover would be reinstated.

It is anticipated that decommissioning would take up to 6 months. Impacts would generally be similar in effect, but shorter in duration, than those experienced during construction. Reuse of materials will be considered first prior to recycling and/or waste disposal.

2.2 Site selection and layout

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

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

In addition, the following specific principles were adopted:

- Minimise native vegetation clearing – areas of high conservation value and/or native vegetation shall be strategically avoided, or managed through low/no impact activity;
- Minimise land disturbance – solar arrays shall be attached using piles either driven into the ground. Ground disturbance shall be limited to the area of contact between the pile and the ground. Design footprints for tracks, cable trenches and support buildings shall be limited to the minimum area required;
- Protect riparian zones – defined 3rd order (Strahler) and higher riparian zones shall be excluded from the developable area and a 50 m buffer implemented due to the heritage constraints identified as per field assessment;
- Use previously disturbed land – as much as possible the Proposed Development shall be located on previously cultivated and/or modified land;
- Protect cultural heritage values – through the identification and evaluation of cultural heritage assets at the Site;
- Minimise direct and indirect impacts – as far as practicable, infrastructure shall be located away from nearby residences and adjoining properties; and
- Adopt a flexible approach to design – the final project design shall respond to identified environmental impacts and constraints.

2.3 Design evolution and key constraints

From the outset, the Proposed Development has adopted a methodology to, in the first instance, avoid possible environmental impacts. This design ethic is central to the current proposal and has been adopted at all stages of design.

The design of the TSF has evolved from project inception, which has included the implementation of mitigation strategies to minimise impacts to the surrounding community, visual amenity, biodiversity and traffic impacts. Figure 3 indicates the main constraints which have assisted with the ongoing design of TSF. The below aspects have been considered and constraints adjusted continually throughout the design of the Proposed Development:

- Visual impacts, considering comments from the local community and directly affected residents;
- Biodiversity and water impacts, considering minimising the impacts to native vegetation as much as possible;
- Heritage impacts, considering the Aboriginal due diligence study;
- Land impacts, considering combined low-pressure grazing in conjunction with electricity generation on the Site;
- Noise and transport, assessing options for transporting material and workers into the Site to ensure safety and community acceptance; and
- Hazards and risks, reviewing potential hazards to the solar farm and surrounding land owners to ensure all risks have been identified early so that they can be managed.

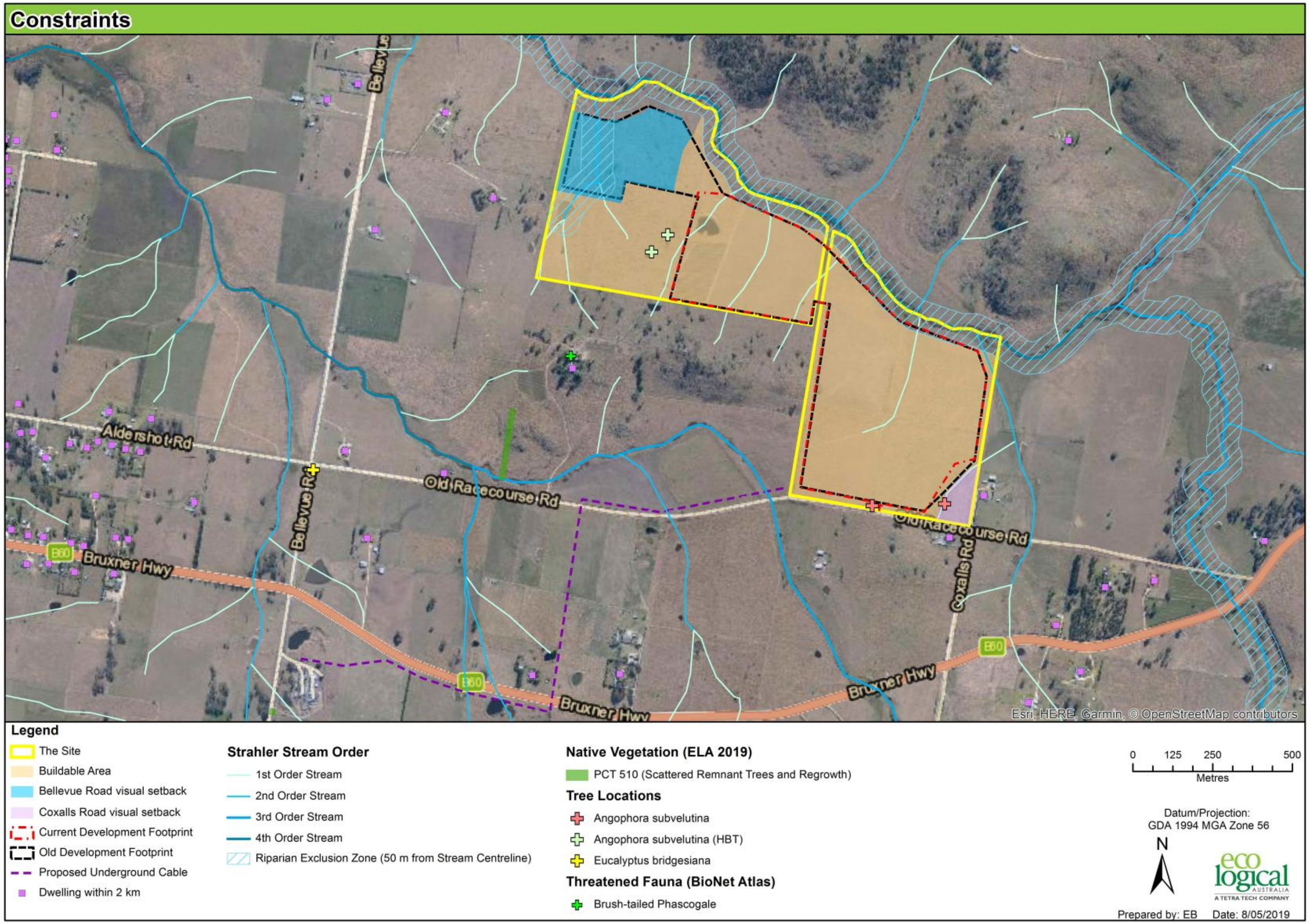


Figure 3: Environmental constraints

Locality – The Tenterfield region was chosen for the proposal site based on the grid connection opportunity and strong stakeholder awareness and acceptance that compared it favourably with other potential locations in the region.

Site – The selected properties were chosen as the preferred Site based on:

- Land access:
- good solar irradiance;
- low relief land;
- close to major transport corridors (New England and Bruxner Highway);
- proximity to existing electrical infrastructure with TransGrid substation (1.5 km away) to avoid the need to add an additional substation;
- limited impacts on residents located within 2 km of Site boundary;
- minimal site disturbance proposed when using pile driven array mounts; and
- minimal long term impacts expected on agricultural capability.

Preliminary Development Footprint – Within the Site, a preliminary Development Footprint was produced which accommodated initial avoidance areas identified through early environmental studies and community consultation. This preliminary Development Footprint was used to assess potential visual and noise impacts to further refine the design of the Proposed Development.

Development Footprint – The Development Footprint represents the final extent of this Development Application, excluding constrained areas of avoidance identified during the assessment process. In particular, this Development Footprint includes additional setbacks of the Proposed Development from neighbouring residences. The Site and Development Footprint are illustrated in the Site Plan (Figure 3).

Conceptual Module Footprint Layout – Figure 4 indicates the conceptual module footprint layout. The blue hashed section shows the areas in which the modules may be placed. The yellow sections in the northern and eastern parts of the Development Footprint is the construction area. The green section in the north west section shows the buffer area where no works will occur due to constraints identified for visual, biodiversity and heritage items. The red dashed line indicates fencing locations and the blue line to the south of the Development Footprint shows the transmission line route.

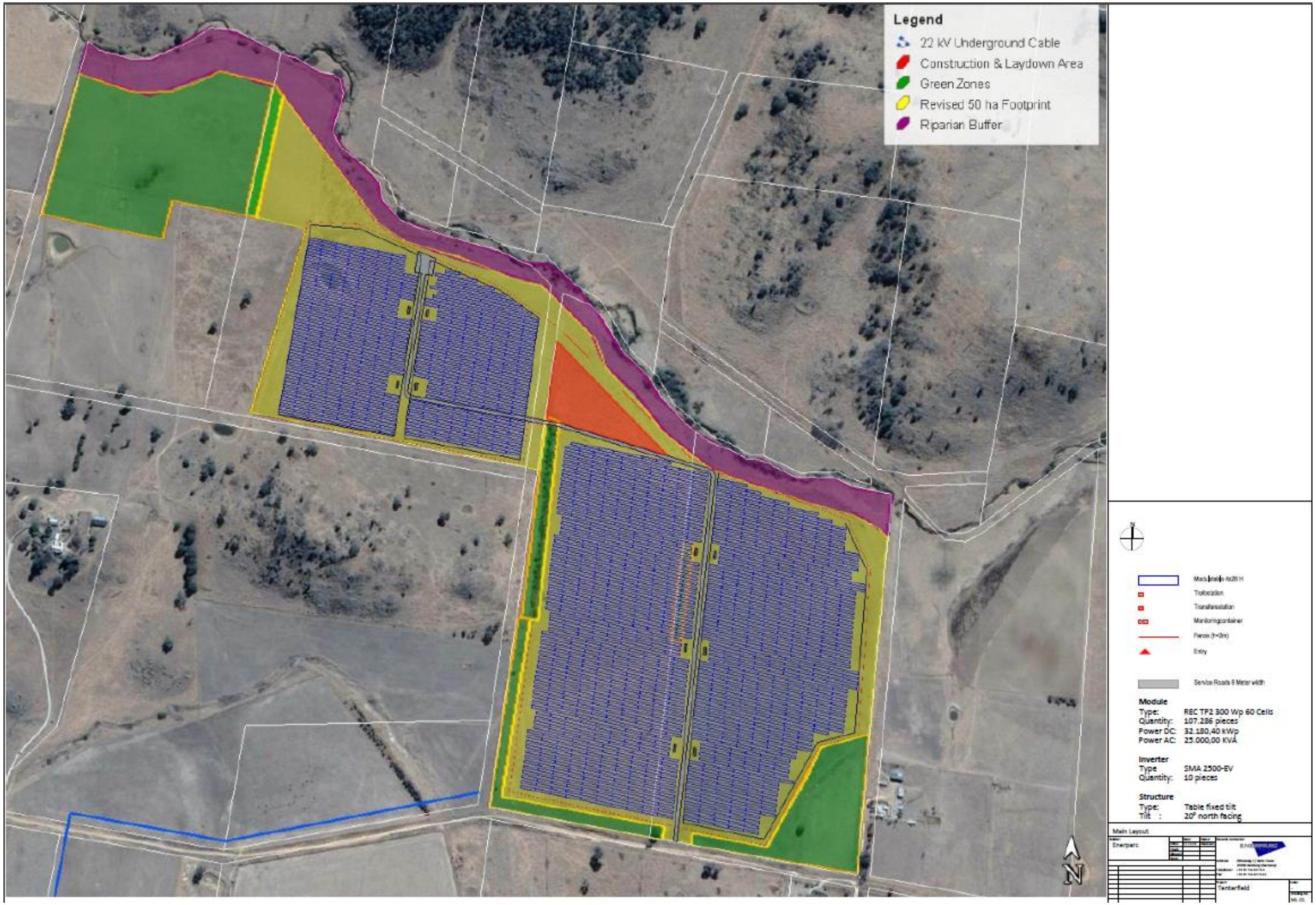


Figure 4: Buildable land and indicative Module Footprint. Source: Enerparc

3 Legislation and Statutory Requirements

A review of relevant legislation and statutory requirements pertinent to the Proposed Development

3.1 Permissibility and approval

The Proposed Development and surrounding land is zoned as RU1 - Primary Production under the *Tenterfield Local Environmental Plan 2013* (Tenterfield LEP). Solar energy systems are permitted with consent in this zone.

As an activity that is permitted with consent, the Proposed Development will be assessed under Division 4.1 of the EP&A Act. The requirements of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) have also been considered during the preparation of this SEE.

Under the *State Environmental Planning Policy (State and Regional Development) 2011* (Schedule 7, section 5), private infrastructure including electricity generating works with a CIV of more than $5 million is considered RSD. The Proposed Development has an estimated CIV of less than $30 million, and above $5 million which generally categorises similar projects as RSD.

The project requires consent from RMS under section 138 of the Roads Act to underbore the Bruxner Highway to install transmission line cabling and a controlled activity approval under section 91(2) of the WM Act will be required for cable and vehicular crossings of waterfront land, accordingly, Division 4.8 of the EP&A Act categorises the works as Integrated Development.

As such, the Proponent is seeking approval for the Integrated Development through the Northern JRPP with assessment through the Tenterfield Shire Council.

3.2 Commonwealth Legislation

3.2.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act protects Matters of National Environmental Significance (MNES), such as threatened species and ecological communities, migratory species (protected under international agreements), and National Heritage places (among others).

Any actions that will or are likely to have a significant impact on MNES require referral and approval from the Australian Government's Environment Minister. Significant impacts are defined by the Commonwealth guidelines and policies (DotEE, 2013) for MNES. Potential impacts to MNES are summarised in Table 3.

Table 3: Impacts on Matters of National Environmental Significance

Factor		Likely impact
a.	*Any impact on a World Heritage property?* The proposal would not impact any World Heritage property	Nil
b.	*Any impact on a National Heritage place?* The proposal would not impact any National Heritage place	Nil
c.	*Any impact on a wetland of international importance?*	Nil

	Factor	Likely impact
	The proposal would not impact any wetland of international importance	
d.	*Any impact on a listed threatened species or communities?* Detailed habitat assessments and targeted flora and fauna surveys addressed in Section 5.1 of this SEE and Appendix B, indicate that the proposal is unlikely to impact on EPBC listed threatened species or communities.	Unlikely
e.	*Any impacts on listed migratory species?* Assessments in Section 5.1 of this SEE and Appendix B, indicate that the proposal is unlikely to impact on any Commonwealth-listed migratory species	Unlikely
f.	*Any impact on a Commonwealth marine area?* The proposal would not impact any Commonwealth marine area	Nil
g.	*Does the proposal involve a nuclear action (including uranium mining)?* The proposal does not involve a nuclear action	Nil
h.	*Additionally, any impact (direct or indirect) on Commonwealth land?* No Commonwealth land would be impacted by the proposal	Nil

Based on the assessment include in this SEE, referral to the Commonwealth Department of the Environment and Energy is not recommended.

3.2.2 Native Title Act 1993

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

The Site is not located within any areas covered by a Native Title Claim. There is however, an application made by the Western Bundjalung People in 2012 exists in the area surrounding the Proposed Development. The boundary of the claim area is to the north-east of the proposed Site, within a 5 km radius. There is also a claim that was withdrawn in 2001 which has been identified as being partially within the Site.

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

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

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

The Proposed Development does not involve the export, import and transit of hazardous waste.

3.3 State Legislation

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

The EP&A Act is the principal planning legislation for NSW. It provides a framework for the overall environmental planning and assessment of development proposals.

As an activity that is permitted with consent, the Proposed Development shall be assessed under Division 4.1 of the EP&A Act. As per Section 3.3.15, consent is required from RMS for the transmission line to cross the Bruxner Highway. Due to this consent being required, Division 4.8 of the EP&A Act categorises the works as Integrated Development.

3.3.2 Environmental Planning and Assessment Regulation 2000 (EP&A Regulation)

Clause 228 of the EP&A Regulation sets out 16 factors that need to be considered when assessing environmental impact under Part 5 of the EP&A Act. These factors are addressed in this report and relevant sections are listed below. Table 4 summarises the compliance of the Proposed Development under the EP&A Regulation and the sections of the SEE where these items have been assessed.

Table 4: Compliance with clause 228(2) of the EP&A Regulation

Clause 228(2) Factors	Impact	Section of SEE
Any environmental impact on a community?		
Visual impacts on the community are anticipated to be generally low and will be mitigated. Associated upgrades to access roads are expected to improve road safety. Short term and minimal adverse impacts to noise, air quality, traffic and water resources would be limited to the construction stage and would be managed through the preparation and implementation of a Construction Environmental Management Plan (CEMP) and environmental safeguards.	Low	Section 5, 6
Any transformation of a locality?		
No significant transformation of locality is proposed as part of the works. The works involve a diversification of land use to incorporate solar energy production with existing grazing activities.	Nil	Section 5.3
Any environmental impact on the ecosystem of the locality?		
The Proposed Development will result in some insignificant impacts to local vegetation within the development footprint that will be minimised by appropriate mitigation measures. The Proposed Development will not result in any significant adverse impacts on the ecosystem of the locality.	Low	Section 5.1, 5.7
Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?		
The proposed modifications will not have any long-term impacts that reduce an aesthetic, recreational, scientific or other environmental quality or value of the locality. Potential short-term impacts to amenity may exist during the construction phase only. The works will not significantly reduce aesthetic, scientific, or other environmental quality or value of the locality. All impacts on threatened species and communities have been considered and mitigated in Appendix B	Low	Section 5.4, 5.3
Any effect in 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?		

Clause 228(2) Factors	Impact	Section of SEE
The TSF will not impact any locality, place or building of significance or special value. Additionally, impacts will be minimised by appropriate mitigation measures and the Site will be restored to its pre-development state post-decommissioning.	Low	Section 5
Any impact on the habitat of protected animals (within the meaning of the *Biodiversity Conservation Act 2016*)?		
There are no significant negative impacts on habitat for protected fauna. If any impacts are identified during the construction phase, these can be readily managed through the implementation of the mitigation measures.	Low	Section 5.1 Appendix B
Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?		
TSF would not result in the endangering of any species of animal, plant or other form of life.	Low	Section 5.1
Any long-term effects on the environment?		
No long-term impacts on the environment are likely.	Low	Section 5
Any degradation on the quality of the environment?		
The operational land use as a solar farm would likely reduce the potential for impacts to water quality, compared to current agricultural landuse practices.	Low	Section 5.3
Any risk to the safety of the environment?		
A low risk to the safety of the environment is associated with this project. Potential for a small chemical spill (e.g. fuel or oil) from machinery used in the works is possible. Mitigation measures will be adopted to minimise this risk even further. The risk to the environment is considered negligible.	Low	Section 5.3
Any reduction in the range of beneficial uses of the environment?		
The TSF would not result in the reduction of beneficial uses of the environment. It is the intention for grazing to continue beneath the panels.	Low	Section 5.3, 5.9
Any pollution of the environment?		
No pollution of the environment is proposed or likely. There is always a small risk of this occurring however the risk is minimal and, in combination with appropriate mitigation measures in the SEE and CEMP, the risk is negligible.	Low	Section 5.3
Any environmental problems associated with the disposal of waste?		
Waste will be disposed of in accordance with EPA (2014) waste classification guidelines. Where possible waste generated would be reused and recycled.	Low	Section 3
Any increased demands on resources, natural or otherwise which are, or are likely to become, in short supply?		
All materials required for the proposed works are available and are not currently or likely to be in short supply.	Low	
Any cumulative environmental effect with other existing or likely future activities?		
No cumulative impacts are anticipated.	Low	Section 5
Any impact on coastal processes and coastal hazards, including those under projected climate change conditions?		
Not applicable.	n/a	

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

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

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

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

The aims of this Policy are as follows:

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

Pursuant to clause 11, land identified as being State significant agricultural land is listed in Schedule 1 of the *State Environmental Planning Policy (Primary Production and Rural Development) 2019*. The lands proposed to be used for the Proposed Development are not contained within this schedule. Therefore, the Proposed Development does not compromise any of the above objectives nor impact upon any State significant agricultural land.

3.3.5 State Environmental Planning Policy No. 44 (Koala Habitat) (SEPP 44)

SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for *Phascolarctos cinereus* (Koala) to ensure a permanent free-living population over their present range and to reverse the current trend of Koala population decline. Developers of land with Koala habitat must consider the impact of their proposal on Koalas, and in certain circumstances, prepare individual Koala plans of management for their land.

Tenterfield Shire Council is listed in Shedule 1 as one of the Councils in which SEPP 44 applies. Councils are encouraged to prepare LGA-wide Koala plans of management, and once agreed to by the NSW Department of Planning, they may be used by developers to address Koala issues and individual plans of management would no longer be required. Currently, potential and core Koala habitat has not been surveyed in the Tenterfield Shire Council LGA, or included as a special provision in the Tenterfield LEP, or the *Tenterfield Development Control Plan 2014*.

Potential koala habitat is defined as areas of native vegetation (>1 ha) where the trees types listed in Schedule 2 of SEPP 44 constitute at least 15% of the total number of trees in the upper and lower strata. Core Koala habitat is defined as an area of land with a resident population of Koalas, evidenced by attributes such as breeding females and recent sightings and historical records of a population.

There is no potential impact on Koalas. The biodiversity assessment (Appendix A) did not identify any Koala feed trees on the Site.

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

SEPP 33 defines and regulates the assessment and approval of potentially hazardous or offensive development. Under clause 1 of the SEPP 33, a 'potentially hazardous industry' is defined as "… *a development for the purposes of any industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would pose a significant risk in relation to the locality:*

(a) to human health, life or property, or
(b) to the biophysical environment,

and includes a hazardous industry and a hazardous storage establishment."

Clause 1 also defines a 'potentially offensive industry' as *"… a development for the purposes of an industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would emit a polluting discharge (including for example, noise) in a manner which would have a significant adverse impact in the locality or on the existing or likely future development on other land, and includes an offensive industry and an offensive storage establishment."*

A preliminary hazard analysis is required for development proposals classified as 'potentially hazardous industry' to determine the risks to people, property and the environment. Appendix 3 of the *Applying SEPP 33* guidelines list the industries that are considered to fall within SEPP 33. Solar farms are not listed in Appendix 3 of the guidelines.

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

SEPP 55 aims to promote remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment.

Under clause 7, a consent authority must not consent to the carrying out of any development on land unless:

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

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

A review of premises currently regulated by an Environmental Protection Licence (EPL) under the Protection of the Environment Operations Act 1997 (POEO Act) and premises that are no longer required to be licensed under the POEO Act revealed no EPLs within the Site.

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

3.3.8 Biodiversity Conservation Act 2016 (BC Act)

The purpose of the BC Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of Ecologically Sustainable Development (ESD). The BC Act contains provisions relating to threatened species and ecological community listings and assessment, section 1.7 (formerly 5A) of the EP&A Act and repealing the *Threatened Species Conservation Act 1995*.

The BC Act also provides for a biodiversity offsets scheme, a single biodiversity assessment methodology (BAM), calculation and retirement of biodiversity credits and biodiversity assessment and approvals. The BC Act also contains measures for flora and fauna protection, repealing parts of the *National Parks and Wildlife Act 1974* (NPW Act). The *Biodiversity Conservation Regulation 2017* supports the Act.

Desktop assessment and field investigations indicate no threatened species are likely to be present on the Site. Field assessment indicates that the Site includes areas of the Threatened Ecological Community (TEC) White box yellow box Blakely's red gum woodland, listed as an endangered ecological community under the BC Act. This TEC is represented by PCT 510 in various condition states.

It is considered that the White box yellow box Blakely's red gum woodland found within the Site does not meet the criteria for listing under the EPBC Act. This is due to the observed lack of presence of key canopy species and floristic abundance in the ground cover layers.

The Development Footprint for the works has been developed to first avoid and then minimise impacts to biodiversity such that potential impacts are not significant and do not trigger the BAM. Further information regarding the desktop and field assessments against the BC Act is given in **Appendix A.**

3.3.9 Fisheries Management Act 1994 (FM Act)

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

One named waterbody (Pitkins Swamp Creek) forms the northern boundary of the Site. The NSW Department of Primary Industries (DPI) maps the creek as Key Fish Habitat (KFH). KFH is not defined under the FM Act, however the DPI provides a definition for KFH as generally including habitats that are crucial to the survival of native fish stock, excluding man-made habitats such as off-stream dams and ponds, and those natural waterways which are dry for the majority of the time or have limited habitat value.

A desktop constraints analysis by Geolyse (2018) identified two endangered aquatic species with potential to occur in Pitkins Swamp Creek. These are the Tusked Frog (*Adelotus brevis,* listed as endangered under the BC Act) and Purple-Spotted Gudgeon (*Mogurnda adspersa,* listed as endangered under the FM Act). Upon inspection of the Creek by an Eco Logical Australia (ELA) aquatic ecologist, it is considered unlikely that Purple-Spotted Gudgeon or Tusked Frog occurs in the area (Section 5.7.1).

The Proposed Development will not harm marine vegetation or block fish passage, as the Proposed Development will ensure a 50 m buffer from the banks of the waterways within and along the boundaries of the Site.

3.3.10 Water Management Act 2000 (WM Act)

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

The Proposed Development will ensure at least a 40 m buffer from the banks of the waterways within and along the boundaries of the Site; however, cables may cross 1st and 2nd Strahler order drainage lines. Therefore, a controlled activity approval under section 91(2) of the WM Act will be required for cable and vehicular crossings of waterfront land (bed, bank or land within 40 m of a watercourse regardless of Strahler order).

3.3.11 Local Land Services Act 2013 (LLS Act)

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

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

The Proposed Development, including any vegetation clearing, is being assessed under Part 4 of the EP&A Act, hence this clearing does not require assessment and approval under Part 5A of the LLS Act.

3.3.12 National Parks and Wildlife Act 1974 (NPW Act)

The main aim of the NPW Act is to conserve the natural and cultural heritage of NSW.

An initial 'due diligence' assessment has indicated that there is a low risk that Aboriginal objects and/or sites may occur within the Site. Despite this, mitigation measures have been recommended to protect potential archaeologically sensitive areas (Section 5.2.3).

3.3.13 Heritage Act 1977 (Heritage Act)

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

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

The potential impacts on historic heritage are addressed in Section 5.2.2 of this SEE. No heritage items or places have been identified within the Site. The Proposed Development would not have any direct or indirect impacts on any items of historic heritage significance and a section 139 permit is not required.

3.3.14 Crown Land Management Act 2016

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

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

No Crown lands or Crown roads will be impacted by the Proposed Development.

3.3.15 Roads Act 1993

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

(a) Erect a structure or carry out a work in, on or over a public road;
(b) Dig up or disturb the surface of a public road;
(c) Remove or interfere with a structure, work or tree on a public road;
(d) Pump water into a public road from any land adjoining the road; and/or
(e) Connect a road (whether public or private) to a classified road.

The Proposed Development’s grid connection route will follow the road reserves, being Old Racecourse Road, Bellevue Road and the crossing of the Bruxner Highway. These are existing public roads. Access (including any necessary upgrades) to the Site will be off the Bruxner Highway, north onto Bellevue Road and right onto Old Racecourse Road. The Bruxner Highway is a classified state road whilst Bellevue Road and Old Racecourse Road are local roads for which Tenterfield Shire Council is the roads authority. Old Racecourse Road is mostly unsealed, with its condition deteriorating to the east. The Proposed Development may also be accessed by Coxalls Road, an existing public local road.

Activities that may change the structure or be considered activities under section 138 will require approval from the appropriate roads authority under section 138 of the Roads Act. The roads authority for Old Racecourse Road and Coxalls Road is Tenterfield Shire Council and RMS is the roads authority for Bruxner Highway.

The proposal is to avoid direct impacts within the Bruxner Highway road corridor through the use of underboring techniques, although consent is required from RMS under section 138 of the Roads Act to undertake these works. This then categorises the Proposed Development as Integrated Development under Division 4.8 of the EP&A Act. Works will be undertaken in consultation with RMS, to ensure compliance with the works authorisation deed that may be applied by RMS upon favourable approval of the Proposed Development.

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

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

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

Part 5.7 of the POEO Act provides the duty to notify the relevant authority of pollution incidents, and under section 120 it is an offence to pollute waters. The Proposed Development will be managed to ensure pollution risks to soil, waterways and amenity are avoided or minimised (Section 5.3.3, 5.5.3, 5.7.3 and 5.8.3). In the event of a pollution incident that causes or threatens material harm to the environment, the NSW EPA would be notified.

The legal requirements for waste management are also established under the POEO Act and the *Protection of the Environment Operation (Waste) Regulation 2005.* Under section 143 it is an offence to unlawfully transport and dispose of waste. The reuse and recycling of the solar farm in the decommissioning phase is discussed in Section 2.1.3.

3.3.17 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 posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

Part 3 of the *Biosecurity Act 2015* applies a General Biosecurity Duty for any person who deals with biosecurity matter or a carrier to prevent, eliminate or minimise any biosecurity risk they may pose. Under section 23 of the Act, a person who fails to discharge a biosecurity duty is guilty of an offence.

Whilst the Act provides for all biosecurity risks, implementation of the Act for weeds is supported by Northern Tablelands Regional Strategic Weed Management Plans (RSWMP) developed for each region in NSW. Appendix 1 of each RSWMP identifies the priority weeds for control at a regional scale. However, landowners and managers must take appropriate actions to reduce the impact of problem weed species regardless of whether they are listed in Appendix 1 of the RSWMP, or not, as the general biosecurity duty applies to these species. There were a number of listed species in the RSWMP that were identified on site. The species identified of particular importance include Black Knapweed (*Centaurea x moncktonii*), Blackberry (*Rubus fruticosus* spp. agg.), and Sweet Briar (*Rosa rubiginosa*).

Weed management is discussed in Section 5.1.3 and Appendix B.

3.3.18 Rural Fires Act 1997 (Rural Fires Act)

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

Bushfire prone mapping available by NSW Planning Portal identifies the portions of the development site in the south and some areas along the grid alignment are mapped as Vegetation Category 2. Category 2 is considered to be a relatively low bush fire risk (NSWRFS, 2015).

The Proposed Development is not a subdivision for residential or rural residential purposes nor is it for a special fire protection purpose, hence issue of a bush fire safety authority under section 100B of the Rural Fires Act is not required. Fire risk is discussed in Section 5.8.

A small portion of the Site is mapped as bush fire prone under Tenterfield Shire Council bush fire prone land map. Council may request a bushfire risk assessment to be prepared in accordance with the Rural Fires Act and section 4.14 (formerly 79BA) of the EP&A Act. Council may refer the bushfire risk assessment to NSW Rural Fire Service (RFS) for determination.

3.3.19 Mining Act 1992

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

There are no current mining or exploration leases or applications over the development Site. There has been one historic exploration license (between 1970 and 1972), owned by Jingellic Minerals (Geolyse, 2018). There are no known mineral occurrences near the Site.

3.4 Other Relevant Policies and Plans

3.4.1 Ecologically Sustainable Development (ESD)

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

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

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

Precautionary principle

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

The environmental consequences of the Proposed Development have been assessed as accurately as possible, using appropriate specialists in relevant disciplines where required. All predictions, however, contain a degree of variability and uncertainty, which reflects the nature of the environment. Where there has been any uncertainty in the prediction of impacts throughout the SEE process, a conservative approach was adopted to ensure the worst case scenario was predicted in the assessment of impacts.

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

- Potential impacts were assessed assuming the use of the full Development Footprint, however, in practice a smaller subunit of this footprint will be developed;
- Where potential threats to the environment have been identified, mitigation measures have been developed to minimise such impacts; and

- Monitoring will be undertaken, if required, as a precautionary measure to reduce the effect of any uncertainty regarding the potential for environmental damage.

Social equity in inter-generational equity

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

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

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

Conservation of biological diversity and maintenance of ecological integrity

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

The commitment from Enerparc to reduce native vegetation disturbance as much as reasonably practical will be implemented to ensure biodiversity integrity. No hollow-bearing trees would be removed. A low level of groundlayer vegetation (mainly exotic grasses with very low levels of scattered natives) are likely to be cleared during clearing works. This clearing has been extensively assessed in Section 5.1 and Appendix A and, given its environmental context, it is considered extremely unlikely that this would result in a significant impact on any threatened species, populations or ecological communities or their habitats.

Areas of higher conservation value have been avoided during the evolution of the project design, and where identified impacts are unavoidable these will be managed by the implementation of mitigation measures. At the conclusion of the proposed 28 year operational phase, the Proposed Development shall be decommissioned and rehabilitated, with the objective of returning the Site to its pre-existing agricultural capability.

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

Improved valuation and pricing of environmental resources

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

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

3.4.2 New England North West Strategic Regional Land Use Plan

The *New England North West Strategic Regional Land Use Plan* has been developed to help address potential land use conflicts, with a particular focus on managing coal and coal seam gas issues. Of relevance to the Proposed Development, the plan identifies land that is considered to be Strategic Agricultural Land, i.e. land that is highly productive and has both unique natural resource characteristics and socio-economic values.

Two categories of strategic agricultural land have been identified:

- Biophysical strategic agricultural land (BSAL); and
- Critical industry clusters.

There are no critical industry clusters within the New England North West and there is no BSAL mapped land within or near the development Site - the closest mapped BSAL is located 30 km east of the development Site.

All State significant mining and Coal Seam Gas projects on BSAL will be referred to the Commonwealth's Independent Expert Scientific Committee as part of the Gateway process. Due to the nature of the Proposed Development, it is unlikely to have many large or permanent detrimental impacts on the land. This SEE considers potential impact to land resources in Section 5.3.2.

3.5 Summary of Land Access, Licences and Approvals Required

The Proponent of the proposed activity has a land access agreement in place for the five parcels of land, all of which are owned by one owner. A three year lease has been signed, with the option of a 25-year lease following that.

Approval is required from RMS under section 138 of the Roads Act, the development is Integrated Development under Division 4.8 of the EP&A Act. As part of the Development Application process, RMS is given 21 days to provide comments regarding the proposed transmission line route under the Bruxner Highway. RMS encourage consultation prior to submission of the Development Application paperwork. A works authorisation deed may be applied by RMS upon favourable approval of the Proposed Development.

A controlled activity approval under section 91(2) of the WM Act will be required for cable and vehicular crossings of waterfront land (bed, bank or land within 40 m of a watercourse regardless of Strahler order).

No additional approvals or licences are required for the Proposed Development.

4 Consultation

Effective and broad community and stakeholder consultation provides communities and stakeholders with a clear understanding of a development proposal as well as opportunities to provide feedback to identify issues important to them. Enerparc has carried out consultation with the local community, local government and specialists in order to understand and respond to community concerns during the design and assessment process leading to this Development Application.

Enerparc's consultation objectives are for open and strategic community consultation with members of the community who may be impacted by the proposed solar farm. Enerparc has first consulted with adjoining landholders to the Site, later followed by landholders who may generally be affected by the Proposed Development in some way, then further out to general community awareness.

A summary of consultation activities undertaken on behalf of the Proposed Development is given in Table 5.

Table 5: Stakeholder consultation

Stakeholder	Reference
Neighbouring residences	Letters, face to face meetings
Further residences	Letters
General community	Letters, website, newspaper article, informational open day
Tenterfield Shire Council	Face to face meetings, verbal and written communication

Letters of introduction outlining the proposed project and provding the opportunity to consult have been sent out by Enerparc prior to Development Application submission. Letters were sent on 16 October, 2 November, 22 November 2018, 2 February and 3 May 2019.

Face to face meetings have been held with and concerned neighbours on 6 November 2018 and 9 April 2019, and a Community information open session was held on 6 December 2018.

The main items that have been discussed during the ongoing consultation process are:

- Visual impacts to residents;
- Potential impacts to property values;
- Community perception of the proposed solar farm;
- Community concerns on land use; and
- Traffic management.

Throughout the preparation of this assessment, and through community and stakeholder consultation has helped guide the design and layout of the proposed TSF. The most pressing constraints that have altered design have been biodiversity, visual impacts and community perception impacts.

Consultation will continue as the proposal progresses to ensure that concerns that are raised are taken into consideration for best outcomes.

5 Environmental Impacts

An assessment of the likely impacts of the Proposed Development on the environment is given in this section, focusing on the specific issues identified below. This section breaks down the environmental aspects relating to the proposed TSF and gives detail on the existing environment likely to be affected by the Proposed Development, an assessment of the likely impacts of all stages of development and a description of the mitigation measures to avoid, mitigate and monitor the impacts of the Proposed Development.

5.1 Biodiversity

A preliminary site inspection was undertaken by Nicole McVicar (ELA ecologist) on 11th October 2018 to create a basic vegetation map and inform constraints analysis of the Site (Appendix A). A comprehensive vegetation survey was undertaken by Liz Brown and Claire Lock (ELA ecologists) from the 25 – 27th February 2019 to fully validate the basic vegetation map, confirm the presence of any potential TECs and identify any habitat attributes likely to support threatened flora and fauna within the Site.

The Site was assessed under the BC Act for the likely biodiversity impacts of the Proposed Development, having regard to the BAM. The results of the current survey and BAM plot data determined that there was not enough native vegetation present to warrant a full BDAR, and a Biodiversity Assessment was considered to be more appropriate for the subject site.

The biodiversity impacts are detailed in a standalone biodiversity assessment, shown in Appendix A and are summarised in the section below.

5.1.1 Existing Environment

Threatened flora, fauna and ecological community records

The Atlas of NSW Wildlife (NSW BioNet) search found that five threatened flora species and 18 threatened/migratory fauna species were previously recorded within a 5 km radius of the Site. No records were returned within the Site. One record of Brush–tail Phascogale *(Phascogale tapoatafa)* has been identified directly south of the Site, but not within the Development Footprint.

The Atlas of NSW Wildlife search also identified five BC Act listed vegetation communities, of which three are also listed under the EPBC Act as having potential to occur within 10 km of the Site.

Forty-eight EPBC listed threatened species, (including 22 threatened flora species and 10 threatened bird species, one threatened fish, one threatened frog, four threatened reptiles and 10 threatened mammals), three listed TECs, 15 listed migratory species, and three Wetlands of International Importance were identified in the Commonwealth Protected Matters Search.

Field validated vegetation communities

The vegetation in the Site comprised a mix of exotic/cultivated pasture, native pasture, areas of native tree and shrub plantings, 'disturbed native dam-fringing' vegetation, scattered paddock trees in exotic pasture, scattered trees in native pasture and regrowth areas in native pasture. Figure 5 below indicates the results of the field based vegetation mapping.

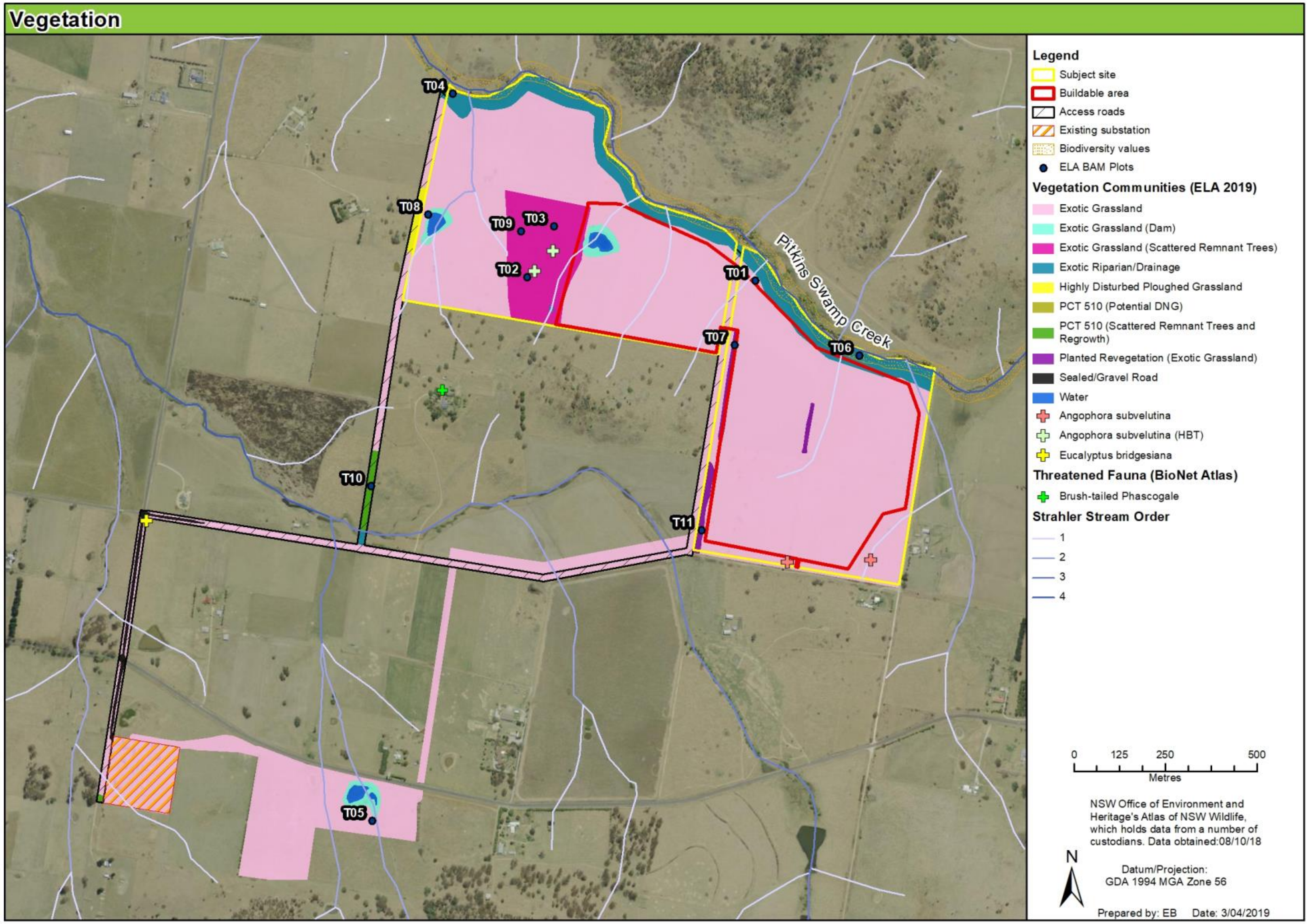


Figure 5: Vegetation mapping

Vegetation communities

The Site is dominated by a combination of exotic/cultivated paddocks, with only small isolated patches of native vegetation, much of which has been planted. One native Plant Community Type (PCT) in the studied area::

- PCT 510 Blakely's Red Gum – Yellow box grassy woodland of the New England Tableland Bioregion

Threatened Ecological Communities, threatened species and important habitat features

A very small area of vegetation within the subject site is considered to represent the Endangered Ecological Community (EEC) *Blakely's Red Gum – Yellow Box grassy woodland of the New England Tableland Bioregion* (PCT 510) listed under the BC Act, due its species composition. This small area of EEC is confined to a strip of land designated as a 'road reserve', which was never developed as such due to the presence of large granite boulders which have served to preserve this remnant in its current form.

No threatened species, listed under the BC Act or EPBC Act have been identified in the Site during the literature review and site inspection. One Atlas of NSW Wildlife record of Brush–tail Phascogale (*Phascogale tapoatafa*) has been identified directly south of the Site. Two large *Angophora floribunda* (Rough-barked Apple) trees were identified in the Site containing a number of hollows which may be considered potential habitat for threatened fauna such as Brush–tail Phascogale and microbat species. Pitkins Swamp Creek may contain potential foraging habitat for threatened microbats species.

Weeds

The study area currently contains a variety of weeds and exotic species, most notably Black Knapweed as a 'prohibited matter', Blackberry as a WoNS and a 'State' and 'Regional Priority Weed', Sweet Briar as a 'Regional Priority Weed' and Coolatai Grass, African Lovegrass and Firethorn as 'Species of Concern' (DPI 2019). These species are established throughout the subject site and within the study area. Regarding Black Knapweed, DPI is currently undertaking control of this species in this area. Delimitation of the infestation by DPI and LLS is ongoing and additional permission may need to be sought regarding earthworks and/or soil movement in the Black Knapweed surveillance area.

5.1.2 Potential Impacts

The proponent has committed to minimise potential impacts to native vegetation, fauna and ecological communities by prioritising development in areas of exotic and cleared vegetation over areas of native vegetation. Anticipated clearing of native vegetation will not exceed 1 ha.

Threatened Species

Impacts were assessed through the application of the Five Part Test of significance process to determine whether the proposed activity is likely to significantly affect threatened species or ecological communities, or their habitats under Clause 7.3 of the BC Act, in accordance with relevant assessment guidelines (DECC 2007). The Five Part Tests of significance have concluded that the proposal is unlikely to have a significant effect on any threatened species, so a BAM is not required.

Following consideration of the administrative guidelines for determining significance under the Commonwealth EPBC Act, it is concluded that the proposal is unlikely to have a significant impact on any

Matters of National Environmental Significance, and a referral to the Commonwealth Environment Minister is not required

Fauna

Negligible risk of fauna mortality during clearing is expected, as few small mammals, reptiles, birds and frogs are expected to be present and will be able to disperse into adjoining habitats as needed. During construction, it is expected that the localised disturbance created by vehicles and machinery may dissuade mobile fauna from visiting the immediate area, however given the extent of similar habitat surrounding the subject, this will not significantly impact upon any species and the disturbance by construction activities it is only short-term. As the important fauna habitat features (hollow-bearing trees and large granite boulders) will be retained *in-situ* under the proposal, it is expected that the long-term impact on fauna will be negligible.

Flora

No old-growth or hollow-bearing remnant trees will be cleared as part of the proposal. A low level of groundlayer vegetation (mainly exotic grasses with very low levels of scattered natives) are likely to be cleared during clearing works.

Given the scale of the proposal and that the area of vegetation which will be affected by the proposed actions is a very small proportion (< 0.1%) of the available habitat within the locality, it can be concluded that the works will not significantly change the habitat values of the locality. The environment to be impacted by the proposed works is already highly disturbed and contains no significant habitat features. Following the completion of construction and restoration works, no long-term or residual impacts are considered likely to occur.

Soil disturbance associated with the clearing of vegetation may benefit some of the weed species present, but the identified weeds are already widespread across the Site. Phytophthora Root Rot (*Phytophthora cinnamomi*) is a soil fungal disease that can be spread in contaminated soil, tools, footwear, vehicles or muddy storm water. There is a small chance that equipment used in construction will act as vectors for invasive species and/or fungal disease from previous work sites.

5.1.3 Mitigation Measures

The Development Footprint has been positioned and designed within the Site in a way as to avoid in the first instance and minimise as far as possible impacts to biodiversity. Post approval, and in consultation with TransGrid, the proponent will determine the final size of the Development Footprint based on the available capacity of the Tenterfield Substation.

The following mitigation measures are recommended:

- Pre-clearing tree protection standards should be followed, although pre-clearing fauna survey and clearing supervision are not provided as no remnant or HBTs are proposed for clearing as part of the proposal
- Retaining coarse woody debris (i.e. logs) *in-situ* as valuable structural habitat resources is highly recommended.
- The extent of the clearing is to be defined by high-visibility bunting or fencing before the commencement of clearing to prevent inadvertent damage or unnecessary removal of vegetation. These clearing limits (no-go zones) should be marked on a map, and clearly communicated to any contractors or machinery operators, prior to undertaking clearing works. The HBTs that are nominated to be retained are to be clearly marked in the field. This includes any scattered or

roadside remnant trees within the subject site, such as the two remnant Broad-leaved Apple trees which are HBTs.

- An Erosion and Sediment Control Plan will be implemented to minimise pollution and sedimentation issues which could arise, particularly when working in proximity to riparian zones. Where practicable, avoid placement of footings and pilings in tributaries to Pitkins Swamp Creek
- Weed management and hygine protocols in accordance with the Northern Tablelands RSWMP. This is of particular importance concerning Black Knapweed, regarding which the client will need to liaise with Tenterfield Shire Council and/or the DPI, who will advise them of relevant restrictions and protocols (e.g. regarding soil movement and machinery hygiene).
- A Waste Management Plan should be incorporated in the environmental management plans and approved by Tenterfield Shire Council prior to the commencement of works, to minimise any pollution issues which may arise.

5.2 Heritage

ELA conducted an Aboriginal Heritage Due Diligence Assessment for the Proposed Development. The due diligence report is provided in Appendix C and is summarised below.

The due diligence process aims to determine whether Aboriginal objects will be harmed by the Proposed Development, as required under Part 6 of the NSW NPW Act. The assessment follows the due diligence Code of Practice as set out in the Office of Environment and Heritage's (OEH) *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010). The due diligence Code of Practice sets out the reasonable and practicable steps which individuals and organisations need to take in order to:

- Identify whether or not Aboriginal objects are, or are likely to be, present in an area;
- Determine whether or not their activities are likely to harm Aboriginal objects (if present); and
- Determine whether an Aboriginal Heritage Impact Permit (AHIP) from the OEH or further assessment is required.

5.2.1 Existing Environment

Previously Recorded Aboriginal sites

Heritage Database Searches

Searches of the Australian Heritage Database, the State Heritage Inventory and Tenterfield LEP using the terms "Tenterfield, NSW", and "Tenterfield Local Government Area, NSW" were conducted on 24 September 2018 in order to determine if any places of Aboriginal significance are located within proximity to the Site.

There are no places on the Australian Heritage Database or the Tenterfield LEP of Aboriginal heritage significance within the Site.

AHIMS Search

An extensive search of the Aboriginal Heritage Information Management System (AHIMS) database was conducted on 4 October 2018 covering Datum: GDA Zone 56, Eastings: 397350 – 417350 (20 km), Northings: 6776856 - 6796856 (20 km) with no buffer, (Appendix C, Figure 2). A total of thirteen Aboriginal sites and zero Aboriginal Places were identified during this search. A breakdown of the Extensive AHIMS results are presented in Table 6 below.

Table 6: Types of Aboriginal site recorded within approximately 10 km of the Development Footprint

Site feature	Number of sites	Percentage of all sites
Artefact	7	53.86%
Potential Archaeological Deposit (PAD)	2	15.38%
Conflict	1	7.69%
Modified Tree (Carved or Scarred)	1	7.69%
Grinding Groove	1	7.69%
Art (Pigment or Engraved)	1	7.69%
Total number of sites	**13**	**100%**

There are no registered AHIMS sites located within the Site.

A site inspection undertaken by ELA Archaeologist Andrew Crisp on 16 and 17 October 2018 identified moderate ground surface visibility across most of the Site due to exposures in the pasture grass. No Aboriginal heritage sites were identified over the course of the site inspection. The inspection confirmed that the majority of the Site shows moderate disturbance as a result of pastoral activities.

Following an analysis of the desktop assessment (review of previously undertaken Aboriginal studies and AHIMS search) and observations made during the archaeological field survey of the Site (Lot 90, 89, 87 and 85 DP751540), the Site can be considered to represent an area of low archaeological potential as a result of physical impacts caused by pastoral activities including vegetation clearing, ploughing, vehicle movement and dam/fence construction.

Similarly the terrain within the proposed route for the underground 22 kV cable through observations made during the archaeological field survey has been identified as moderately to highly disturbed by pastoral activities and represents low archaeological potential.

5.2.2 Potential Impacts

The terrain within 50 m of Pitkins Swamp Creek is considered to represent moderate potential for subsurface archaeological deposits and as such all efforts should be made to avoid impacting this buffer along the 4^{th} order stream (Strahler 1957).

5.2.3 Mitigation Measures

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

Based on the findings of the due diligence and the requirement of the NP&W Act the following measures shall be implemented to remove impacts to potential aboriginal heritage items:

- A buffer zone extending 50 m from the top of the left bank of Pitkins Swamp Creek shall be establish along the northern boundary of the Site. No development shall occur in this area moderate potential for subsurface archaeological deposits;
- All access to the site shall be via existing established roads (Old Racecourse Road and Coxalls Road);
- Aboriginal objects are protected under the NPW Act regardless of whether or not they are registered on AHIMS. If suspected Aboriginal objects, such as stone artefacts are located during future works, works must cease in the affected area and an archaeologist called in to assess the finds. If the finds are found to be Aboriginal objects, the OEH shall be notified under section 89A of the NPW Act. Appropriate management and avoidance or approval under a section 90 AHIP should then be sought if Aboriginal objects are to be moved or harmed.
- In the extremely unlikely event that human remains are found, works should immediately cease and the NSW Police should be contacted. If the remains are suspected to be Aboriginal, the OEH may also be contacted at this time to assist in determining appropriate management.

5.3 Land

Potential impacts associated with the Proposed Development on agricultural land, flood prone land and the use of the Site for agricultural purposes during and after operations are assessed in this section, along with the assessment of potential cumulative impacts of the development on agricultural land with other similar projects in the region.

5.3.1 Existing Environment

Regional and local context

The Proposed Development lies within the New England Tableland bioregion, and within the Tenterfield Plateau sub-region. The New England Tableland Bioregion has an area of 3,004,202 ha of which approximately 95% of the bioregion lies within NSW. The bioregion lies between the North Coast and Nandewar bioregions in north east NSW, extending north just into Queensland. In NSW, the bioregional boundary extends from north of Tenterfield to south of Walcha and includes towns such as Armidale and Guyra, with Inverell just outside the boundary (NPWS, 2003).

The Site has historically been used for agricultural use, is currently improved for cattle grazing, and there are a number of farm dams present.

The Site lies on the Tenterfield Plateau sub-region. The characteristic soils in this area include shallow gritty sands on steep slopes to harsh texture contrast soils. There is some evidence of salinity in some areas (NPWS, 2003).

The Site and surrounding land, is zoned RU1 - Primary Production under the provisions of the Tenterfield LEP. Solar energy systems are permitted with consent in this zoning.

The objectives of the RU1 - Primary Production zone are:

- *To encourage sustainable primary industry production by maintaining and enhancing the natural resource base* - The Proposed Development does not deleteriously impact the natural resource base and it is reasonable to expect that the natural resource base may be enhance through reduced agricultural pressure and biodiversity management commitments
- *To encourage diversity in primary industry enterprises and systems appropriate for the area* - The Proposed Development represents a diversification of existing primary production values through harvesting sunshine. Leases paid to the landholder allow diversification of income streams and provide a climate independent source of revenue;
- *To minimise the fragmentation and alienation of resource lands* - Leases have been taken for the entirety of each Lot included within the Site. During the lease period these lots shall continue to be managed in order to prevent fragmentation and/or alienation of the enclosed lands and at the conclusion of the lease they shall be rehabilitated to a standard to allow the resumption of agricultural practices; and
- *To minimise conflict between land uses within this zone and land uses within adjoining zones* - All efforts have been made by the proponent to minimise potential for conflict between land uses within this zone. This includes the identification and implementation of mitigation strategies identified within this document as well as ongoing stakeholder consultation.

At a regional scale, the Inverell – Tenterfield Statistical Area (Level 3) covers 3,056,628 ha, of which 1,905,461 ha is used for dryland and irrigated agricultural production (ABS, 2013). The Proposed Development will impact not more than 60 ha, representing 0.003 % of land currently used for agricultural production. Therefore impacts of the Proposed Development on agricultural production at a regional level are not considered to be significant. At the conclusion of the life of the project, the Site would be decommissioned in order to permit the resumption of grazing activities or other agricultural uses. Therefore, the Proposed Development does not conflict with the objectives of the RU1 - Primary Production zone as described by the Tenterfield LEP.

Historically, the breeding of beef cattle and production of superfine wool from Merino sheep has been a significant industry in the Tenterfield region and still plays an important role in both the social and economic wellbeing of the region today. The Proposed Development involves a temporary diversification in land use of up to 60 ha for the duration of the project life (30 years). This changed land use may temporarily reduce production. However, once constructed, sheep grazing may continue within the Site to control vegetation beneath the solar array.

A search of the contaminated lands register (EPA, 2018) revealed that there are no listed contaminated areas within the Site.

Land Use

Of relevance to the Proposed Development, the *New England North West Strategic Regional Land Use Plan* identifies land that is considered to be Strategic Agricultural Land, i.e. land that is highly productive and has both unique natural resource characteristics and socio-economic values. Two categories of strategic agricultural land have been identified:

- Biophysical strategic agricultural land (BSAL); and
- Critical industry clusters.

There are no critical industry clusters within the New England North West and no BSAL mapped land within or near the development Site. The closest mapped BSAL is located 30 km east of the Site. As such, the land on which the Proposed Development is situated has no listed ‘critical industry clusters’ or BSAL. Compliance with this planning instrument is given in Section 3.4.2.

Soil landscapes

Regionally, in the New England Tableland bioregion, soil landscapes are generally derived from granites. Red earths and mellow texture contrast soils of relatively low fertility and poor structure are widespread across the bioregion and are prone to erosion. In basalt areas, shallow stony loams are found on steep areas and deep, red brown and brown to black, fertile, well-structured loams are found on flatter slopes. Soils are sometimes waterlogged in valley floors. Siliceous sands and red earths occur on associated Tertiary sands and gravels. Harsh texture contrast soils in the bioregion derived from Permian sedimentary rocks are generally yellow, thinner and stonier on steep slopes. Some areas of slightly saline soils also occur. Site specific soil testing has not been undertaken.

Land and soil capability

The Site is located within a fairly low undulating landscape, with a number of stock dams on the Site. A considerable portion of the Site has been cultivated for improved pasture.

Land capability classes aim to classify land according to its inherent ability and protection from erosion and other forms of land degradation. The classification of any land is based on biophysical features which determine the limitations and hazards of that land. The main hazards and limitations include: water erosion, wind erosion, soil structure decline, soil acidification, salinity, waterlogging, shallow soils, rockiness, and mass movement. The eight class system recognises four types of land uses with land capability decreasing from Class 1 to Class 8 (OEH, 2012):

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

The 60 ha of the proposed Site is classified as Class 4 (land and soil capability assessment scheme). This 60 ha makes up 0.07 % of the total Class 4 in the Tenterfield LGA. Land and soil capability mapping corresponds to each soil landscape, based on the most limiting factor.

Under the land and soil capability assessment scheme (OEH) Class 4 land has moderate to severe limitations for some land uses that need to be consciously managed to prevent soil and land degradation. These limitations can be overcome by specialised management practices with high levels of knowledge, expertise, inputs, investment and technology. This class includes sloping lands (10–20% slope). This land is generally used for grazing, and is suitable for pasture improvement.

Flood prone land

There is no flood planning mapping in the Tenterfield LEP and no directly relevant prior flood studies that would enable informed comment about the extent of flooding in the Site (Geolyse, 2018).

The *Tenterfield Floodplain Risk Management Study and Plan* (Jacobs, 2014) was conducted to provide basis of the management of existing and future flood risks for the township of Tenterfield and includes the township of Tenterfield, with the area extending from Tenterfield Dam to just downstream of Rouse Street. As such, this modelling does not consider the flood hydrology of Pitkins Swamp Creek.

Based on stakeholder feedback and an absence of floodplain development within the Site, it is concluded that sporadic, minor flooding of the site may accompany periods of wet weather, however, such periods of local inundation are likely to be occasional and of short duration.

Mining

There are no current mining or exploration leases or applications over the development Site. There has been one historic exploration license (between 1970 and 1972), owned by Jingellic Minerals. There are no known mineral occurrences near the development Site.

5.3.2 Potential Impacts

Due to the nature of the Proposed Development, it is unlikely to have many large or permanent detrimental impacts on the land.

The Proposed Development will have a life span of approximately 30 years and will not involve permanent changes to the landscape. Due to the relatively small size of the Site (60 ha), its development will not compromise or significantly diminish the availability of land for primary production purposes within the Tenterfield LGA or more broadly within the region.

Furthermore, due to sunshine harvesting being a passive land use, the Proposed Development will not reduce or impact any BSAL, or compromise the capacity for immediate neighbours to conduct existing or proposed primary production in the immediate vicinity. During operation, the development will allow for dual use of the property, allowing sheep to potentially graze among the PV arrays. Once the Proposed

Development is decommissioned, the land will be returned to a suitable condition to permit a return to agricultural use.

Construction

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

Within the solar array, soil disturbance would be limited to the piles driven into the ground to support and orientate the PV panels and trenching for cable installation. As such, the majority of the groundcover will be retained across the Site. Consequently, soil disturbance from localised excavation activities will be relatively small, isolated and temporary. Depending on the final design, farm dam/s may be required to be removed.

Where the ground surface is disturbed for support buildings, inverter stations, access tracks, the temporary construction compound, laydown and parking areas, there is greater potential for increased runoff and/or soil erosion. Footings, access tracks and hardstanding areas that would require compaction and/or foundations would reduce soil permeability, leading to increased run off and potentially concentrated flows, which could result in soil erosion. Soil compaction associated with construction machinery will be low, due to the small and discrete footprint of the light equipment required for panel installation.

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

Operation

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

- compacted and impervious access tracks; and
- impervious PV panels.

These concentrated flows could potentially result in the erosion of the access tracks and localised soil erosion below the panels. The potential for wind erosion is considered to be low due to areas of soil disturbance being rehabilitated post construction.

As discussed in the section above, fuels, lubricants and herbicides will be used for maintenance activities, and pose a potential contamination risk to soil, surface and groundwater as a consequence of misuse or a spill event.

Decommissioning

At the end of the proposed 28 year operational phase, the Proposed Development shall be decommissioned, with the objective of returning the Site to its pre-existing agricultural capability.

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

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

5.3.3 Mitigation Measures

Land use

Potential for land use conflicts are considered low, but may include nearby landholder concerns regarding drainage, dust generation, fencing, fire, lighting, noise, pesticide usage, pollution, impacts to roads, potential for theft/vandalism and weeds/pest management. Such concerns can generally be mitigated through appropriate consultation and dialogue. As such the proponent will establish and maintain a website and phone contact to receive and respond to community concerns during construction, operation and decommissioning.

Potential land use conflict may arise over changes to visual amenity, potential mitigation strategies are identified in section 5.4.3.

The removal of farm dams will require a dewatering protocol within a Construction Environmental Management Plan (CEMP) and an ecologist may be required to supervise the management of fauna during dam removal.

Soils and Land Resources

Construction

The construction works are short term and would be managed in accordance with the *Managing Urban Stormwater: Soils and Construction* (Blue Book) series, namely:

- Managing Urban stormwater: Soils and Construction, Volume 1, 4th Edition (known as the Blue Book) (Landcom, 2004);
- Volume 2A Installation of Services (DECC, 2008a); and
- Volume 2C Unsealed Roads (DECC, 2008b).

Soil and erosion control measures in accordance with the above guidelines would be described in a CEMP to be developed following project approval and include the following measures:

- Construction and/or installation of erosion and sediment control structures in accordance with the specifications provided in the Blue Book;
- Regular inspection and programmed maintenance of erosion and sedimentation controls will be undertaken and documented in a register of inspections and actions;
- Cable trenches will be constructed in accordance with relevant regulations and ground conditions. Trenches will be excavated and filled progressively to ensure they are left open for the shortest period possible. Surface conditions will be rehabilitated as soon as practicable to prevent the formation of preferential flow pathways;

- Management of erosion generated by traffic shall include a driving code of practice, installation of appropriate drainage controls, inspection and maintenance of unsealed road surfaces and dust management strategies;
- Separation of topsoil and subsoil for stockpiling and correct reinstatement to ensure a suitable growth medium is retained;
- Appropriate stockpile management to ensure air and water erosion is minimised, soil health, organic matter and structure are retained and weed infestation minimised; and
- Account for climatic events during construction;
  - If heavy rainfall is predicted the Site should be stabilised and works modified to prevent erosion for the duration of the wet period; and
  - Works methods shall be modified during high wind conditions if excess dust is generated.

To avoid release to the environment, all hazardous materials (fuels, lubricants, herbicides, etc.) will be disposed of off-site in accordance with EPA guidelines (EPA, 2016). Onsite refuelling shall occur in an area that is located greater than 100 m from the nearest drainage line and within an impervious bunded area. Machinery will be inspected daily to ensure no oil, fuel or lubricants are leaking from the machinery. All hazardous materials will be stored in accordance with relevant regulations. All contractors and staff will be appropriately trained through site induction and toolbox talks to prevent, minimise and manage accidental spills.

A Spill Response Plan will be prepared as part of the CEMP and Operational Environment Management Plan (OEMP). The Spill Response Plan will outline the procedures to respond to a spill event and the measures required to prevent the spread of spills to adjacent areas. It will also include an emergency response protocol, EPA notification procedures and remediation requirements.

Despite no recorded contaminated sites, the potential remains for unidentified contamination to be encountered during excavation. Should this be the case, works in the area would cease and the relevant authorities would be notified. Protocols for such an event would be included in the CEMP and OEMP.

Operation

An OEMP will be prepared to guide operational environmental management following the final design of the Proposed Development, and would be subject to statutory approved by Council or the JRPP.

Limited soil disturbance during the operational phase of the Proposed Development means that the potential for soil erosion would be limited to the exposed access tracks and areas below the solar array.

Maintaining access tracks in good condition and ensuring that associated drains and/or sedimentation traps are monitored and maintained will ensure that the potential erosion associated with the tracks is minimised. Water carts may be used to limit wind erosion and dust generation.

The maintenance of appropriate vegetation cover across the Site will assist in reducing potential erosion, particularly below the panels to prevent scouring following significant rainfall events. As such, an inspection program following significant rainfall events would implemented and stabilisation works would be undertaken as required.

Further to this, any erosion prevention and/or sedimentation traps installed as part of the design of the Proposed Development will be monitored to ensure effectiveness is maintained.

Weed management strategies will also be outlined in the OEMP. These strategies aim to prevent and minimise the spread of weeds and will include:

- Management strategies for any declared priority weeds according to the stipulations of the *Biosecurity Act 2015* during the construction and operational phases; and
- Protocols for weed hygiene in relation to plant and machinery entering and leaving site, and for the importation of fill to site.

It is likely that sheep will be permitted to graze within the solar array to help manage vegetation down over the Site. This would contribute to weed control and fuel load reduction, as well as the continuation of agricultural activities across the Site.

Fire management strategies would be included in the OEMP and an Emergency Response Plan will be prepared. Further information regarding fire risk mitigation is provided in **Section 5.8.3.**

Decommissioning

At the end of the proposed 28 year operational phase, the Proposed Development shall be decommissioned. Decommissioning activities, and hence mitigation measures, shall be similar to those for construction. Decommissioning activities and mitigation measures have been discussed with the landholder to return the land to an agreed pre-existing agricultural capacity shall be incorporated into the negotiated lease.

A Decommissioning Management Plan (DMP) will be prepared prior to decommissioning. The DMP shall include appropriate mitigation strategies to manage potential environmental impacts and to return the land to agricultural use at closure of the project. The main objectives for the decommissioning stage include:

- Reuse of recyclable materials
- Return the land to its prior condition
- Ensuring no environmental harm

5.4 Visual Amenity

The purpose of the visual impact assessment is to identify and describe the existing landscape character, identify visual amenity receptors and, as a consequence of the introduction of the Proposed Development, to assess potential visual impacts. The assessment then considers how mitigation strategies could be implemented to reduce the effect of any identified impacts.

The assessment adopts a conservative approach, identifying potential receptors based on the broader Site, and potential impacts based on a preliminary development footprint, before describing and assessing potential mitigation strategies and a draft landscaping plan to inform the final Development Footprint. Key visual components associated with the Proposed Development include:

- Installation of approximately up to 30 ha of fixed PV solar panels;
- On-site inverter stations and associated electrical infrastructure; and
- Construction and operational support buildings, perimeter fencing and vehicular access tracks.

The assessment area boundaries vary depending upon which of the following assessments are being considered (Figure 6):

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

5.4.1 Existing Environment

The Proposed Development lies between Bellevue Road, Old Racecourse Road, Coxalls Road and Pitkins Swamp Creek. The landscape is characterised by rolling hills, areas of retained native vegetation (mainly on hilltops), agricultural enterprises and rural residences. It is considered typical of other landscape types found in surrounding areas, as well as landscapes within the wider regional context of the Northern Tablelands (NSW) and Granite Belt (QLD).

Nearby areas of public visual amenity include Mount Mackenzie, as well as numerous national parks and nature reserves located within 20 km, particularly to the north and the east of the Proposed Development; however, their setting combined with distance and vegetation screening would limit the opportunity for views toward the Proposed Development. The Proposed Development is generally not visible from main roads or from within the Tenterfield urban area.

The Site itself is located in a rolling landscape, where elevation ranges around 880 - 890 m above sea level Australian Height Datum (AHD). The topography of the Site drains generally in a northerly direction via first and second order Strahler streams (Strahler 1957) to Pitkins Swamp Creek, which forms the northern boundary. Land within the Site has been historically cleared for grazing and most has been sown with improved pastures. There are small patches of native vegetation along roadsides, paddock edges, lower lying areas along drainage lines and scattered throughout paddocks. It is due to the rolling to hilly nature of the surrounding the land that the solar infrastructure should be largely obscured and/or screened from direct views.

Figure 6: Assessment Areas and wider Site context

Landscape Character

The landscape character of the Site and the majority of the surrounding area is classified as one Landscape Character Unit (LCU1), however within a wider 2 km radius a second LCU is identified (LCU2). These are described below:

- LCU1 is dominated by rolling to hilly agricultural land. The LCU is rural in nature, with rural and rural residential dwellings scattered across the wider landscape. Residential densities are variable with increased densities adjacent to Bellevue Road and the Bruxner Highway. Due to historic clearing for grazing, vegetation cover is generally low except for along hilltops, road reserves and within nature reserves. A representative image of LCU1 is shown in Figure 7.
- LCU2 comprises the urban areas of Tenterfield, which lies in the west-south-west of the Site. This LCU is a more urbanised area containing private dwellings and businesses including heritage-listed places. A mixture of native and exotic vegetation is retained throughout the urban area. A representative image of LCU2 is shown in Figure 8.

Figure 7: Typical views of LCU1, showing flat rural landscape and clear vegetation across the Site

Figure 8: Typical views of LCU2 viewed from Rouse Street (New England Highway), Tenterfield. Source: Wikipedia (2018)

General visibility

Given its proximity to Tenterfield, the Proposed Development has a relatively confined area of visibility due primarily to topography and assisted by areas of vegetation. Solar farms generally seek out relatively flat areas associated with plains, valley floors and foothills. The Site is generally most visible from cleared areas along Pitkins Swamp Creek to the north west and south east of the Site, and from elevated areas to the north and east of the Proposed Development. Further views are generally buffered by topography and distance.

5.4.2 Potential Impacts

Landscape character impact assessment

This landscape impact assessment considers direct and indirect impacts of the Proposed Development on the two LCUs associated with the Site, within a 2 km buffer of the Site boundary. The assessment takes into account the relationship between 'visual sensitivity' (the ability of a landscape character area to absorb a development) and the 'magnitude of visual change' to determine the potential impact of the Proposed Development on each LCU (Appendix F).

Landscape Character Unit 1

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

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

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

Landscape Character Unit 2

The visual sensitivity of LCU2 is assessed as **moderate**, as it comprises the township of Tenterfield.

The magnitude of visual change to LCU2 during both the construction and operational phases is considered to be **low** because the combination of distance and screening from the Proposed Development would reduce visibility to where it would likely not be seen from most parts of the town. The overall impact on the landscape character within LCU2 is assessed as **low**.

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

Visual Amenity Impact Assessment – Viewshed analysis

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

Bare Earth Digital Terrain Model

A bare earth ZVI heat map for a 2.5 m high preliminary Development Footprint based on the digital terrain model (DTM) is presented in Figure 9. The ZVI illustrates that within the undulating topography that characterises the landscape, theoretical visibility is high from elevated areas adjoining Pitkins Swamp Creek. Furthermore, the heat map, stratified by the percentage of the preliminary Development Footprint potentially visible from any given viewpoint, clearly demonstrates that the rolling topography within the Site itself, tends to reduce the amount of the preliminary Development Footprint visible as distance from the Proposed Development increases.

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

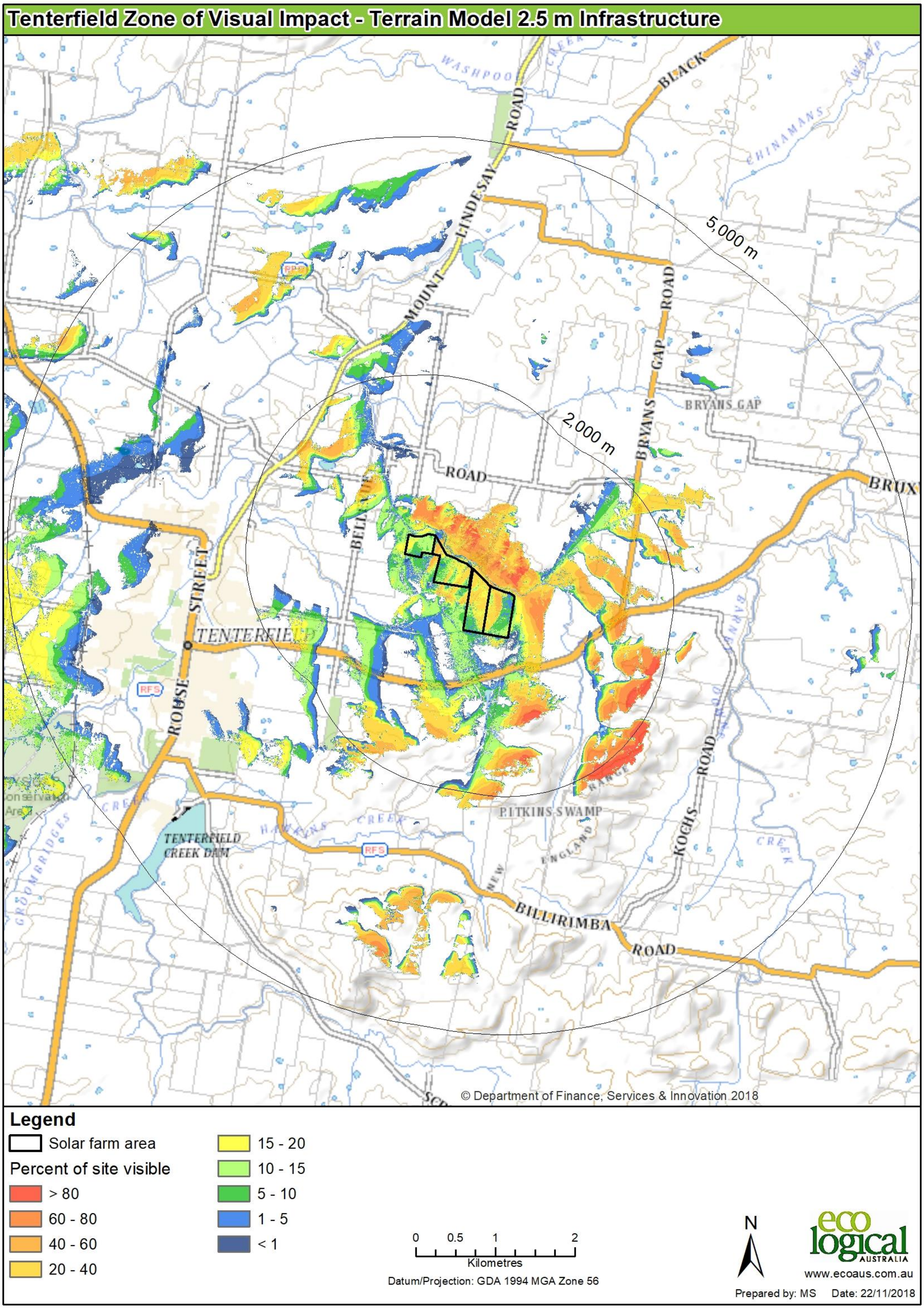


Figure 9: Bare earth DTM ZVI for 2.5 m tall panel array

Surface Model

A digital surface model (DSM) ZVI heat map for a 2.5 m high preliminary Development Footprint is presented in Figure 10. Unlike the DTM, the DSM incorporates screening effects of vegetation and built structures within the landscape. This provides a more realistic indication of potential visibility than the DTM, however, it may sightly underestimate visibility from nearby viewpoints as it does not incorporate partial visibility through buffers (such as through scattered stands of sparse vegetation).

The DSM demonstrates generally reduced levels of visibility compared to the bare earth DTM, and it is within this context that further efforts to minimise impacts to visual amenity are assessed.

As part of the visual impact assessment, this information has assisted in guiding community consultation between Enerparc and the surrounding community members that have expressed interest in the Proposed Development. The module layout within the Development Footprint has undergone many iterations to ensure minimal visual impacts to as many impacted community members as practically possible.

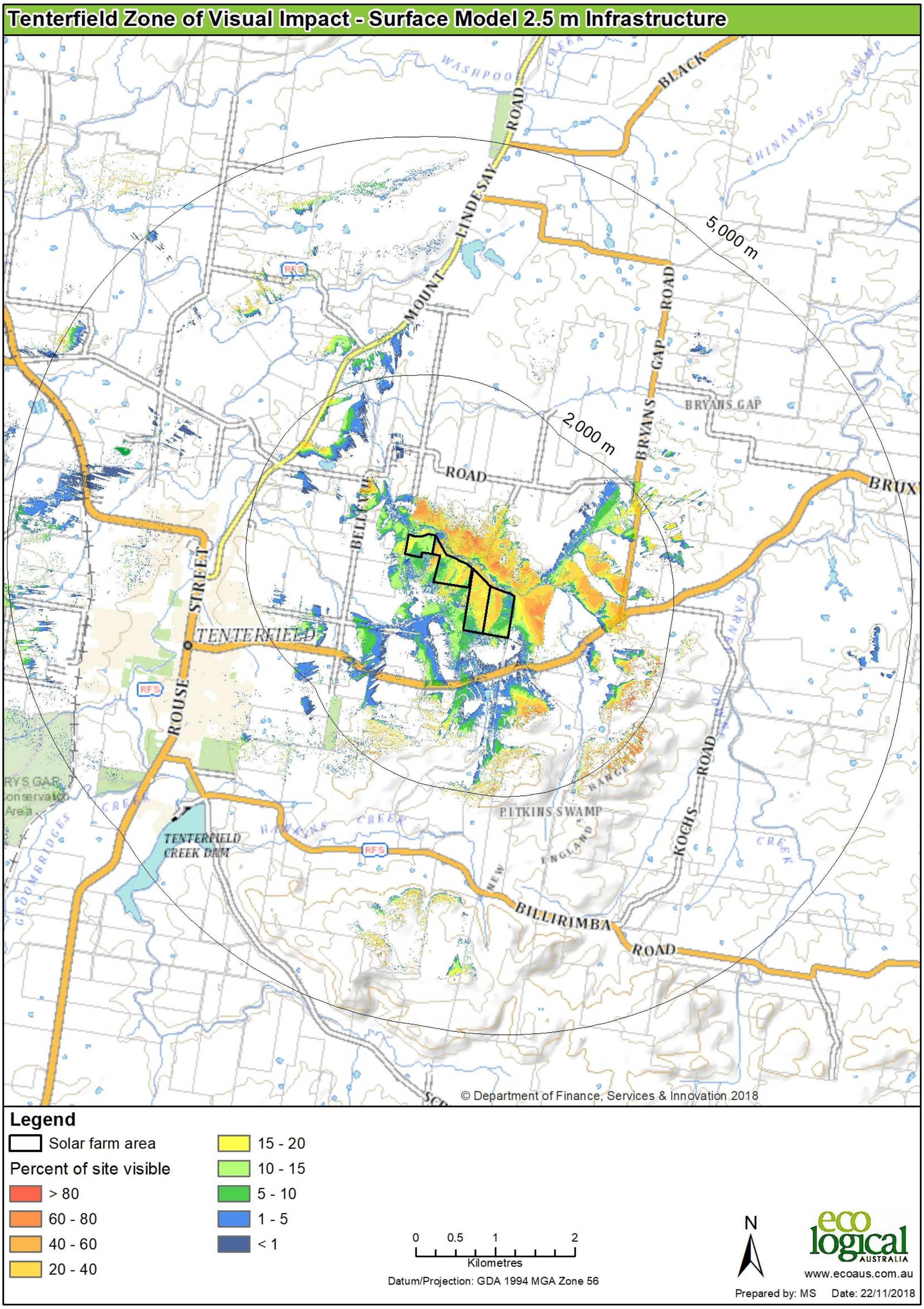


Figure 10: Current state DSM ZVI for 2.5 m tall panel array

Visual Amenity Impact Assessment – Residential viewpoints

Due to its proximity to urban area of Tenterfield, the desktop spatial assessment identified 1,725 residences and/or potential dwellings within 5 km of the Proposed Development (Figure 11). Of these, 101 were located within 2 km of the Proposed Development.

ZVI analysis using the bare earth DTM identified that the Proposed Development is theoretically visible to 189 potential receptors, however, the majority of these are located more than 2 km from the Site (Table 7), a distance at which the visual impact of the Proposed Development is reduced.

Of the 53 residences located within 2 km, the effect of existing landscape screening reduces the Site's visibility further, with 17 residences modelled as likely to see the development once the effect of existing vegetation and other screening infrastructure is considered (Table 7). Furthermore it is noted that the average area of the Site visible from each residence is generally low, relative to the total area of the Site as assessed (60 ha).

Table 7: Effect of existing landscape screening and proposed visual buffering within the Site

Distance from Site	Number of impacted dwellings		Average area of Site visible (ha)	
	No existing landscape screening (DTM)	Existing landscape screening (DSM)	No existing landscape screening (DTM)	Existing landscape screening (DSM)
0 - 2 km	53	17	5	3
2 - 5 km	136	16	1	>1
Combined	189	33	2	1

Potential visual impacts to individual residences within 2 km were modelled (Appendix E) and assessed, with the resultant impacts shown in Table 8 and Figure 11. Generally, impacts to visual amenity associated with the Proposed Development are assessed as moderate to low, however five residences are assessed as highly impacted. In these cases, targeted consultation with landholders regarding potential visual setbacks and/or screening options has been undertaken to develop acceptable mitigation and screening strategies. General ongoing consultation with other impacted landholders has also been undertaken.

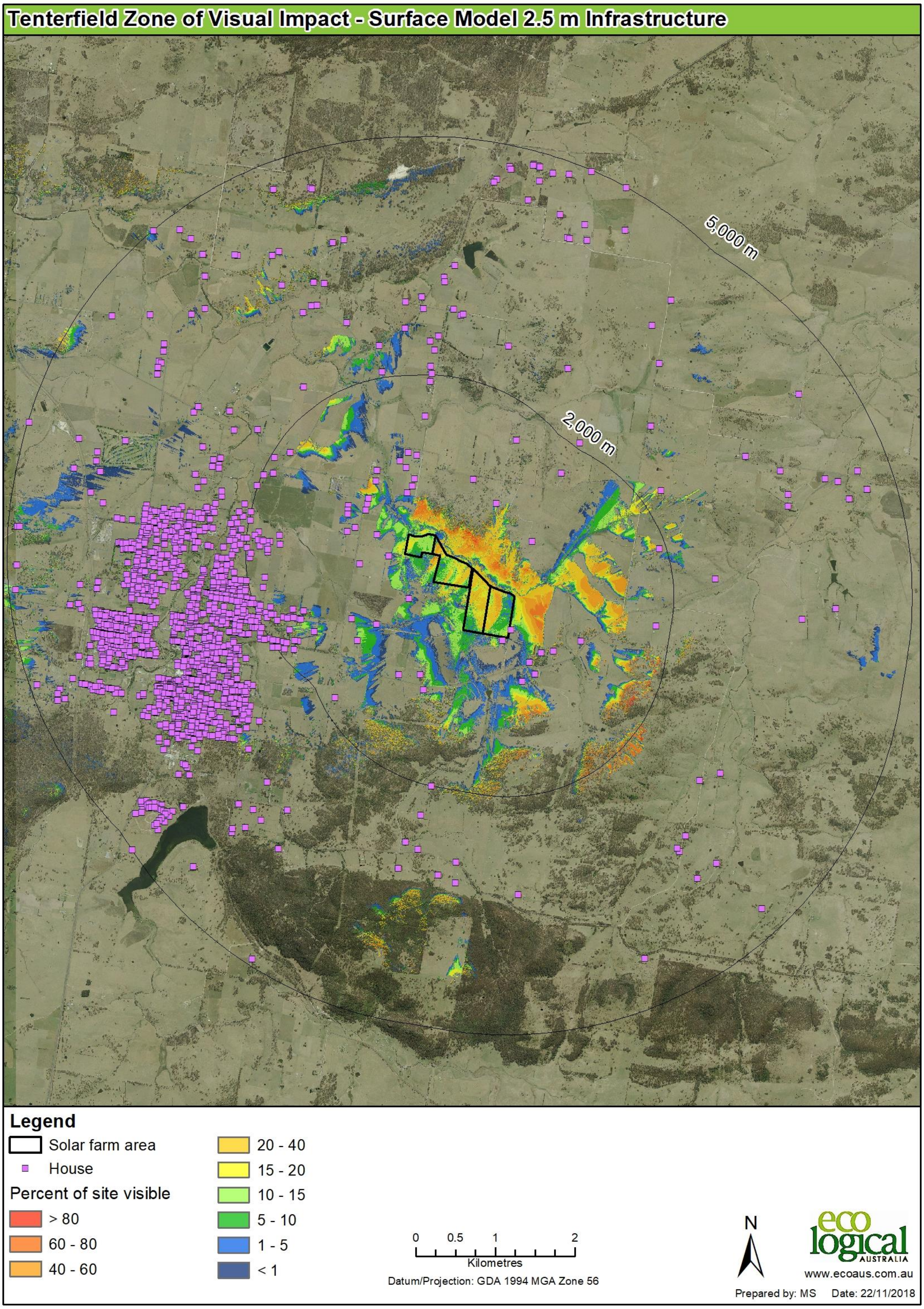


Figure 11: Visual amenity impact assessment on residential viewpoints

Table 8: Summary of impacts to visual amenity and recommendations

View point	Distance to Site (m)	Direction from Site	Area of Site visible (Ha)	Visual sensitivity	Magnitude of change	Visual Amenity impact	Mitigation	Post Mitigation Visual Impact
1,682	31	East	2.6	Very high	High	High	Vegetation screening and setback	Moderate
1,683	47	South	2.9	Very high	High	High	Vegetation screening and setback	Moderate
1,650	370	West	0.7	High	Low	Low		
25	388	West	0.2	High	Low	Low		
1,688	414	South-East	0.8	High	Low	Low		
1,725	519	North	2.7	High	Moderate	Moderate	Visual setback	Low
1,692	575	South-East	0.7	High	Low	Low		
1,691	585	South-East	0.1	High	Low	Low		
310	616	North- West	4.6	High	High	High	Visual setback	Nil
311	642	North- West	5.4	High	High	High	Visual setback	Low
1,719	675	North- West	5.4	High	High	High	Visual setback	Low
312	785	North- West	1.6	Moderate	Low	Low		
32	805	North- West	3.1	Moderate	Moderate	Moderate	Visual setback	Low
1,671	845	North	10.9	High	Moderate	Moderate	Liaise with landholders regarding screening options	Low
1,720	1,022	North- West	>0.1	Moderate	Insignificant	Insignificant		
1,717	1,122	West	1.6	Moderate	Low	Low		
12	1,495	West	2.1	Moderate	Low	Low		

Visual Amenity Impact Assessment – Public Viewpoints

Public viewpoints within 5 km of the Site are restricted to public roads. During field investigations it was confirmed that the Proposed Development would be clearly visible from the following roads:

- Old Racecourse Road; and
- Coxalls Road.

Potential glimpses of the Proposed Development may be possible from:

- Bellevue Road;
- Bryans Gap Road; and
- Bruxner Highway.

DSM ZVI mapping (Figure 10) indicates that potential views from public roads are generally screened by existing vegetation. While it may be possible to catch glimpses of the solar array from other roads within 5 km from the Proposed Development, such glimpses are considered to be insignificant.

Visual impacts on public roads are shown to be low or insignificant (Table 9), therefore, additional mitigation strategies for public viewpoints are not recommended.

Table 9: Summary of impacts to public visual amenity

Viewpoint	Distance to TSF	Visual sensitivity	Magnitude of visual change	Visual Amenity impact
Old Racecourse Road	0 m	Low	Moderate	Low
Coxalls Road	0 m	Low	Moderate	Low
Bellevue Road	850 m	Low	Low	Low
Bryans Gap Road	1,350 m	Insignificant	Insignificant	Insignificant
Bruxner Highway	400 m	Low	Insignificant	Insignificant

Other considerations

Night lighting

There is no requirement to light the solar farm at night. The only facilities with provisions for night lighting will be associated with the operations and maintenance building. Lighting at this location will be on-demand only. As such, it is recommended that night lighting be developed to minimise light spill and that vegetative screenings be considered as an additional mitigation, if required.

Glint, glare and reflections

When the sun is reflected off a smooth surface, it can result in a glint (a quick reflection) or glare (longer reflection). In both cases, the intensity of light will depend upon the reflectiveness of the surface from which the sun is being reflected. Solar farms are not considered to be reflective, since PV panels are designed to absorb as much sunlight as possible and convert it into electricity.

Solar panels feature low-iron glass that is designed to minimise reflection and maximise the transmission of light through the glass. Low-iron glass reflects between 4% and 7% of light (Spaven Consulting, 2011). SunPower, (2009), established that the reflectivity of a PV solar panel is similar to or less than those of still water and significantly less than reflections from glass and steel. Additionally, NGH, (2010) reported that PV panels are no more reflective than areas of vegetation such as grasslands, crops and forested areas associated with rural landscapes, and far less reflective than standing water such as water in dams, rivers and lakes.

Glint and glare effects can only ever occur when the weather is clear and sunny. In the scenario where a solar reflection is possible towards a road user or resident in a surrounding dwelling, the individual will also be looking in the general direction of the sun. This means the sun and solar reflection will be visible simultaneously. The sun is a significantly brighter source of light.

Targeted glint and glare assessment for residences located directly north of the Proposed Development (1671 see Appendix F) concluded the residence will not be impacted by glint or glare from the Proposed Development.

Air traffic

The nearest public airport is Tenterfield Airport, a local airstrip supporting private and commercial aviation, is located approximately 12 km north west of the Site. Concerns regarding glare from solar farms has generally focussed on solar facilities on, or within 10 km of airfields. Evidence of the limited risks posed by reflections from PV panels is the increasing installation of large solar arrays within airports in order to take advantage of large open areas and high local day-time electricity demand. Australian examples include Darwin Airport, Adelaide Airport, Alice Springs Airport, Newman (WA) Airport and Ballarat Airport (Solar Choice, 2013).

Spaven Consulting (2011) conclude that off-airfield ("*en route*") facilities are unlikely to present glare problems to pilots. Their reasoning includes that aircraft in the *en route* phase of flight will be at higher angles of elevation than where glare occurs, and that pilots in the *en route* phase are already subjected to glare from a number of existing sources such as large assemblies of parked cars, major glasshouse facilities and large bodies of water.

Road traffic

Solar reflections are theoretically possible towards road users, however, solar reflections would generally only in the early morning or late evening close to sun rise and/or sunset. As indicated in Figure 10 and Table 9, the Site is generally not visible from nearby public roads. Those with extended views of the Site (Old Racecourse Road and Coxalls Road) are subject to very low traffic volumes and low speeds.

The overall expected impact upon road users with respect to safety is conservatively classified as low where the reflecting solar panels are visible. Where the solar panels are not visible, there is no impact.

Decommissioning

At the conclusion of the operational phase of the Proposed Development, all above ground infrastructure associated with the solar farm shall be removed from Site and the Site rehabilitated to a condition to allow the resumption of agricultural activities. As such, all visual impacts post decommissioning are considered to be insignificant.

Cumulative visual impacts

No other major projects are known to create a potential cumulative visual impact in the vicinity of the Proposed Development.

5.4.3 Mitigation Measures

The following mitigation measures will be implemented over the life of the project.

- Implement visual setback areas within the site to eliminate, where possible, or mitigate visual impacts to highly impacted residences.
- Minimise vegetation clearing and earthworks and rehabilitate bare earth progressively.
- Implement commitments to establish vegetation screening and setbacks.
- Continued consultation with moderately impacted landholders will be undertaken to identify, where possible, the location of mutually agreeable vegetation screening both pre and post construction.
- Where practicable use muted, low contrast colours for all supporting infrastructure, so that they blend into the landscape as far as possible.
- Where practicable select infrastructure to minimise potential for reflectivity and glare.
- Minimise night lighting.

Additional observer point vegetation screening shall be developed, if requested, in consultation with impacted landholdings.

Draft Landscaping Plan

A draft landscaping plan was developed in consultation with potentially impacted adjoining landholders and has been adjusted in response to the findings of this assessment (Figure 12). The proposed vegetation buffers (Coxsalls Road) and visual setbacks (Coxsalls Road and Bellevue Road) will augment existing vegetation retained within the landscape. Where appropriate, endemic native species shall be selected based on agreed performance criteria to provide complementary biodiversity outcomes.

Additional vegetation screenings at impacted landholding may be negotiated.

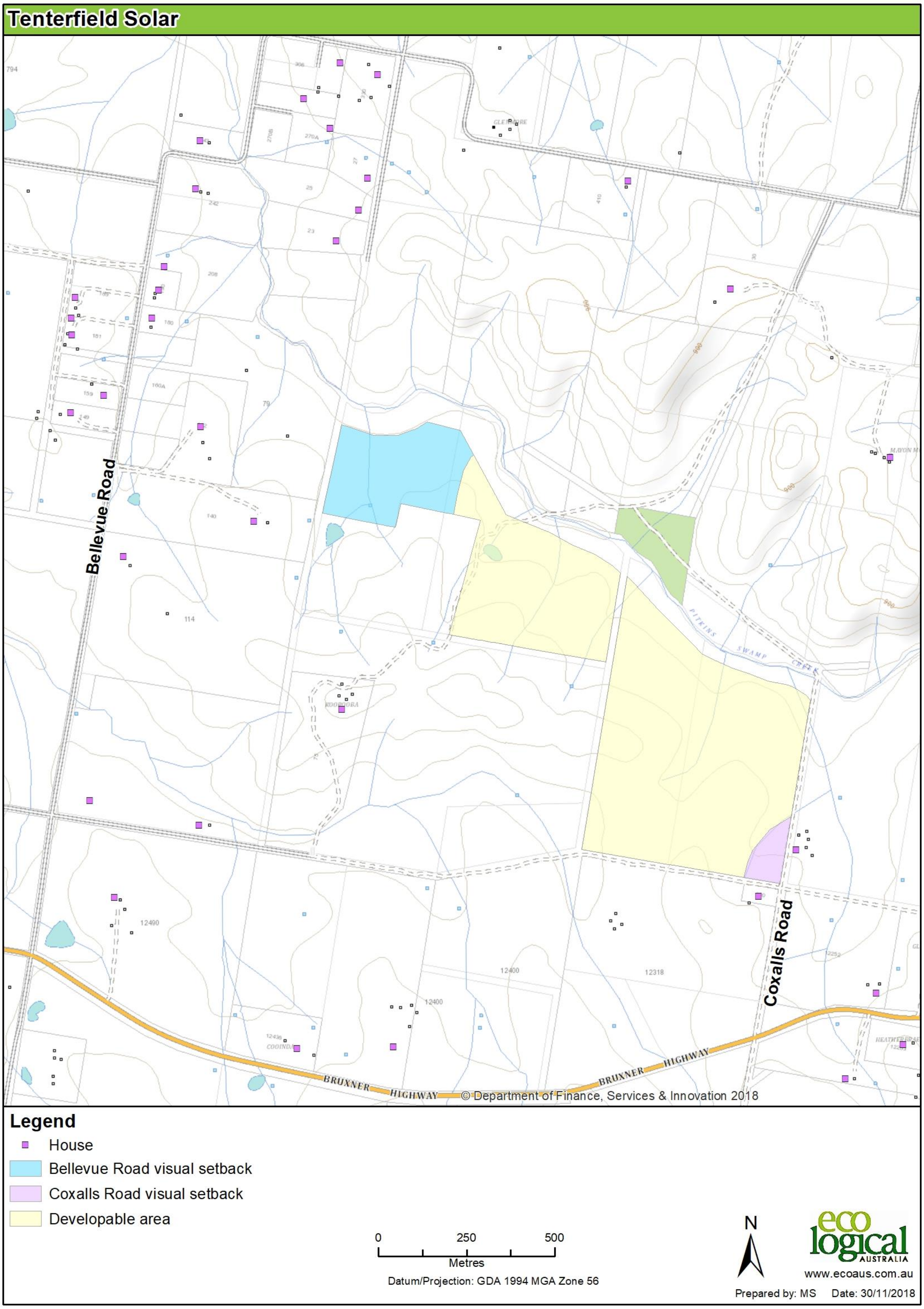


Figure 12: Draft Landscaping Plan

5.5 Noise

TTM Consulting Pty Ltd (TTM) have conducted a stand-alone noise assessment for the Proposed Development. This includes an assessment of the construction noise impacts of the development in accordance with the Department of Environment and Climate Change's *Interim Construction Noise Guideline* (ICNG) and operational noise impacts in accordance with the *NSW Noise Policy for Industry*.

The noise assessment was undertaken prior to neighbour feedback and subsequent revisions to the Development Footprint. Accordingly, the assessment adopts a conservative approach, based on the broader Site, and potential impacts based on a preliminary development footprint that has since evolved and reduced in area in response to environmental constraints identified through the SEE assessments to inform the final Development Footprint. As such, it is anticipated that potential noise impacts will be experienced at less receptors than than identified within the initital assessment, and that potential noise levels at impacted receptors would be lower than predicted.

A full copy of the noise assessment is provided in Appendix G. This chapter provides a summary of the existing environment, potential impacts and mitigation measures.

5.5.1 Existing Environment

The Site is generally flat with cleared farmland, located within a rural landscape. The Site is farmed mainly for livestock grazing. Access to the Site would be via an existing access point from Old Racecourse Road. Bruxner Highway, located south of the Site, is the main access to Tenterfield from the east. Residential areas of Tenterfield are approximately 2 km to the west. There are 35 dwellings which have been identified within 1 km of the preliminary Development Footprint. The nearest noise sensitive receivers (NSR) have been identified in Table 10.

Table 10: Nearest noise sensitive receivers

ELA ID	Distance to Site (metres)	Lot and DP Number	Longitude	Latitude
1682	31	Lot 91 on DP751540	152.0608	-29.0521
1683	47	Lot 1 on DP809079	152.0597	-29.0532

The location of the NSRs are shown in Figure 13.

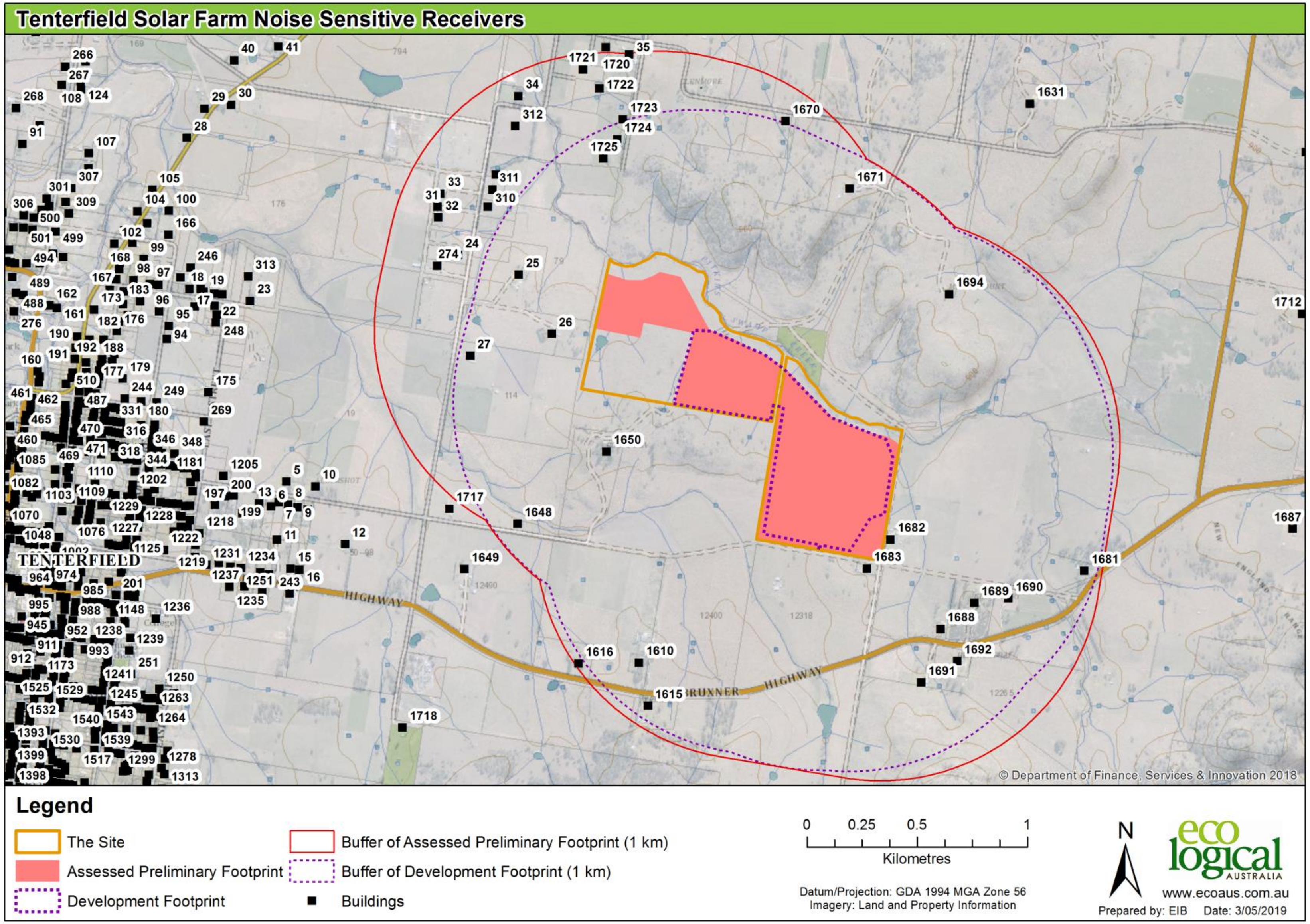


Figure 13: Neighbouring properties within a 1 km radius

The Site is located in a rural area with an acoustic environment that is dominated by natural sounds, having relatively little road traffic noise from Old Racecourse Road and Bruxner Highway (average annual daily traffic less than 2000[1]). The area is generally characterised by low background noise levels. The settlement pattern is typically sparse.

The identified NSRs are expected to experience a similar acoustic environment with low background noise levels. The background noise levels of the area have therefore been estimated by referring to Appendix A of Australian Standard AS 1055.24. The standard provides estimated average background noise levels for different residential areas in Australia, which may be used as a guideline. These background levels are summarised in Table 11.

Table 11: Average background noise levels

Time period	Average background noise level, L90, in dB(A)	Note
Day	40	Day-time period is from 0700 to 1800 (Monday to Saturday) and 0900 to 1800 (Sundays and Public Holidays)
Evening	35	Evening period is from 1800 to 2200
Night	30	Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0900 (Sundays and Public Holidays)

Receiver number 1682 and 1683 are potentially the most affected receivers based on their proximity to the Proposed Development. The ambient noise levels at both receivers are expected to be similar to each other.

Construction noise assessment – Interim Construction Noise Guideline (ICNG)

The ICNG provides guidelines for the assessment and management of noise from construction works. Construction activities and associated duration for the Proposed Development mean that it is considered a major construction project. Therefore, the quantitative approach has been adopted for the construction noise assessment.

The ICNG suggests the following standard hours for construction activities where noise is audible at residential premises:

- Monday to Friday, 7 am to 6 pm;
- Saturday, 8 am to 1 pm; and
- No construction work is to take place on Sundays or public holidays.

Time restrictions on construction works are the primary management tool of the ICNG. The construction working hours of the Proposed Development are expected to be in line with the above standard hours.

The guideline also provides noise management levels for residential premises for both the recommended, and outside standard hours of construction. The noise management Rating Background Levels (RBL)

[1] Roads and Maritime Services - Tenterfield Heavy Vehicle Bypass Preliminary Route Options Report, May 2014

recommended for residential receivers have been extracted from the ICNG and are summarised in Table 12.

Table 12: ICNG noise management levels

<table>
<tr><th>Time of day</th><th>Management level, $L_{Aeq\ (15\ min)}$ *</th><th>How to apply</th></tr>
<tr><td rowspan="2">Recommended standard hours:
Monday to Friday 7am to 6pm
Saturday 8am to 1pm
No work on Sundays or public holidays</td><td>Noise affected
RBL + 10 dB</td><td>The noise affected level represents the point above which there may be some community reaction to noise:
• Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level; and
• The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.</td></tr>
<tr><td>Highly noise affected
75 dB(A)</td><td>The highly noise affected level represents the point above which there may be strong community reaction to noise:
• Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:
a. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences; and
b. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.</td></tr>
<tr><td>Outside recommended standard hours</td><td>Noise affected
RBL + 5 dB</td><td>• A strong justification would typically be required for works outside the recommended standard hours;
• The proponent should apply all feasible and reasonable work practices to meet the noise affected level;
• Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community; and
• For guidance on negotiating agreements see section 7.2.2 of the ICNG.</td></tr>
</table>

Note: * Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

The main construction activities/stages are as follows:

- Site establishment and preparation for construction (vegetation clearing, preliminary civil works and drainage, including access road construction);
- Installation of mounting system to support the PV modules;
- PV module attachment;
- Installation of inverter stations and other electrical infrastructure;
- Grid connection;
- Commissioning and testing; and
- Removal of temporary construction facilities.

5.5.2 Potential Impacts

Construction noise impacts

The predicted construction impact shows that there are no exceedances of the ICNG highly noise affected limit of 75 dB(A) at any receivers.

The predicted construction impact shows that ICNG Noise Management Level of 50 dB(A) are exceeded at the receivers summarised in Table 13. Section 6.3 of the noise assessment in Appendix G gives a thorough definition of the impact categories expressed in Table 13.

Table 13: Receivers - Exceedances of ICNG noise management level

Construction Phase	Duration	Receivers and Exceedance over 50 dB(A)			
		Average Impact		Worst-case Impact	
		Category 4	Category 6	Category 4	Category 6
Site Preparation	2 months	-	-	1682 (+14dB) 1683 (+11dB) 26 (+4dB)	1682 (+16dB) 1683 (+14dB) 26 (+8dB) 1650 (+1dB) 25 (+3dB)
PV Panel System Installation	4 months	1682 (+2dB) 1683 (+2dB)	1682 (+2dB) 1683 (+2dB)	1682 (+16dB) 1683 (+13dB) 26 (+6dB) 25 (+1dB)	1682 (+19dB) 1683 (+16dB) 26 (+10dB) 1650 (+4dB) 25 (+6dB) 1688 (+1dB) 1689 (+1dB) 1725 (+2dB)
Inverter stations, and Electrical Collector System Installation	2 months	-	-	1682 (+12dB) 1683 (+9dB) 26 (+2dB)	1682 (+14dB) 1683 (+12dB) 26 (+6dB) 25 (+1dB)

The noise modelling by TTM has shown predicted noise levels at individual residences at different stages of the project, with different environmental conditions attached. In a worst case scenario, with unfavourable weather conditions, the site preparation phase may see a short term exceedance of the ICNG noise management level of 50 dB(A) at receivers 1682, 1683 and 26. The installation of the PV panel system is also expected to see an exceedance of the ICNG noise management level of 50 dB(A) at receivers 1682 and 1683 (over by 19, 16 and 10 dB(A) respectively. This phase also sees minimal exceedances at five other residences (Table 13). The noise impacts in the installation of the inverter stations and electrical collector systems phase is expected to be similar to those during the site preparation phase. With all stages of construction, as works move towards the centre of the Site and away from the receiver, the noise impacts are expected to reduce or be removed completely.

Construction traffic noise impacts

The traffic accessing the Site will be during the construction phase and consist of a mix of broad traffic categories as follows:

- General traffic generated by staff travelling to / from the Site (i.e. utes, vans and private cars)
- Over Dimensional (OD) used for the delivery of the large substation components, and
- Other heavy vehicles (HV) which are used for the delivery of the solar panel components and construction materials such as aggregate.

The likely traffic mix for the various works that are anticipated during construction are summarised in Table 14.

Table 14: Total heavy vehicle movements

Plant/Equipment	Description	Heavy Vehicles
Modules	107, 268 modules (392 modules per 40' container) delivered on semi-trailers	275
Mounting frames	30 x 40' container per MW, inclusive of piles, and structural frames and materials	30
Inverter Stations	10 x inverter station – delivered 1 per semitrailer	10
Battery storage	6 x 20' shipping containers and 6 x 40; shipping containers on semitrailers	9
Concrete	Estimated 200 m3 required inverter assembly foundations and security fence in 10m3 concrete trucks	20
Gravel	Estimated 2000 m3 (~4000 tonne) of gravel for internal access roads and temporary hardstand lay down and construction compound area: delivered in 42.5 tonne truck & dog trailers. Assumes access road and hardstand all at 100 mm	100
Sand	Estimated 2200m3 of sand (~3200 tonne) would be delivered in 42.5 tonne truck & dog trailers	80
Miscellaneous	Provision for 5 miscellaneous deliveries (fencing, building materials, cable drums, water for dust suppression etc) a week during construction period, dropping to an average of 2 trucks a week for the one month shoulder periods	116
	TOTAL	640

During the delivery of the materials, a total of 640 vehicles are expected, including 180 42.5 tonne truck & dog trailers. The 42.5 tonne truck & dog trailers represent the biggest risk of an adverse noise impact to residents living close to public roads used by the delivery vehicles.

Spread over a 7-month period for construction works, an average of five vehicles would access the Site per day, including one truck & dog trailer. The closest receiver to the proposed access route is approximately 25 metres from the boundary of the road.

Using this scenario, a Truck & Dog articulated trailer has an approximate maximum pass-by noise level of 81 dB LAmax at 10 m (Source: DEFRA database, Table 2, Ref 33 Articulated Dump Truck). This translates to a noise level incident at the façade of the receiver of 73 dB LAmax.

As all traffic movements associated with the Site will occur during daytime hours (7 am – 6 pm) sleep disturbance is not expected.

With an average of one pass-by event from a truck & dog trailer occurring during a 11-hour construction period from 7 am – 6 pm, it follows that the impact will be insignificant. In addition, it should be noted that 73 dB LAmax is a maximum noise level, and as such, the noise will be at this level only for a very short duration, and the whole pass-by will be over in a matter of seconds.

Therefore, the risk of an adverse noise impact being caused to residents is considered low. Other construction related traffic is not expected to result in an adverse noise impact to residents.

Operational noise impacts

The solar modules at the Site are to operate during daylight hours, seven days per week, 365 days per year. No permanent employees are expected to be stationed on-site throughout the duration of project operations. The operation and maintenance tasks are summarised below.

Noise from the operation of Inverter stations

When the solar farm is fully operational, noise from the inverter stations may impact upon nearby receivers. The inverter stations emit noise only while generating electricity (daylight hours) and are expected to be located within the module layout area away from potential receptors. To minimise potential impacts invertor stations should be located away from nearby residences.

Solar module washing

The solar modules are to be periodically washed to remove any excess dirt, dust or other matter (i.e. bird droppings), which may prevent sunlight from effectively reaching the solar cells and subsequently reducing the electricity production output. The solar panels are anticipated to be cleaned via means of water spray from a water truck driven through the informal roadways constructed on-site. No chemicals will be added to the water to ensure minimal impact to the surrounding environment through runoff.

Vegetation, weed, and pest management

Weed and vegetation control will be conducted throughout the Site for the duration of project operations. Weed control is likely to consist of any or, all of the following methods: biological (sheep grazing), mechanical or manual, or chemical methods. Site conditions are to be evaluated prior to the selection of the management method to ensure the method employed is the most appropriate to the environmental conditions of the Site.

Equipment maintenance and inspection

Responding to automated electronic alerts based on monitored data, including actual versus expected tolerances for system output and other key performance metrics.

Security detail

To ensure safety and security at the Site, a security fence will be installed around the perimeter of the Proposed Development in accordance with the Proponent's requirements to ensure entry into the Site is controlled. Once operational, all access points will be gated and Site access arrangements will be regulated for staff through identification requirements. The Site security system may also include sensor lighting and closed-circuit television at several locations around the Site to act as a deterrent to possible nefarious activity.

For each operational task, the expected equipment and associated sound levels are summarised in Table 15.

Table 15: Operational sound levels

Task	Item	Equipment	Sound Level, dB(A)	Reference*
Noise from Inverter Stations	Inverter stations	-	64 SPL @10m	Data provided by ELA
Solar module washing	Water spraying	Water Truck	107 SWL	AS 2436
		Water Pump	93 SWL	Ref. No. 45, Table 2 in DEFRA
Vegetation, weed, and pest management	Mechanical method	Truck	107 SWL	AS 2436
		Pump	93 SWL	Ref. No. 45, Table 2 in DEFRA
Equipment maintenance and inspection	Insignificant noise impact			
Security detail	Insignificant noise impact			

Note: * DEFRA – Department for Environment Food and Rural Affairs (DEFRA), 2005. Update of noise database for prediction of noise on construction and open sites. Noise levels are given as a sound pressure level at 10 metres from the source. The sound pressure levels have been converted to sound power levels in the table.

Operational noise impacts have been assessed against the appropriate noise trigger levels and found to be minimal.

Noise generated from the operation of the solar farm has also been assessed No additional noise mitigation measures are recommended.

5.5.3 Mitigation Measures

The opportunities for practical physical noise control are few given the transient and constantly moving nature of the construction work. However, it is recommended to use mobile noise barriers/enclosures during certain construction work, such as around stationary work activities and plant.

In addition to physical noise control or in situations where this is not practical, management measures should be employed to minimise the construction noise impact for residential and commercial premises. These should include all feasible and reasonable measures employed by the contractor such as:

- Locate the stations at least 260 m away from the closest NSR.
- Informing and consulting with residents and interested parties, as far as practicable, regarding impending or current events that may cause high levels of noise and how long they are expected to take. This may take the form of letter drops, or community notices.
- Provide a complaints telephone number prominently displayed where the works are taking place and on any letter drops or community notices.
- Respite hours agreed with residents when noisy works will not take place if necessary.
- Investigate complaints when received to establish the cause, and where possible implement a corrective action such as, provide a respite period or other practical measure.
- Minimising the operating noise of machinery brought on to the Site.
- Where appropriate, obtaining acoustic test certificates for machinery brought on to the Site.
- Undertake noise monitoring at the start of a new noisy activity so noise levels can be investigated should a complaint be received.
- If there is excessive noise from any process, that process will be stopped and if possible that noise attenuated to acceptable levels. Where there is no alternative the process will be rescheduled to non-sensitive hours.
- Ensuring that plant is not left idling when not in use.
- Ensuring that plant is well maintained and in good working order and not causing unnecessary noise, such as damaged mufflers on plant, and
- All access hatches for plant to be kept closed.

5.6 Transport

TTM have conducted an independently prepared Traffic Impact Assessment as well as a Road Safety Audit associated with both the construction and operational phases of the Proposed Development. This includes an assessment of the Site access route, Site access point and likely transport impacts and cumulative transport impacts (including peak and average traffic generation) of the development on the capacity and condition of roads, a description of the measures that would be implemented to mitigate any impacts during construction, and a description of any proposed road upgrades developed (if required).

A full copy of the traffic assessment and Road Safety Audit is provided in Appendix H. This chapter provides a summary of the existing environment, potential impacts and mitigation measures.

5.6.1 Existing Environment

The Site is located to the north of Old Racecourse Road in Tenterfield. The Proposed Development will be accessed via a new access point off Old Racecourse Road.

Most construction trucks and staff vehicles will come via New England Highway, Bruxner Highway, Bellevue Road, and Old Racecourse Road. The local roads (other than the Bruxner Highway) are used by the residents to access their farms and houses. Traffic flows on the local roads are low. The closest traffic count survey along the New England Highway is approximately 67 km south of Tenterfield. The heavy vehicle volume on this road is close to 25 % of all traffic (Table 2-2 Road Safety Audit, Appendix H).

The Bruxner Highway to Tenterfield is a state road which provides an important link for the rural communities of the upper northwest of NSW to commute and transport their products to wider markets in Casino, Lismore and Ballina. The published traffic volumes on the Bruxner Highway between Tenterfield town centre and the subject are presented in RMS's "Tenterfield Heavy Vehicle Bypass Preliminary Route Options Report" (2014, which is summarised in Table 14).

The Independent Road Safety report prepared to support the traffic assessment concludes that the crash data from the period of 2013 and 2017 in the Tenterfield area had occurred at locations other than the intersections proposed for the construction traffic of the TSF. There were three crashes along the section of the Bruxner Highway from Bellevue Road to the New England Highway. Two were non-casualty crashes and one was moderate injury.

The Road Safety Audit considered the following intersections near the Site:

- New England Highway / Bruxner Highway intersection
- Bruxner highway / Bellevue Road intersection
- Bellevue Road / Old Racecourse Road intersection
- Old Racecourse Road / Site Access locations

5.6.2 Potential Impacts

The Proposed Development is forecast to generate around five heavy vehicles and up to 40 light vehicles a day during the seven month construction period. The existing road network will not be significantly affected by the additional traffic.

The Road Safety Audit identified potential sight distance issues. The sight distance issues are addressed in the mitigation measures section below and Appendix H. There have been three crashes along the section of the Bruxner Highway from Bellevue Road to New England Highway between 2013 to 2017. One of the crashes involved a moderate injury. The Proposed Development would not influence potential for future road crashes.

5.6.3 Mitigation Measures

As per the Road Safety Audit report, the following recommended roadworks are considered to be directly related to the construction phase and shall be addressed prior to commencement of construction activities:

- Truck crossing signs (W5-22) for trucks crossing or entering are recommended to be on the Bruxner Highway approaches to Bellevue Road during the construction period (Applicant responsibility).
- Repainting of the “Give Way” line marking on Bellevue Road at the intersection of Bruxner Highway and Bellevue Road (Council/RMS responsibility).
- Renewal of hazard markers on the Bruxner Highway (RMS responsibility).
- Installation of additional frangible posts including reflective markers at the intersection of Old Racecourse Road and Bellevue Road (Applicant responsibility).
- Provide localised shoulder widening on Old Racecourse Road for laybys to ensure a total width of 7 m at up to 3 locations (Applicant responsibility).

Car-pooling shall be encouraged among contractors during the construction phase with information regarding the benefits of carpooling included in the CEMP.

5.7 Water

This section consiers potential impacts associated with the Proposed Development on water resources, having regard to surface water and groundwater resources, riparian land, groundwater dependent ecosystems (GDEs), acid sulphate soils, related infrastructure, adjacent licensed water users and basic landholder rights.

5.7.1 Existing Environment

The Site lays within the upper reaches of the Border Rivers Catchment area. The Border Rivers comprise the catchments of the Dumaresq, Severn, Macintyre and Barwon Rivers which drain from the Great Dividing Range between Inverell in far northern NSW and Warrenbayne in Southern Queensland. The catchment occupies an area of approximately 49,500 km^2 of which approximately 24,500 km^2 is situated within NSW. The Dumaresq River, Macintyre River and part of the Barwon River downstream of the Weir River form the border between NSW and Queensland for approximately 470 km (Green et al., 2012).

Pitkins Swamp Creek adjoins the northern boundary of the Site and is listed as a fourth order stream (Strahler, 1952). Pitkins Swamp Creeks forms part of the Tenterfield Creek Water source, which is a tributary of the Dumaresq River. The water source has an area of about 892 square kilometres and is generally undulating cleared agricultural land (DIPNR, 2005).

A river flow gauging station on Tenterfield Creek has operated at ‘Clifton’ since 1921. Tenterfield Creek has highly variable flow, responding rapidly to rainfall events, which are more frequent in summer. The water source experiences extended periods of low or no flow, the longest being 238 days in 1940.

Surface and groundwater

A desktop constraints analysis by Geolyse (2018) identified two endangered aquatic species with potential to occur in Pitkins Swamp Creek. These are the Tusked Frog (*Adelotus brevis*- listed as endangered under the NSW BC Act) and Purple-Spotted Gudgeon (*Mogurnda adspersa,* listed as endangered under the NSW FM Act). NSW DPI also maps the creek as KFH.

Pitkins Swamp Creek was assessed by Eco Logical Australia aquatic ecologist, Dr Peter Hancock on 2 October 2018. Pitkins Swamp Creek is a narrow creek winding through highly modified agricultural land. The substrate along most of the creek was mud or fine sand. The creek is impacted by historical land management activities. No native trees occur in the riparian zone, although it is sparsely vegetated with willows (*Salix* spp.) and blackberry (*Rubus fruticosus*). Eroded tracks and cattle pads leading into the water indicate that livestock regularly access the creek (Figure 14a). During the site visit on 2 October 2018, flow levels were low, and in many places consisted of a shallow trickle less than 5 cm deep.

In the upstream reach of the inspected length of stream, the creek consisted of occasional pools up to 10 m long, 2 m wide, and approximately 1.5 m deep (Figure 14a). Between the pools, the creek consisted of shallow runs 3 to 20 cm deep, and often less than 1 m wide (Figure 14b).

Mid-way along the survey reach, there was a narrow causeway across the creek that had a 30 cm steel pipe running through the centre (Figure 14c). Water level was too low to flow through the pipe, although a small amount seeped through the rubble underneath. This causeway constitutes a significant barrier to fish passage in its current state. Immediately below the causeway the creek bed drops approximately 0.7 m (Figure 14d), then further downstream the channel becomes more incised. At the downstream end of the reach, the banks were approximately 3 m above water level (Figure 15).

a) b)

c) d)

Figure 14: a) Pool at upstream water sampling site; b) Shallow run between pools; c) Causeway across Pitkins Swamp Creek, looking downstream; d) Looking upstream towards the causeway, showing the drop in creek bed.

Figure 15: Pool at downstream end of study reach, showing high banks and surface of water partly covered with Azolla

Aquatic vegetation was sparsely distributed in the creek, and diversity was low. At the upstream reach, rushes (*Juncus* sp.) and sedges (*Cyperus* sp.) grew along the water edge. Watercress (*Rorippa nasturtium-aquaticum*) and River Buttercup (*Ranunculus inundatus*) grew in the shallow sections of the upstream reach, where water was less than 5 cm deep. *Azolla* sp. covered as much as 40 % of some pools downstream of the causeway (Figure 15), but was less common upstream.

Eastern Longnecked Turtles were seen in some of the large pools, and Eastern Sedge-Frogs (*Litoria fallax*) were heard calling from along the creek. Plague Minnow (*Gambusia holbrooki*) was the only species of fish seen in the creek.

Physico-chemistry was measured at one location near the upstream end of the survey reach, and one location downstream (Table 16). At the upstream location, Electrical Conductivity was higher; while turbidity, temperature, pH and dissolved oxygen concentrations were lower (Table 16). This may be due to a stronger groundwater input to the upper reaches, and to the downstream reach being dominated by overland flow and runoff. According to local landholders, the upper reaches of the creek never go dry, which is further support to the idea that they are groundwater-fed.

Table 16. Physico-chemistry at two locations at either end of the survey reach.

Parameter	Upstream location	Downstream location
Latitude	29° 02’ 48”S	29° 02’ 27”S
Longitude	152° 03’ 30”E	152° 03’ 05”S
Turbidity (NTU)	18.7	69.4
Temperature (°C)	15.7	19.17
Electrical Conductivity (µS/cm)	837	669
Dissolved Oxygen (% Saturation)	72.5	120.8
Dissolved Oxygen (mg/L)	7.15	11.09
pH	7.53	7.99

Assessment of habitat for threatened species

Assessment of terrestrial habitat for threatened species is given in Appendix A.

Purple-Spotted Gudgeon is now currently confined to small remnant populations in the Macquarie, Gwydir, and Border Rivers catchments. Pitkin Swamp Creek flows into Tenterfield Creek, then Dumaresq Creek and is part of the Border Rivers catchment. Although Pitkins Swamp Creek is mapped as Purple-Spotted Gudgeon habitat (DPI 2017), no specimens have been reported from this waterbody or its tributaries. The nearest specimens were collected from Deepwater River near Bolivia, approximately 40 km to the south, and Clarence River near Keybarin, 56 km to the east (Atlas of Living Australia for Purple-Spotted Gudgeon, accessed 11 October 2018).

Purple-Spotted Gudgeon are a benthic species that prefer slow-moving or still waters in streams with low turbidity (DPI 2017). Cover in the form of aquatic vegetation, overhanging vegetation, rocks or snags are important for this speices (DPI 2017). Most remnant populations in NSW occur in small to medium-sized streams. The species is threatened by a loss of favourable habitat, particularly aquatic plants; increased turbidity and damage to stream banks by livestock access; and isolation from other nearby populations.

Pitkins Swamp Creek is unlikely to be suitable for Purple-Spotted Gudgeon because impacts caused by previous agricultural practices. The creek has high turbidity, and the banks are eroded. Cattle currently access the water and continue to contribute to bank instability. Although there are some habitat features that may be used by Purple-Spotted Gudgeon, such as boulders, and occasional large woody debris from fallen willlows, there is little aquatic vegetation in the deeper pools, and no native riparian vegetation to give additional woody structure.

Tusked Frogs (*Adelotus brevis*) once occurred from the north coast of NSW, westward to the New England Tablelands, and the North West Slopes. However, it is now very rare on and west of the tablelands, so is listed under the NSW BC Act, as an endangered population in the Nandewar and New England Tablelands Bioregions of NSW (OEH 2017). The species is predicted to occur in the project area, and specimens were collected from nearby in the early 1970's. However, there are no records more recent than 1973 (Atlas of Living Australia for Tusked Frog, accessed 11 October 2018) and the species appears to have gone from the area. Current populations from the upper Clarence River catchment and the species is more common in areas of lower altitude and closer to the coast.

Tusked Frogs occur in rainforests, wet forests, and flooded grassland and pasture, usually near creeks, ditches or ponds. Key threats to the species include Chytrid fungal disease, reduced water quality, and predation of eggs and tadpoles by exotic species such as Plague Minnows. The species is also vulnerable to the destruction of riparian habitat, and degradation resulting from agricultural and urban development.

Pitkins Swamp Creek has potential to be Tusked Frog habitat upstream of the proposed project area, where banks are not incised and grassland may become flooded. However, adjacent to the project area, the potential for flooded grassland and pasture to occur is minimal. The lack of a natural riparian zone, extensive agricultural activity along the creek, and the presence of plague minnow, make it even less likely that Tusked Frog occur at the Site.

Riparian land

Upon inspection on 2nd, 16th and 17th October 2018, the 2nd order stream was described as a gentle sloping area that extends into a low lying floodplain adjacent to Pitkins Swamp Creek.

The solar PV module area includes 1st order streams and a 2nd order stream (Strahler, 1952). The design of the TSF incorporates a buffer distance of at least 40 m from the bank of Pitkins Swamp Creek. Riparian vegetation and the riparian zone generally throughout the Site are cleared and/or highly degraded to support agricultural activities and comprise exotic species.

Groundwater dependent ecosystems (GDEs)

GDEs are ecosystems that have their species composition and natural ecological processes wholly or partially determined by groundwater. Types of ecosystems that can rely upon groundwater include:

- Terrestrial vegetation that show seasonal or episodic reliance on groundwater;
- River base flow systems which are aquatic and riparian ecosystems in or adjacent to streams/rivers dependent on the input of ground water for base flows;
- Aquifer and cave ecosystems;
- Wetlands;
- Estuarine and near-shore marine discharge ecosystems; and,
- Fauna which directly depend on groundwater as a source of drinking water of that live within water which provide a source.

A search of the Bureau of Meteorology GDE Atlas (BoM, 2012) identified no mapped GDEs. The mapping provides for aquatic, terrestrial and subterranean GDEs. The BoM assessment is based on regional studies involving remote sensing, vegetation community mapping and groundwater level data. The Water Sharing Plan for the *NSW Border Rivers Unregulated and Alluvial Water Sources* (2012) identified no high priority GDEs within the Site.

Acid sulphate soils

The Australian Soil Resource Information System online data base indicates that there is a low probability of occurrence of acid sulfate soils (*Acid sulphate class Bn(p4))* at the Site (CSIRO, 2018). Acid sulfate soils are typically associated with low lying coastal areas. The Site is approximately 140 km west of the coast at high altitude and as such the potential for acid sulfate soils to occur is negligible.

Related infrastructure

No water related infrastructure, such as dams, weirs, urban water supply are located in the immediate area of the Proposed Development. The closest drinking water supply is the Tenterfield Dam. The Dam is located approximately 4 km from the Site in a south-westerly direction. Pitkins Swamp Creek is not part of the Tenterfield Dam drinking water catchment. Flood modelling for the Tenterfield Creek and Dam system does not extend to the area of the Proposed Development.

Adjacent licensed water users and basic landholder rights

There is no groundwater vulnerable land mapping in the Tenterfield LEP. There are six registered groundwater bores within a 1 km radius of the Site as shown in Table 17 (Geolyse, 2018).

Table 17: Summary of bore data

ID	Bore Depth (m)	Water Bearing Zone Upper Limit (m)	Standing Water Level (m)	Use/Purpose
GW902755	18.3	14.0	5.5	Stock/Domestic
GW060582	31.0	unknown	unknown	Stock/Domestic

ID	Bore Depth (m)	Water Bearing Zone Upper Limit (m)	Standing Water Level (m)	Use/Purpose
GW068433	20.5	8	7	Stock/Domestic
GW069024	27.4	15.9	9	Domestic
GW902650	12.2	11.0	4	Domestic
GW306653	90	37	37	Stock/Domestic

5.7.2 Potential impacts

The Proposed Development has been assessed as having no direct impacts on water resources. There is low potential for indirect impacts to occur during the construction, operation and decommissioning stages through the process of erosion and sedimentation. The Development Footprint has been designed to minimise potential impacts to water resources. The module layout has been designed to ensure a buffer distance from Pitkins swamp creek, with no creek crossings proposed. Potential impacts to water quality, quantity and aquatic ecosystems for both surface and groundwater resources during construction (including decommissioning) and operational phases are considered in the following sections.

Solar panels will be located away from the waterway, and there is no construction planned for inside the riparian corridor, so impacts to Pitkins Swamp Creek from the proposed solar farm will be negligible or minor. If the creek is fenced off from stock, and stocking rates lowered, the ecological condition of Pitkins Swamp Creek may potentially improve. Background searches of threatened species that may occur in the locality had indicated potential impact for two aquatic species within Pitkins Swamp Creek. However, field survey has concluded that it is unlikely that Purple-Spotted Gudgeon or Tusked Frog occur in the area, so the potential for impact to either species is negligible.

The solar farm is unlikely to have a significant impact on the aquatic ecology of Pitkins Swamp Creek as the creek and its riparian zone is already relatively degraded by past clearing and cattle access, fences excluding stock would allow the creek to improve in condition. Pitkins Swamp Creek is unlikely to be suitable for Purple-Spotted Gudgeon because impacts caused by previous agricultural practices.

The proposed construction and decommissioning works involve a range of activities that disturb soils and could potentially lead to sediment laden runoff, affecting local waterways during rainfall events. These activities include:

- Excavations for the construction of internal roads, support buildings, construction laydown and parking areas;
- Ground preparations associated with the installation of PV panels and inverter stations;
- Trenching for below ground cable installation; and
- Soil compaction and reduced permeability in areas of hardstand and access tracks.

The use of fuels, lubricants, herbicides and other chemicals during construction pose a risk of surface and groundwater contamination in the event of a spill, this is also discussed in Section 5.3.2. Waste or debris created during construction works could pollute surrounding waterways, for example via strong winds or runoff to Pitkins Swamp Creek during unforeseen extreme weather events.

Operational impacts to water quality are considered negligible. The operational land use as a solar farm would likely reduce the potential for impacts to water quality, compared to current agricultural landuse practices. Potential water quality benefits would include a decrease in soil disturbance as the current land use is cattle grazing, increasing the potential for sediments to enter surface water. A reduction in stocking rates would also reduce erosion, sedimentation and riparian disturbance at the Site and hence impacts on surface water. In addition, a decrease in fertiliser use and stocking rates would reduce the potential for nutrients to enter surface waters.

Although the installation of PV panels presents a large impervious surface standing above the ground at approximately 2.5 m, the shape of the panels, and the separation distance between rows will quickly return rainfall as runoff to the natural ground to allow surface penetration and/or run-off to occur in a typical manner. Disturbed areas would be revegetated in order to stabilise the ground surface. This should prevent soil erosion and, thus, sedimentation impacts to surface water. However, it is acknowledged that soil scarring resulting from large rainfall events could occur under the panels which may, if left untreated, result in soil erosion and potential impacts to surface water. Sedimentation may also occur from increased runoff due to the more impervious nature of the permanent access tracks and hardstand areas.

No operational activities would affect groundwater at the Site. No groundwater is proposed to be sourced during operation of the Proposed Development. The Proposed Development will not impact on the quantity of water available to adjacent water users or impacts upon water related infrastructure. Any additional water required for the Site should be met without the need for an application for a water licence, therefore not impacting upon surrounding water users. If a licence is required, the regulator is to determine the potential impact as part of the application process.

5.7.3 Mitigation measures

The Proposed Development has been designed to minimise potential impacts to water resources and aquatic ecosystems. Potential environmental constraints within the Site have been excluded from developable land. As a result of a design philosophy that, in the first instance seeks to avoid impacts, the following environmental protections apply:

- Exclusion of Pitkins Swamp Creek from the Development Footprint (4th order stream);
- Avoidance of footings and pilings, where practicable, from 1st and 2nd order riparian zones;
- Avoidance of creek crossings for internal access and cabling;
- Sourcing of non-potable water from onsite dams and/or existing water licenced sources offsite; and
- Sourcing all potable water requirements from offsite.

Management plans shall be developed to assess and identify appropriate operational protocols to ensure the protection of surface and groundwater quality, maintenance of water supplies and rights of access, and the protection of riparian, aquatic and GDEs. Specific mitigation to potential impacts by topic are outlined below.

Surface water and riparian land

Construction and decommissioning activities will avoid impacts to riparian and aquatic ecology, avoiding direct impacts where possible and adopting best practice where necessary.

To minimise impacts to riparian and aquatic ecosystems, excavation activities will be located away from drainage lines where possible. This ensures against direct impacts to riparian, aquatic and GDEs.

Water quality

Erosion and sedimentation impacts associated with soil disturbance from construction activities can be minimised by undertaking works in accordance with provisions of the Managing Urban Stormwater: Soils and Construction series, in particular:

- Managing Urban Stormwater: Soils and Construction, Volume 1, 4th edition (Landcom, 2004), known as 'the Blue Book';
- Volume 2A Installation of Services (DECC, 2008a); and
- Volume 2C Unsealed Roads (DECC, 2008b).

Procedures shall be adopted to minimise the risk of water quality impacts associated with contamination of surface water resources (Section 5.3.2).

Water quality protocols include establishing and maintaining groundcover across the Site to minimise potential for erosion and sedimentation impacts to water quality. Groundcover species selection and management will balance grazing and bushfire management objectives to avoid a build-up in combustible vegetation.

Access tracks shall be maintained in good condition, ensuring that associated drains and/or sedimentation traps are monitored and maintained so that potential erosion, which could lead to impacts on water quality, is minimised. Any erosion prevention and/or sedimentation traps installed as part of the design of the Proposed Development would be monitored to ensure effectiveness is maintained.

Management of construction waste and sewage would be detailed in appropriate management plans. Waste produced from toilets shall be stored until it is trucked off site and disposed of in accordance with EPA (2016) requirements. All hazardous materials will be classified and appropriately stored to prevent contamination of drainage lines and creeks.

Hazardous materials (fuels, lubricants, construction chemicals, herbicides, etc.) will be transported and disposed off site in accordance with EPA (2016) guidelines. Onsite refuelling shall occur within designated areas located more than 100 m from the nearest drainage line and within an impervious bund. Machinery will be inspected daily to ensure no oil, fuel or lubricants are leaking from engines or hydraulic systems. All contractors and staff will participate in toolbox talks to prevent, minimise and manage accidental spills.

A spill response strategy will be developed and included in the appropriate environmental management plan. All contractors and staff will be trained regarding appropriate spill response strategies. Should a spill occur, incident management procedures will be implemented and the EPA will be notified of any incidents that cause harm to the environment, pursuant to sections 147 – 153 of the POEO Act.

Onsite refuelling shall occur in an area that is located greater than 100 m from the nearest drainage line and within an impervious bunded area. Machinery will be inspected prior to use, to ensure no oil, fuel or lubricants are leaking from the machinery.

Water Quantity

To avoid any potential impacts on surface water quantity, and in accordance with surface water harvesting rights, Enerparc will source no more than 10 % of the total surface water from existing surface water dams located within the Site. Storm water detention basins may provide an additional source of non-potable water during construction. Any additional non-potable water required for the Proposed Development would be sourced offsite under agreement with existing water access licences. As such, a water access licence from DPI Water would not be required for construction activities. Potable water will be sourced off-site, via registered water suppliers. Water resources required for the construction, maintenance and decommissioning phases of the Proposed Development will be sourced from local water cartage services in the surrounding area, along with ensuring appropriate DPI water licences are held.

5.8 Hazards and Risks

An environmental hazard is an item or situation that has the potential to threaten the environment or human health. This section provides an assessment of potential hazards associated with the Proposed Development. Potential hazards that are considered include electrical and bushfire, as well as the potential for electromagnetic interference for the proposed grid connection infrastructure.

5.8.1 Existing Environment

Small portions of the transmission line route, the Site, and its surrounds are mapped as Bushfire Prone Land on the Tenterfield LGA Bushfire Prone Land Map (NSW RFS, 2018). The Proposed Development is located within cleared areas, away from infrastructure, residences and Pitkins Swamp. Figure 16 shows the Development Footprint with grid connection infrastructure alongside the road corridors in relation to Bushfire Prone Land.

Bushfire and electrical fire

Risk of fire can be considered in terms of environmental that increase the risk or severity of fire (vegetation, topography and weather patterns), as well as specific activities and infrastructure that increase combustion or ignition risks.

In the wider area, due to historic clearing for agriculture, vegetation cover is generally low except within road reserves, in isolated patches in paddocks and gullies, and in gardens surrounding the homesteads which are scattered across the landscape. In cleared areas groundcover consists of exotic grasses.

The Site will cover up to 60 ha of rural land, the majority of which has been cleared for grazing and sown with improved pastures and there are patches of planted vegetation scattered along fencelines. The Site is located within an undulating landscape. Bushfire prone mapping available by NSW Planning Portal identifies the portions of the Site in the south and small areas along the transmission line route are mapped as Vegetation Category 2. Category 2 is considered to be a relatively low bush fire risk (NSW RFS, 2015), see Figure 16.

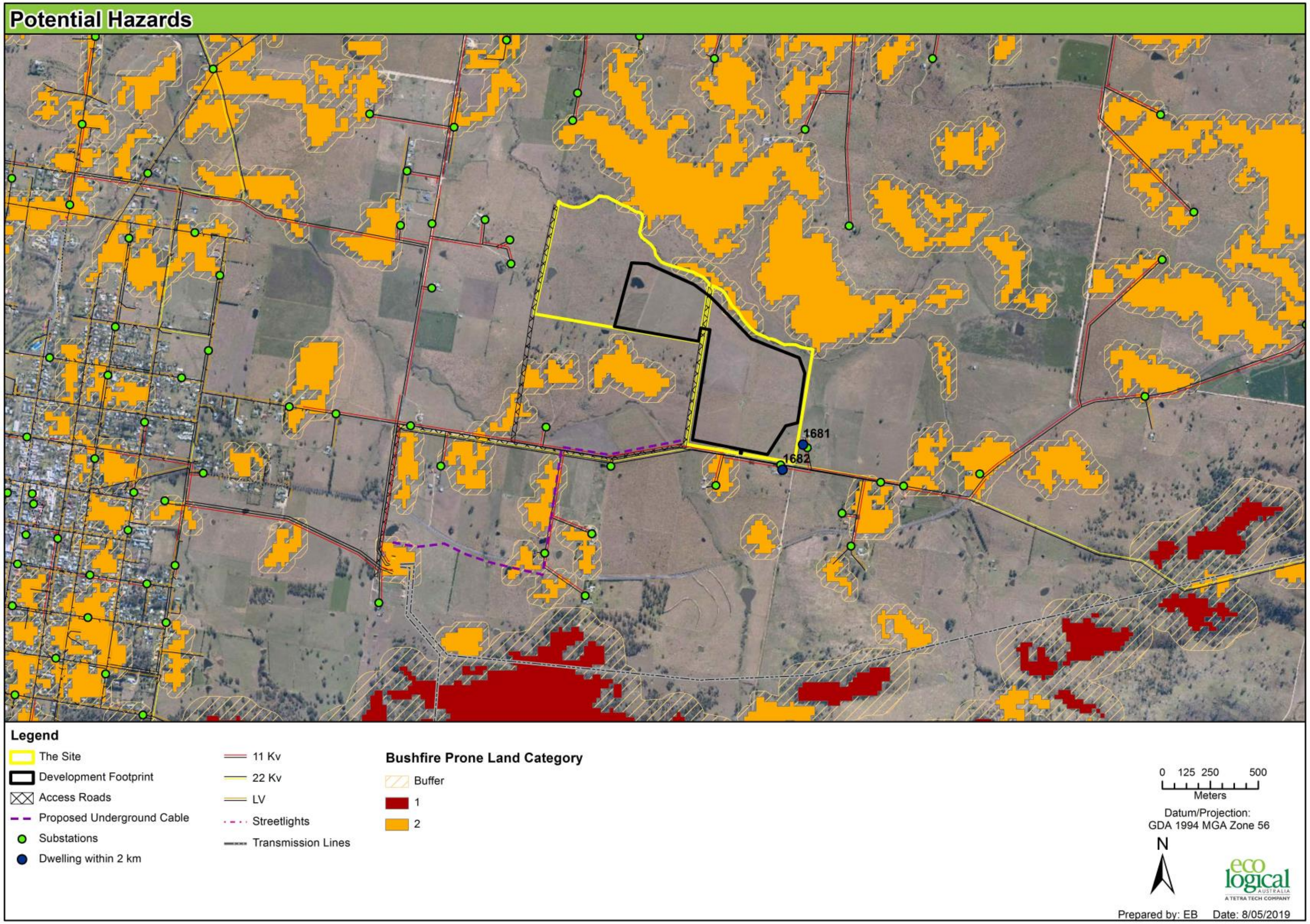


Figure 16: Potential hazards surrounding Proposed Development

The existing overhead electricity transmission lines may pose a potential hazard, however, TransGrid is required to maintain line infrastructure to minimise fire risk. This too applies to overhead distribution lines maintained by Essential Energy.

The statutory Bush Fire Danger Period is between October and March reflecting seasonal fire hazards; however, this will vary from year to year depending on the prevailing climatic conditions in the region. The bushfire danger period for 2018 was pulled forward to August 2018 and extended until the end of April 2019 due to prevailing dry conditions (RFS, 2018a).

All NSW Fire and Rescue stations are equipped with the resources and trained personnel required to deal with fire (and hazmat incidents). The nearest NSW Fire Brigades are the Tenterfield Fire Station 3.5 km west from the Site, and Glen Innes Fire Station 96 km south-west from the Site. The nearest RFS Brigade is at Tenterfield, approximately 4.5 km south-west of the Site.

In terms of onsite resources, the Site is well serviced by multiple sealed roads (Old Racecourse Road and Bellevue Road). There will also be internal access tracks created for the Proposed Development. These roads can provide emergency evacuation routes and emergency vehicle entry.

Existing receivers at most risk from fire include the two dwellings to the south of the Proposed Development Site that align with the bushfire mapping (recievers 1682 and 1683) (Figure 16) and associated infrastructure located within the Site.

In accordance with relevant guidelines, consideration is given to human health and safety as well as potential interruption of existing services during the construction operational and decommissioning phases of the Proposed Development.

The existing environment is low and undulating, with 35 receivers within a 1 km radius of the proposed works. It is likely to be characterised by relatively weak radio signal strengths (primarily due to distance from transmission stations). Existing potential sources of electromagnetic interference within the vicinity of the Site include the TransGrid Tranmsision lines and substation, and the Essential Energy distribution network. The existing electricity infrastructure network in the locality is shown in Figure 16.

5.8.2 Potential Impacts

Bushfire and electrical fire

Fire could damage structures and impact the safety of employees and contractors at the Site. Fire leaving the Site poses a human safety and property threat and imperils native flora, fauna and ecosystems.

Native and exotic grasses are present across most of the Site with a small section of planted trees along a north-south fence line. Minimal native vegetation disturbance will occur within the Development Footprint. With this type of vegetation mix on the Site, it is considered unlikely the Proposed Development will pose a significant bushfire risk. Most of the Site is not mapped as bushfire prone land, although there is a small portion of the southernmost end of the Site where there is category 2 bushfire prone land mapped (NSW DPE, 2018).

The flammability of solar farms is very low as they are predominantly constructed of glass, silicon, steel and aluminium. The risk of fire originating from the Site is very low. Although, fires (such as grassland fires) have the potential to occur.

Construction and decommissioning

Potential ignition sources during the construction and decommissioning phases of the Proposed Development would include:

- Machinery movement in long grass;
- Hot work activities, including welders and grinders;
- The storage of waste and combustible materials onsite;
- Storage of flammable liquids;
- Electrical faults;
- Lightning strikes; and
- Cigarette butts disposed of carelessly on-site and from cars travelling along roads.

Considering the sparse vegetation cover over the Site and other factors discussed above, it is considered unlikely that the Proposed Development would pose a significant bush fire risk.

Potential fire risk during decommissioning activities would be similar to those for construction.

Operation

In addition to the potential ignition sources identified above, the operational phase would include fire risks associated with damaged or faulty electrical equipment.

With appropriate mitigation strategies in place, as discussed below, bushfire and electrical fire risks during the operation of the solar farm are considered highly manageable.

Electromagnetic fields

Electromagnetic Fields (EMFs) consist of electric and magnetic fields and are produced by electrical equipment of all size and voltage, and also occur naturally. Electric fields are produced by voltage while magnetic fields are produced by current. EMFs exist close to wires and lines that carry electricity and electrical devices and appliances that are operating. The strength of both electric and magnetic fields reduce quickly with distance, and while electric fields are insulated to an extent by their surroundings (buildings or the earth in which cables may be buried), magnetic fields are not.

In Australia, transmission lines and other electrical devices and infrastructure operate at 50 Hertz (Hz), and fall within the Extremely Low Frequency range of 0 – 300 Hz. Short-term exposure to very high levels of EMFs can be detrimental to human health, however exposure to EMFs generated within the Extremely Low Frequency range, at the low levels experienced by the general public, do not have substantive impacts to health. This is the case for the EMFs that would be produced by the Proposed Development (and the transmission lines that already exist on site).

There is uncertainty about the health impacts of longer term exposure to Extremely Low Frequency EMFs. Advice from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA, 2015) indicates that scientific evidence of exposure to 50 Hz electromagnetic fields near transmission lines has not established a human health hazard. However, where any risk does exist, it would be small (ARPANSA, 2015).

In the absence of Australian standards for regulating exposure to Extremely Low Frequency EMFs, the National Health and Medical Research Council's (NHMRC) *Interim guidelines on limits of exposure to 50/60 Hertz electric and magnetic fields* (1989) has been used to assess the impact of the Proposed Development infrastructure to contractors and the general public's health (Table 18).

Table 18: Summary of NHMRC's Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields

Exposure characteristics	Electric field strength (Kilovolts per metre – kV/m)	Magnetic flux density (Microtesla - µT)
Occupational		
Whole working day	10	500
Short term (maximum exposure is 2 hours/work day)	30	5,000
General public		
Up to 24 hours/day	5	100
Few hours/day	10	1,000

Construction and decommissioning

The potential of EMF impacts during the construction and decommissioning phases is low. Exposure by construction staff would be limited to intermittent periods, during works at and around existing 132 kV transmission lines, 11kV and 22kV distribution lines and 132/22 kV Tenterfield substation.

Operation

Potential EMF impacts would occur only during the operational phase, when the solar farm infrastructure is capable of generating EMFs. The EMFs generated would vary due to the type and size of electrical equipment on site, and whether potential sources of EMF are overhead or buried.

EMF generating components at the Proposed Development include:

- The PV array and its wiring system; and,
- The underground (up to) 22 kV cables connecting the array area with the substation.

Magnetic fields produced by the PV solar array would be significantly less than those produced for household applications and are indistinguishable from background levels at the Site boundary (Chang & Jennings, 1994). Therefore, the health risk of EMFs from solar arrays would be insignificant.

The 22 kV cabling connecting the solar array to the adjacent existing TransGrid 132/22 kV substation will be underground and will produce both electric and magnetic fields. Electric field would be non-significant due to the insulative effect of burial and the built in cable screening. The typical magnetic field from the underground cables is 1 µT(1 µT =10mG) immediately above a 22 kV or 33 kV cable buried at 0.5 m (Figure 17).

These levels are below the requirements for contractors and public exposure levels as per NHMRC's Interim guidelines in Table 11. Any EMFs produced by the substation would comply with exposure limits (EMFs Info, 2017) and is not considered further.

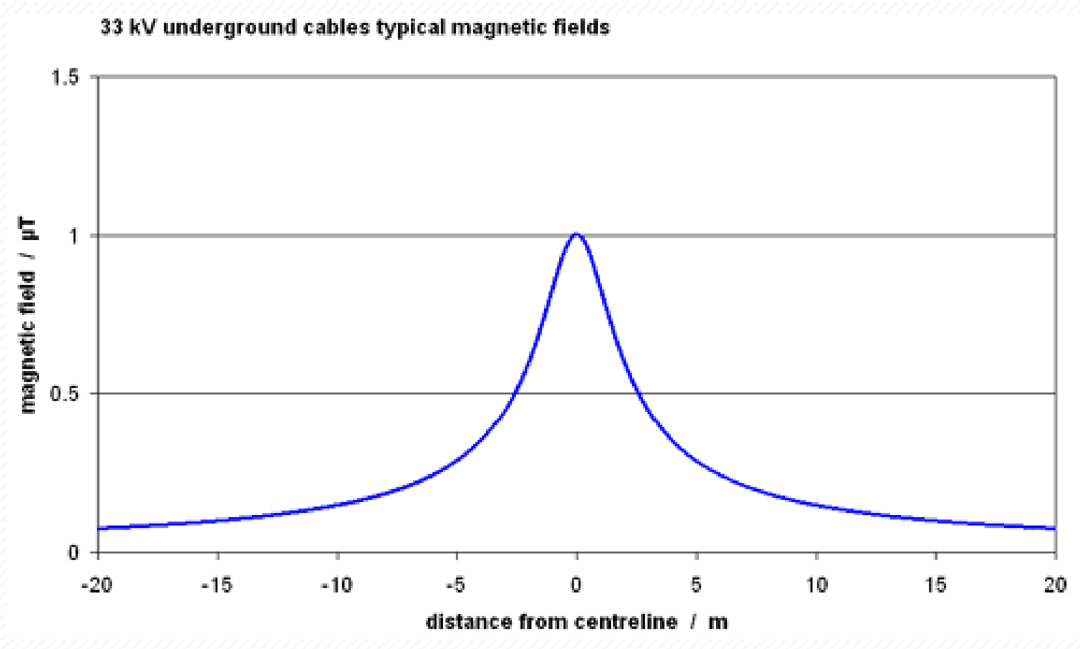


Figure 17: Typical magnetic field from a 33 kV underground cables (EMFs Infor, 2018)

There are 35 residences located within approximately 1 km of the Site boundary, the closest of which are between 30 m and 50 m away. One hundred and one residences are within approximately 2 km from the Proposed Development. Given the distance from the highest EMF emitter (the substation) and the low EMFs emitted from the PV solar arrays, and the existing 11 kV and 22 kV distribution networks and two TransGrid 132kV transmission lines located near these residences, EMFs from the Proposed Development are likely to be indistinguishable from background levels at the boundary fence.

All AC electrical equipment that would be used as part of the Proposed Development will operate at 50 Hz. Household appliances and devices, as well as telecommunication signals operate at much higher frequencies. For example, microwave ovens and Wi-Fi routers operate at 2.4 GHz, while mobile phones currently operate at 1.8 GHz. As these devices operate at higher frequencies which do not overlap with 50 Hz, and due to the rapid dissipation with distance from the source of EMFs, it is considered that they would not be impacted by EMFs from the Proposed Development.

5.8.3 Mitigation Measures

Bush and electrical fire

The *Planning for Bush Fire Protection 2006* has been revised to account for lessons learnt in major bushfire events, and changes in building codes and construction standards. The revised *Planning for Bush Fire Protection 2018* (PBP 2018) has been published which is in its 'pre-release' stage, it is expected to become legislated by mid-2019. The revised document is encouraged to be used on a performance basis until the PBP 2018 becomes legislated. The following mitigation measures are proposed to reduce and manage the risk of fire, and reduce the impact of any fires within or surrounding the Proposed Development, and are in accordance with the PBP 2018 guidelines.

The bush fire hazard associated with the activities listed above is considered highly manageable through electrical equipment selection, appropriate access arrangements, fuel load reduction programs, safety protocols during periods of high fire risk and the implementation of an emergency response plan as detailed below.

Risk assessment

Following final design, and prior to commencing construction, undertake a bush and electrical fire risk assessment to assess specific risks associated with the Site and prepare a bushfire management plan to identify a suite of strategies and mitigation measures to manage these risks.

Design

Electrical equipment selected for the 28-year life span of the Proposed Development would be designed to minimise the potential for ignition and certified to comply with relevant Australian Standards. All equipment installed would be earthed appropriately following comprehensive testing of soil conductivity to ensure lightning effects are not harmful to the operation of the Proposed Development.

Chemical storage will be in accordance with safety data sheet requirements and would consider potential fire hazards (e.g. the use of fire cupboards for the storage of chemicals).

There will also be a 20,000 litre water tank located on site for the sole use of fire protection in line with the RFS standards (RFS, 2018).

Access and Firebreaks

Appropriate emergency vehicle access will be provided across the entire Site, including access to the 10 inverter stations. Infrastructure setbacks from the boundary shall include a firebreak (up to 5 m) that will be adequate to allow emergency vehicles to access the permitter of the Site. The RFS recommends that firebreaks around valuable assets be mown, grazed or ploughed.

Fuel reduction

The fuel load across the Proposed Development will be monitored, and will be mechanically slashed, grazed or ploughed to reduce the risk of grass fires starting within the Site and ensuring that fires originating from outside the Site do not intensify as a consequence of entering the Site. In addition, asset protection zones would also be designed and maintained around buildings and infrastructure to reduce the risk of fuel loads building up around sensitive assets. These management actions will be included in the relevant environmental management plans.

Emergency Response Plan

The OEMP will include an emergency response plan and a copy will be provided to the RFS and Fire and Rescue NSW. This will allow the first responders to a fire to have ready access to information that details the effective control measures for a fire at the Site and for these to be implemented quickly. The emergency response plan will include the controls required to mitigate the potential risks that could be experienced by fire fighters at the Proposed Development, including the methods required to safely shut down and isolate the necessary components of the solar farm.

Safety protocols

Environmental management plans will provide safety protocols to ensure all staff and contractors are aware of the bushfire risk on site and the mitigation measures required to reduce this risk. Protocols, will include, but are not limited to:

- Basic training of all staff in the use of firefighting equipment on site;
- Firefighting equipment lists will be detailed in the Work Method Statements;

- Management procedures for hot works, smoking, vehicle use off formal access tracks, and the use and storage of fuel and flammable chemicals; and
- Daily monitoring of the Fire Danger Rating, and communication of any further mitigation measures required to all staff and contractors.

Electromagnetic fields

In limiting exposure to electromagnetic fields, following advice from the International Commission on Non-Ionizing Radiation Protection, priority would be given to engineering and access controls so that:

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

In addition to the above, potential exposure levels on site are predicted to be below the exposure limits for staff in the NHMRC's Interim Guidelines *1989* (Table 18), therefore further mitigation is not proposed.

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

Receptors – public safety

To reduce the potential for chronic or acute exposure to EMFs, no unsupervised public access to the Proposed Development would be permitted. As discussed above there is unlikely to be any negative impact to public health from EMFs outside of the Site.

The landholder or its employees may have limited access to the Site for grazing activities, however there will be no need to spend extended periods near electrical infrastructure. As such, the potential for impacts from EMFs is low.

The landholder or its employees would not have access to the grid connection infrastructure or inverter stations.

Receptors - electrical devices

As noted, electrical equipment commissioned as part of the Proposed Development would be designed to reduce possible interference in line with Australian Standards. It would also operate at different frequencies to household electrical devices and telecommunication signals. In addition, due to potential receptors' location outside of the Site, there would be no impact on any electrical devices. Impact to household devices created by EMFs would require no additional mitigation measures.

5.9 Socio-economic

5.9.1 Existing Environment

The Proposed Development occurs within Tenterfield Shire Council, approximately 18 km south east of the NSW Queensland border. Under current NSW planning, the population of the Tenterfield LGA is expected to remain the same over the next 20 years from a projected value of 7,150 in 2016 to a predicted 7,150 in 2036 (DPE, 2016).

As per the 2016 Census, the Tenterfield LGA has a population of 6,628, of these 49.1% were male and 50.9% were female (ABS, 2018). Aboriginal and Torres Strait Islander people made up 6.0% of the population. Population growth rates for the Tenterfield LGA are steady and are expected to remain steady over the next 20 years. The median age of people in the Tenterfield LGA is 53 years, sixteen years older than the national median. Children aged between 0 and 14 years make up 15.7% of the population and people aged 65 years and over made up 27.6% of the population (ABS, 2018).

Local Economy

The New England and North West regional economy has historically been based on agriculture, and it remains one of the most productive agricultural areas in Australia. The agricultural, forestry and fishing industry in the region is worth approximately $1.3 billion annually. The gross value of agricultural commodities in the 2014-15 financial year was $2.1 billion (NSW DPE, 2017). The agricultural industry is complemented or supported by urban industries and services ranging from manufacturing to professional services such as education, training and health care. The region has been identified as one of the best locations in NSW for the promotion and generation of renewable energy (NSW DPE, 2017). Other solar farms in the region includes Moree, with the potential to supply 24,000 homes and White Rock (Inverell) with projected supply of energy to 75,000 homes (NSW DPE, 2017).

Tenterfield provides essential retail, commercial and community services to local communities, as the northern gateway to New England adjoining the Queensland border (NSW DPE, 2017). Tenterfield has a strong economy based on agriculture, as well as the retail trade, health, education and tourist accommodation.

Of the employed people in Tenterfield (LGA), 30 % worked in the agriculture, forestry and fishing industry. The next major industry of employment included construction with 13.5 % of the LGA population (ABS, 2017).

Community Strategic Plans

The Tenterfield Shire Council has in place Strategic Plans to provide information on aspiration goals for the community, including the Council's mission and purpose.

Tenterfield Community Strategic Plan 2017 – 2027

The *Tenterfield Community Strategic Plan 2017 – 2027* was adopted by Tenterfield Shire Council in 2017. The Community Strategic Plan identifies the Councils mission “Quality nature, quality heritage and quality lifestyle.” The Proposed Development finds support in a number of the community’s listed visions in the Communities strategic plan, these are detailed below in Table 19:

Table 19: Tenterfield Shire Council Community Strategy goal and how the Proposed Development relates

Section in Strategic Plan	Council vision	How the project relates
6.1	Implement tools for efficient development processes and encourage quality commercial, industrial and residential development	The Proposed Development has been in regular consultation with the local Council to allow for efficient development.
6.4	Support, promote and participate in regional economic collaboration opportunities including planning, industry support and innovation	The Proposed Development has incorporated multiple stakeholders in regard to the planning and design of the proposed solar farm.
6.5	Land use planning strategies and policies enhance and support sustainable economic growth in the Tenterfield shire	The Proposed Development will promote up to 100 employees for the construction of the solar farm in the peak period of construction.
8.4	Maximise the accessibility of business and industrial operations to ensure the exchange of goods and services is supported by sustainable infrastructure	The Proposed Development is identified as sustainable infrastructure as a renewable energy source, as well as the implementation of best practice recycling and waste processes.
9.1	Land use planning provisions support and promote sustainable land use and management in the shire	The Proposed Development incorporates dual land uses of clean renewable energy generation and sheep grazing opportunities.
10.1	Land use planning and management enhances and protects biodiversity and natural heritage	The Proposed Development protects biodiversity through the extensive buffers for the Development Footprint, whilst also reducing the amount of native vegetation removal. No heritage impacts are proposed within the Development Footprint.

At a national-level, renewable energy sources, particularly solar as something Australia has an abundance of and should take the opportunity to exploit, develop and export. For example, in a 2017 survey, 79 % of respondents named solar power among their top three most preferred energy sources (The Climate Institute, 2017).

Other renewable projects

The Proposed Development is situated near the New England Renewable Energy Precinct. Other renewable energy projects within the precinct include:

- Glen Innes Wind Farm – approved;
- White Rock Wind Farm – operational;
- White Rock Solar Farm – operational;
- Sundown Solar Farm – SEARs issued and environmental assessment underway.
- Sapphire Wind Farm – operational;
- Sapphire Solar Farm – approved; and
- Biala Wind Farm – approved.

Close proximity of multiple construction and/or operational projects provides opportunity for potential cumulative impacts. Key mitigation strategies for cumulative impacts are:

- Spatial separation of impacts;
- Temporal separation of impacts; and
- Development specific mitigation strategies.

In this case spatial and temporal separation are sufficient to mitigate any cumulative impacts.

5.9.2 Potential Impacts

The socioeconomic and environmental benefits of developing renewable energy sources, and transitioning to a low carbon future are large, providing potential benefits to entire communities and helping to maintain quality of life. Increased adoption of renewable energy sources will assist Australia to transition away from traditional carbon intensive energy production which is linked to atmospheric pollution and carbon emissions associated with climate change. Reduced carbon emissions have the potential to reverse or slow the effects of climate change, benefitting current and future generations.

Electricity produced from the Site provides a clean power source for local and regional consumers in a cost-effective manner. With a 25 MW_{AC} and up to 32,180 kWp the solar farm will produce 52.45 GWh of clean renewable energy per year to the local electricity transmission network, providing enough energy to power up to 4,500 average homes each year. This would reduce up to 38,616 tonnes of CO^2 per annum through the displacement of conventional electricity supply.

The Proposed Development would have an overall positive impact on the local and wider economy during the construction period. Construction will take up to seven months and up to 100 staff during the peak time of construction will be required. The construction and decommissioning stages of the Proposed Development will generate the largest economic gain for the greatest number of people and businesses in adjoining LGAs. This is due to the hiring of a large temporary work force over these periods. Employment opportunities would involve concreting, earthworks, steel works and electrical cabling during construction, with demolition and removal during decommissioning.

Where practicable, Enerparc will source from local companies. Indirect employment opportunities would involve food industries, fuel, accommodation and other services that contractors coming to the area would require. Local employment opportunities will be generated, while additional workers from outside the region would stimulate the local economy through demand for accommodation, hospitality and retail services. A temporary influx of staff may lead to a small, but temporary, increase in pressure on local services, including accommodation.

It is not anticipated that the Proposed Development would have any adverse impacts on tourism given its limited visibility and the general positive attitude of Australians towards renewable energy and solar developments. Elsewhere, solar farms, as well as other renewable energy projects are being used as a tourism drawcard (SERREE, 2016).

5.9.3 Mitigation Measures

Construction

A Community Consultation Plan will be prepared and implemented outlining the measures that will be taken during the construction phase to increase positive benefits to the Tenterfield community and to reduce any adverse impacts. It will note protocols to keep the community updated on project progress during the construction phase, how relevant stakeholders will be informed of potential impacts, and the resolution process, for any complaints received.

Enerparc will liaise with relevant local representatives to maximise the benefits to the local economy, by recruiting contractors from the local area and implementing an informal ‘buy local’ practice where goods and services are purchased from local businesses, provided that they are competitive in terms of quality and price.

Mitigation measures that would reduce risk associated with increased traffic volumes during construction to acceptable levels have been provided in Section 5.6.3.

Mitigation of noise impacts are addressed in Section 5.5.3. It is concluded that predicted noise levels for the Site will be generally acceptable with the implementation of standard construction noise mitigation measures. These procedures will also be included in the CEMP.

Operation and decommissioning

No additional mitigation measures are considered necessary for the operational period. Mitigation and enhancement strategies for the decommissioning period would be the same as those outlined for the operational period.

6 Environmental Management

Environmental Management Plans would be prepared following final design and prior to each respective development stage to provide an overall framework for the management of environmental impacts that could potentially arise during the construction, operation and decommissioning of the Proposed Development. These plans will also include an Emergency Response Plan, Erosion and Sediment Control Plan, a Spill Response Plan, a Waste Management Plan, a Bushfire Management Plan, and a Community Consultation Plan.

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

- Relevant legislation;
- Conditions of consent; and
- Commitments provided in this SEE.

Impact	Mitigation measure
Biodiversity	Pre-clearing tree protection standards should be followed, although pre-clearing fauna survey and clearing supervision are not provided as no remnant or HBTs are proposed for clearing as part of the proposal
	Retaining coarse woody debris (i.e. logs) *in-situ* as valuable structural habitat resources is highly recommended.
	The extent of the clearing is to be defined by high-visibility bunting or fencing before the commencement of clearing to prevent inadvertent damage or unnecessary removal of vegetation. These clearing limits (no-go zones) should be marked on a map, and clearly communicated to any contractors or machinery operators, prior to undertaking clearing works. The HBTs that are nominated to be retained are to be clearly marked in the field. This includes any scattered or roadside remnant trees within the subject site, such as the two remnant Broad-leaved Apple trees which are HBTs.
	An Erosion and Sediment Control Plan will be implemented to minimise pollution and sedimentation issues which could arise, particularly when working in proximity to riparian zones. Where practicable, avoid placement of footings and pilings in tributaries to Pitkins Swamp Creek
	Weed management and hygine protocols in accordance with the Northern Tablelands RSWMP. This is of particular importance concerning Black Knapweed, regarding which the client will need to liaise with Tenterfield Shire Council and/or the DPI, who will advise them of relevant restrictions and protocols (e.g. regarding soil movement and machinery hygiene).
	A Waste Management Plan should be incorporated in the environmental management plans and approved by Tenterfield Shire Council prior to the commencement of works, to minimise any pollution issues which may arise.
Heritage	A buffer zone extending 50 m from the top of the left bank of Pitkins Swamp Creek shall be establish along the northern boundary of the Site. No development shall occur in this area moderate potential for subsurface archaeological deposits;

Impact	Mitigation measure
	All access to the site shall be via existing established roads (Old Racecourse and Coxalls Road);
	Aboriginal objects are protected under the NPW Act regardless of whether or not they are registered on AHIMS. If suspected Aboriginal objects, such as stone artefacts are located during future works, works must cease in the affected area and an archaeologist called in to assess the finds. If the finds are found to be Aboriginal objects, the OEH shall be notified under section 89A of the NPW Act. Appropriate management and avoidance or approval under a section 90 AHIP should then be sought if Aboriginal objects are to be moved or harmed.
	In the extremely unlikely event that human remains are found, works should immediately cease and the NSW Police should be contacted. If the remains are suspected to be Aboriginal, the OEH may also be contacted at this time to assist in determining appropriate management.
Land	the proponent will establish and maintain a website and phone contact to receive and respond to community concerns during construction, operation and decommissioning.
	The removal of farm dams will require a dewatering protocol within a CEMP) and an ecologist may be required to supervise the management of fauna during dam removal.
	The construction works are short term and would be managed in accordance with the *Managing Urban Stormwater: Soils and Construction* (Blue Book) series, namely: • Managing Urban stormwater: Soils and Construction, Volume 1, 4th Edition (known as the Blue Book) (Landcom, 2004); • Volume 2A Installation of Services (DECC, 2008a); and • Volume 2C Unsealed Roads (DECC, 2008b).

	Soil and erosion control measures in accordance with the above guidelines would be described in a CEMP to be developed following project approval and include the following measures:
	• Construction and/or installation of erosion and sediment control structures in accordance with the specifications provided in the Blue Book;
	• Regular inspection and programmed maintenance of erosion and sedimentation controls will be undertaken and documented in a register of inspections and actions;
	• Cable trenches will be constructed in accordance with relevant regulations and ground conditions. Trenches will be excavated and filled progressively to ensure they are left open for the shortest period possible. Surface conditions will be rehabilitated as soon as practicable to prevent the formation of preferential flow pathways;
	• Management of erosion generated by traffic shall include a driving code of practice, installation of appropriate drainage controls, inspection and maintenance of unsealed road surfaces and dust management strategies;
	• Separation of topsoil and subsoil for stockpiling and correct reinstatement to ensure a suitable growth medium is retained;
	• Appropriate stockpile management to ensure air and water erosion is minimised, soil health, organic matter and structure are retained and weed infestation minimised; and
	• Account for climatic events during construction;
	  o If heavy rainfall is predicted the Site should be stabilised and works modified to prevent erosion for the duration of the wet period; and
	  o Works methods shall be modified during high wind conditions if excess dust is generated.

Impact	Mitigation measure
	To avoid release to the environment, all hazardous materials (fuels, lubricants, herbicides, etc.) will be disposed of off-site in accordance with EPA guidelines (EPA, 2016). Onsite refuelling shall occur in an area that is located greater than 100 m from the nearest drainage line and within an impervious bunded area. Machinery will be inspected daily to ensure no oil, fuel or lubricants are leaking from the machinery. All hazardous materials will be stored in accordance with relevant regulations. All contractors and staff will be appropriately trained through site induction and toolbox talks to prevent, minimise and manage accidental spills.
	A Spill Response Plan will be prepared as part of the CEMP and OEMP. The Spill Response Plan will outline the procedures to respond to a spill event and the measures required to prevent the spread of spills to adjacent areas. It will also include an emergency response protocol, EPA notification procedures and remediation requirements.
	Despite no recorded contaminated sites, the potential remains for unidentified contamination to be encountered during excavation. Should this be the case, works in the area would cease and the relevant authorities would be notified. Protocols for such an event would be included in the CEMP and OEMP.
	Maintaining access tracks in good condition and ensuring that associated drains and/or sedimentation traps are monitored and maintained will ensure that the potential erosion associated with the tracks is minimised. Water carts may be used to limit wind erosion and dust generation.
	The maintenance of appropriate vegetation cover across the Site will assist in reducing potential erosion, particularly below the panels to prevent scouring following significant rainfall events. As such, an inspection program following significant rainfall events would implemented and stabilisation works would be undertaken as required.
	Further to this, any erosion prevention and/or sedimentation traps installed as part of the design of the Proposed Development will be monitored to ensure effectiveness is maintained.
	Weed management strategies will also be outlined in the OEMP. These strategies aim to prevent and minimise the spread of weeds and will include: • Management strategies for any declared priority weeds according to the stipulations of the *Biosecurity Act 2015* during the construction and operational phases; and • Protocols for weed hygiene in relation to plant and machinery entering and leaving site, and for the importation of fill to site.
	It is likely that sheep will be permitted to graze within the solar array to help manage vegetation down over the Site. This would contribute to weed control and fuel load reduction, as well as the continuation of agricultural activities across the Site.
	The Decommissioning Management Plan (DMP) shall include appropriate mitigation strategies to manage potential environmental impacts and to return the land to an agreed pre-existing agricultural capacity at closure of the project. The main objectives for the decommissioning stage include: • Reuse of recyclable materials • Return the land to its prior condition • Ensuring no environmental harm
Visual amenity	Implement visual setback areas within the site to eliminate, where possible, or mitigate visual impacts to highly impacted residences.
	Minimise vegetation clearing and earthworks and rehabilitate bare earth progressively.

Impact	Mitigation measure
	Implement commitments to establish vegetation screening and setbacks.
	Continued consultation with moderately impacted landholders will be undertaken to identify, where possible, the location of mutually agreeable vegetation screening both pre and post construction.
	Where practicable use muted, low contrast colours for all supporting infrastructure, so that they blend into the landscape as far as possible.
	Where practicable select infrastructure to minimise potential for reflectivity and glare.
	Minimise night lighting.
	Additional observer point vegetation screening shall be developed, if requested, in consultation with impacted landholdings.
Noise	ICNG standard hours for construction will be adopted for residential properties where noise impacts are apparent. These are: • Monday to Friday – 7 am to 6 pm; • Saturday – 8 am to 1 pm; and • No construction work on Sundays or public holidays.
	Locate the inverter stations at least 260 m away from the closest NSR.
	It is recommended to use mobile noise barriers/enclosures during certain construction work, such as around stationary work activities and plant
	Informing and consulting with residents and interested parties, as far as practicable, regarding impending or current events that may cause high levels of noise and how long they are expected to take. This may take the form of letter drops, or community notices.
	Provide a complaints telephone number prominently displayed where the works are taking place and on any letter drops or community notices.
	Respite hours agreed with residents when noisy works will not take place, if necessary.
	Investigate complaints when received to establish the cause, and where possible implement a corrective action such as, provide a respite period or other practical measure.
	Minimising the operating noise of machinery brought on to the Site.
	Where appropriate, obtaining acoustic test certificates for machinery brought on to the Site.
	Undertake noise monitoring at the start of a new noisy activity so noise levels can be investigated should a complaint be received.
	If there is excessive noise from any process, that process will be stopped and if possible that noise attenuated to acceptable levels. Where there is no alternative the process will be rescheduled to non-sensitive hours.
	Ensuring that plant is not left idling when not in use.
	Ensuring that plant is well maintained and in good working order and not causing unnecessary noise, such as damaged mufflers on plant, and
	All access hatches for plant to be kept closed.

Impact	Mitigation measure
Transport	As per the Road Safety Audit report, the following recommended roadworks are considered to be directly related to the construction phase and shall be addressed prior to commencement of construction activities: • Truck crossing signs (W5-22) for trucks crossing or entering are recommended to be on the Bruxner Highway approaches to Bellevue Road during the construction period (Applicant responsibility). • Repainting of the "Give Way" line marking on Bellevue Road at the intersection of Bruxner Highway and Bellevue Road (Council/RMS responsibility). • Renewal of hazard markers on the Bruxner Highway (RMS responsibility). • Installation of additional frangible posts including reflective markers at the intersection of Old Racecourse Road and Bellevue Road (Applicant responsibility). • Provide localised shoulder widening on Old Racecourse Road for laybys to ensure a total width of 7 m at up to 3 locations (Applicant responsibility).
	Car-pooling shall be encouraged among contractors during the construction phase with information regarding the benefits of carpooling included in the CEMP.
Water	As a result of a design philosophy that, in the first instance seeks to avoid impacts, the following environmental protections apply: • Exclusion of Pitkins Swamp Creek from the Development Footprint (4th order stream); • Avoidance of footings and pilings, where practicable, from 1st and 2nd order riparian zones; • Avoidance of creek crossings for internal access and cabling; • Sourcing of non-potable water from onsite dams and/or existing water licenced sources offsite; and • Sourcing all potable water requirements from offsite.
	Construction and decommissioning activities will avoid impacts to riparian and aquatic ecology, avoiding direct impacts where possible and adopting best practice where necessary.
	Management plans shall be developed to assess and identify appropriate operational protocols to ensure the protection of surface and groundwater quality, maintenance of water supplies and rights of access, and the protection of riparian, aquatic and GDEs.
	Excavation activities will be located away from drainage lines where possible. This ensures against direct impacts to riparian, aquatic and GDEs.
	Erosion and sedimentation impacts associated with soil disturbance from construction activities can be minimised by undertaking works in accordance with provisions of the Managing Urban Stormwater: Soils and Construction series, in particular: • Managing Urban Stormwater: Soils and Construction, Volume 1, 4th edition (Landcom, 2004), known as 'the Blue Book'; • Volume 2A Installation of Services (DECC, 2008a); and • Volume 2C Unsealed Roads (DECC, 2008b).
	Water quality protocols include establishing and maintaining groundcover across the Site to minimise potential for erosion and sedimentation impacts to water quality. Groundcover species selection and management will balance grazing and bushfire management objectives to avoid a build-up in combustible vegetation.

Impact	Mitigation measure
	Access tracks shall be maintained in good condition, ensuring that associated drains and/or sedimentation traps are monitored and maintained so that potential erosion, which could lead to impacts on water quality, is minimised. Any erosion prevention and/or sedimentation traps installed as part of the design of the Proposed Development would be monitored to ensure effectiveness is maintained.
	Management of construction waste and sewage would be detailed in appropriate management plans. Waste produced from toilets shall be stored until it is trucked off site and disposed of in accordance with EPA (2016) requirements. All hazardous materials will be classified and appropriately stored to prevent contamination of drainage lines and creeks.
	Hazardous materials (fuels, lubricants, construction chemicals, herbicides, etc.) will be transported and disposed off site in accordance with EPA (2016) guidelines. Onsite refuelling shall occur within designated areas located more than 100 m from the nearest drainage line and within an impervious bund. Machinery will be inspected daily to ensure no oil, fuel or lubricants are leaking from engines or hydraulic systems. All contractors and staff will participate in toolbox talks to prevent, minimise and manage accidental spills.
	A spill response strategy will be developed and included in the appropriate environmental management plan. All contractors and staff will be trained regarding appropriate spill response strategies. Should a spill occur, incident management procedures will be implemented and the EPA will be notified of any incidents that cause harm to the environment, pursuant to sections 147 – 153 of the POEO Act.
	Onsite refuelling shall occur in an area that is located greater than 100 m from the nearest drainage line and within an impervious bunded area. Machinery will be inspected prior to use, to ensure no oil, fuel or lubricants are leaking from the machinery.
	To avoid any potential impacts on surface water quantity, and in accordance with surface water harvesting rights, Enerparc will source no more than 10 % of the total surface water from existing surface water dams located within the Site. Storm water detention basins may provide an additional source of non-potable water during construction. Any additional non-potable water required for the Proposed Development would be sourced offsite under agreement with existing water access licences. As such, a water access licence from DPI Water would not be required for construction activities. Potable water will be sourced off-site, via registered water suppliers. Water resources required for the construction, maintenance and decommissioning phases of the Proposed Development will be sourced from local water cartage services in the surrounding area, along with ensuring appropriate DPI water licences are held.
Hazards	Following final design, and prior to commencing construction, undertake a bush and electrical fire risk assessment to assess specific risks associated with the Site and prepare a bushfire management plan to identify a suite of strategies and mitigation measures to manage these risks.
	The bush fire hazard associated with the Proposed Development is considered highly manageable through electrical equipment selection, appropriate access arrangements, fuel load reduction programs, safety protocols during periods of high fire risk and the implementation of an emergency response plan as detailed below.

Impact	Mitigation measure
	The OEMP will include an emergency response plan and a copy will be provided to the RFS and Fire and Rescue NSW. This will allow the first responders to a fire to have ready access to information that details the effective control measures for a fire at the Site and for these to be implemented quickly. The emergency response plan will include the controls required to mitigate the potential risks that could be experienced by fire fighters at the Proposed Development, including the methods required to safely shut down and isolate the necessary components of the solar farm.
	Electrical equipment selected for the 28-year life span of the Proposed Development would be designed to minimise the potential for ignition and certified to comply with relevant Australian Standards. All equipment installed would be earthed appropriately following comprehensive testing of soil conductivity to ensure lightning effects are not harmful to the operation of the Proposed Development.
	Chemical storage will be in accordance with safety data sheet requirements and would consider potential fire hazards (e.g. the use of fire cupboards for the storage of chemicals).
	There will also be a 20,000 litre water tank located on site for the sole use of fire protection in line with the RFS standards (RFS, 2018).
	Appropriate emergency vehicle access will be provided across the entire Site, including access to the 10 inverter stations. Infrastructure setbacks from the boundary shall include a firebreak (up to 5 m) that will be adequate to allow emergency vehicles to access the permitter of the Site. The RFS recommends that firebreaks around valuable assets be mown, grazed or ploughed.
	The fuel load across the Proposed Development will be monitored, and will be mechanically slashed, grazed or ploughed to reduce the risk of grass fires starting within the Site and ensuring that fires originating from outside the Site do not intensify as a consequence of entering the Site. In addition, asset protection zones would also be designed and maintained around buildings and infrastructure to reduce the risk of fuel loads building up around sensitive assets. These management actions will be included in the relevant environmental management plans.
	Environmental management plans will provide safety protocols to ensure all staff and contractors are aware of the bushfire risk on site and the mitigation measures required to reduce this risk. Protocols, will include, but are not limited to: • Basic training of all staff in the use of firefighting equipment on site; • Firefighting equipment lists will be detailed in the Work Method Statements; • Management procedures for hot works, smoking, vehicle use off formal access tracks, and the use and storage of fuel and flammable chemicals; and • Daily monitoring of the Fire Danger Rating, and communication of any further mitigation measures required to all staff and contractors.
	The final design of the TSF would be undertaken by qualified and competent persons;
	Design would meet relevant Australian standards, ensuring electromagnetic fields would be minimised as far as possible; and
	Access to electrical equipment would be limited to qualified personal only.
	To reduce the potential for chronic or acute exposure to electromagnetic fields, no unsupervised public access to the Proposed Development would be permitted.

Impact	Mitigation measure
	The landholder or its employees may have limited access to the Site for grazing activities, however there will be no need to spend extended periods near electrical infrastructure. The landholder or its employees would not have access to the grid connection infrastructure or inverter stations.
Socio economic	A Community Consultation Plan will be prepared and implemented outlining the measures that will be taken during the construction phase to increase positive benefits to the Tenterfield community and to reduce any adverse impacts. It will note protocols to keep the community updated on project progress during the construction phase, how relevant stakeholders will be informed of potential impacts, and the resolution process, for any complaints received.
	Enerparc will liaise with relevant local representatives to maximise the benefits to the local economy, by recruiting contractors from the local area and implementing an informal 'buy local' practice where goods and services are purchased from local businesses, provided that they are competitive in terms of quality and price.

Project Justification

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

7 Conclusions

The TSF, is located approximately 2 km east of the town of Tenterfield, NSW. The Proposed Development would have an electricity generation capacity of approximately 25 MW_{AC} and would produce enough energy to power the equivalent of up to 9530 average NSW households each year.

The Proposed Development is recognised as RSD and is subject to assessment under Part 4 of the EP&A Act. This SEE has examined and taken into account all matters affecting or likely to impact the environment by reason of the Proposed Development.

Information about the Proposed Development has been shared with local communities through a variety of consultation approaches including an open day in Tenterfield as well as letter notifications. Issues raised during the community consultation process have been addressed in this SEE and through the evolution of the design. The Proposed Development has received positive feedback from the general community with a limited number of concerns being raised. Where concerns were raised, mitigation strategies have been identified and are described within this SEE.

Potential environmental impacts associated with the Proposed Development have been first avoided, and then reduced during the concept development process. In the absence of mitigation, the Proposed Development would result in minor environmental impacts.

The Proposed Development would also provide a number of employment opportunities and benefits to the local economy, while reducing carbon emissions and providing progress towards national and international environmental commitments.

Environmental impacts associated the construction, operation and decommissioning of the Proposed Development are compliant with the requirements for ESD under the EP&A Act and other relevant State and Commonwealth legislation. Potential environmental impacts are minor and can be appropriately managed through the application of identified mitigation strategies and ongoing stakeholder consultation.

On the basis of the information provided in this SEE, it is concluded that the proposal presents relatively minor and manageable environmental impacts, which can be effectively mitigated using best practice strategies and methodologies. Potential benefits associated with the Proposed Development are a reduction in greenhouse gas emissions, reduced reliance on non-renewable energy sources and positive outcomes for the local community. On this basis the Proposed Development is strongly justified.

References

Atlas of Living Australia Website at https://bie.ala.org.au/search?q=purple-spotted+gudgeon. Accessed 11 October 2018.

Atlas of Living Australia Website at https://bie.ala.org.au/search?q=tusked+frog. Accessed 11 October 2018.

Australian Bureau of Statistics (ABS). (2013). *National Regional Profile: Inverell - Tenterfield (Statistical Area Level 3)*. Retrieved from http://www.abs.gov.au/AUSSTATS/abs@nrp.nsf/Previousproducts/11002Environment/Energy12007-2011?opendocument&tabname=Summary&prodno=11002&issue=2007-2011&num=&view=. Accessed 19/11/18

Australian Bureau of Statistics (ABS). (2017). *2016 Census of Population and housing – general community profile. Catalogue number 2001.0.*

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). (2015). *Fact Sheet – Electricity and Health.* Retrieved from https://www.arpansa.gov.au/sites/g/files/net3086/f/legacy/pubs/factsheets/ElectricityAndHealth.pdf. Accessed 15 November 2018.

Bureau of Meteorology (BoM). (2012). *Atlas of Groundwater Dependent Ecosystems*. Retrieved from http://www.bom.gov.au/water/groundwater/gde/map.shtml. Accessed 13 November 2018.

Chang, G. J. and Jennings, C. (1994). *Magnetic field survey at PG&E photovoltaic sites*. Prepared for Pacific Gas and Electric Company Research and Development Department, California.

CSIRO The Australian Soil Resource Information System (ASRIS) online data base website. Retrieved from http://www.asris.csiro.au/mapping/viewer.htm. Accessed 14/11/18.

Department for Environment Food and Rural Affairs (DEFRA). (2005*). DEFRA - Update of noise database for prediction of noise on construction and open sites – 2005.*

Department of the Environment (DotE). (2013). *Matters of National Environmental Significance – significant impact guidelines 1.1 – Environment Protection and Biodiversity Conservation Act 1999.*

EMFs info. (2018). *EMFs.info Electric and Magnetic Fields and Health*. Retrieved from http://www.emfs.info/. Accessed 15 November 2018.

Environment Protection Authority (EPA). (2016). *Hazardous waste storage and processing: guidance for the liquid waste industry.*

Geolyse (2018). *Tenterfield Solar Farm Desktop constraints mapping.* Prepared for Enerparc September 2018.

Jacobs. (2014). *Tenterfield Floodplain Risk Management Study and Plan (TFRMSP).*

Landcom. (2004). *Managing Urban Stormwater: Soils and Construction (Blue Book).* New South Wales Government.

National Health and Medical Research Council (NHMRC). (1989). *Interim guidelines on limits of exposure to 50/60 Hertz electric and magnetic fields.*

National Parks and Wildlife Service (NPWS). (2003). *The Bioregions of New South Wales: their biodiversity, conservation and history*, NSW National Parks and Wildlife Service, Sydney.

NGH Environmental. (2010). *Environmental Assessment: Capital Solar Farm.* Prepared for Infigen - Suntech

NSW Department of Environment, Climate Change and Water (DECCW). (2010). *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*. Hurstville, NSW.

NSW Department of Environment & Climate Change (DECC). (2008a). *Managing Urban Stormwater: Soils and Construction Volume 2A Installation of Services.* Retrieved from http://www.environment.nsw.gov.au/resources/stormwater/0801soilsconststorm2a.pdf. Accessed 15 November 2018.

NSW Department of Environment & Climate Change (DECC). (2008b). *Managing Urban Stormwater: Soils and Construction Volume 2C Unsealed Roads.* Retrieved from http://www.environment.nsw.gov.au/resources/stormwater/0802soilsconststorm2c.pdf. Accessed 15 November 2018.

NSW Department of Environment & Climate Change (DECC). (2009). *Interim Construction Noise Guideline*. Department of Environment & Climate Change, Sydney.

NSW Department of Infrastructure, Planning and Natural Resources. (2005). *A guide to the water sharing plan for the Tenterfield Creek water source.*

NSW Department of Planning and Environment (DPE). (2018). *NSW Planning Portal: Find a Property*. Retrieved from https://www.planningportal.nsw.gov.au/find-a-property/property. Accessed 21 November 2018.

NSW Department of Primary Industries (DPI). (2017). *New England North West Regional Plan 2036*. ISBN 978-0-6481534-0-5.

NSW Department of Primary Industries (DPI). (2017). Southern Purple Spotted Gudgeon- *Mogurnda adspersa*. Primefact 1275, second edition

NSW Environment Protection Authority (EPA). (2017). *Contaminated land, record of notices*, Retrieved from http://www.epa.nsw.gov.au/prclmapp/searchregister.aspx. Accessed 19 November 2018.

Office of Environment and Heritage (OEH). (2017). *Tusked Frog population in the Nandewar and New England Tableland Bioregions – profile*. Retrieved from https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10032

NSW Roads and Maritime Services (2014). *Tenterfield Heavy vehicle bypass. Assessment of route options – Preliminary route options report.*

NSW Rural Fire Service (RFS). (2006). *Planning for Bushfire Protection: A guide for Councils. Planners, Fire Authorities and Developers.* NSW Rural Fire Service.

NSW Rural Fire Service (RFS). (2018). Draft *Planning for Bushfire Protection: A guide for Councils. Planners, Fire Authorities and Developers.* NSW Rural Fire Service.

NSW Rural Fire Service (RFS). (2018a). *Ten LGAs to commence Bush Fire Danger Period on 1 August*. Retrieved from https://www.rfs.nsw.gov.au/news-and-media/media-releases/ten-lgas-to-commence-bush-fire-danger-period-on-1-august. Accessed 15 November 2018.

Solar Choice. (2013). *Solar farm projects near airports: Is glare an issue?* September 19, 2013 in ACT, Commercial solar power, Positioning solar PV panels, Solar Farms

South East Region of Renewable Energy Excellence (SERREE). (2016). *Renewable Energy Trail*. Retrieved from http://serree.org.au/projects/renewable-energy-trail/

Spaven Consulting. (2011). *Solar Photovoltaic Energy Facilities: Assessment of potential for impacts on aviation.* January 2011. Report No. 10.344/RPS/1

The Climate Institute. (2017). *Climate of the Nation 2017 – Australian attitudes on climate change. ISBN 978-1-921611-36-0.*

WRM Water and Environment. (2013). *Hydrological Modelling for Tenterfield Creek Dam Upgrade Design.* NSW Public Works.

Appendix A : Preliminary Biodiversity Constraints Assessment

Enerparc Australia Pty Ltd
223 Liverpool Street
Darlinghurst NSW 2010

ECO LOGICAL AUSTRALIA PTY LTD
ABN 87 096 512 088
www.ecoaus.com.au

Project reference: 11475

30 November 2018

Tenterfield Solar Farm Biodiversity Constraints

Eco Logical Australia (ELA) has been engaged by Enerparc Australia to undertake an initial biodiversity constraints assessment of the proposed Tenterfield Solar Farm site (referred hereafter as the 'subject land' (which also includes the access road and proposed cable easements)). This assessment is part of a Statement of Environmental Effects (SEE), prepared to assist in an application for approval under Part 4 of the NSW *Environmental Planning and Assessment Act 1979.*

This report provides a description of the known and potential biodiversity constraints in the subject land and provides direction on future biodiversity assessment requirements once the preferred footprint has been finalised. Please note that an analysis of the context of the subject land and relevant local, state and Commonwealth government planning instruments has been provided in the main body of the SEE and therefore not covered in this report.

The main findings of this constraints assessment are provided below.

Vegetation communities

The subject land contains a combination of exotic/cultivated paddocks and remnant native vegetation. Habitat was identified in the subject land for the following Plant Community Types (PCTs):

- *PCT 574 Tea-tree riparian shrubland/heathland wetland on drainage areas of Nandewar Bioregion and New England Tableland Bioregion*
- *PCT 510 Blakely's Red Gum – Yellow box grassy woodland of the New England Tableland Bioregion*

Threatened Ecological Communities, threatened species and important habitat features

- The subject land provides habitat for the Threatened Ecological Community (TEC) *White box yellow box Blakely's red gum woodland,* listed as an endangered ecological community under the NSW *Biodiversity Conservation Act 2016* (BC Act). This TEC is represented by PCT 510 in various condition states
- It is considered that the *White box yellow box Blakely's red gum woodland* found within the subject land does not meets the criteria for listing under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This is due to the observed lack of presence of key canopy species and floristic abundance in the ground cover layers. Floristic plot data collection should be undertaken to verify this conclusion.
- No threatened species, listed under the BC Act or EPBC Act have been identified in the subject land during the literature review and site inspection. One Atlas of NSW Wildlife record of Brush–tail Phascogale *(Phascolarctos cinereus)* has been identified directly south of the subject land.

- The two large *Angophora floribunda* (Rough-barked Apple) trees were identified in the subject land containing a number of hollows which may be considered potential habitat for threatened fauna such as Brush–tail Phascogale and microbat species.
- Pitkins Swamp Creek may contain potential foraging habitat for threatened microbats species.
- Our preliminary assessment has found the following threatened species may require further assessment:

  Flora

  - *Thesium australe* (Austral toadflax) potential habitat in native pastures (BC Act and EPBC Act)
  - *Dichanthium setosum* (Bluegrass) potential habitat in native pastures (BC Act and EPBC Act)
  - *Lepidium peregrinum* potential habitat (although considered highly marginal) in native pastures (BC Act and EPBC Act)

  Fauna

  - Brush-tail Phascogale *(Phascogale tapoatafa)* (potential nesting habitat in tree hollows) (BC Act)
  - Southern Myotis *(Myotis macropus)* (potential foraging habitat Pitkins Swamp Creek) (BC Act)
  - Eastern False Pipistrelle *(Falsistrellus tasmaniensis)* potential roosting habitat in tree hollows and foraging habitat in the subject land (BC Act)
  - Eastern Bentwing-bat *(Miniopterus schreibersii oceanensis)* potential foraging habitat in the subject land (BC Act)
  - Greater Broad-nosed Bat *(Scoteanax rueppellii)* potential roosting habitat in tree hollows and foraging habitat in the subject land (BC Act)
  - Yellow – bellied Sheathtail – bat *(Saccolaimus flaviventris)* potential roosting habitat in tree hollows and foraging habitat in the subject land (BC Act).

Biodiversity Offsets Scheme

The Biodiversity Offset Scheme (BOS) under the BC Act may be applicable to the development if the BOS thresholds are triggered. This would then require application of the Biodiversity Assessment Methodology (BAM) and a Biodiversity Development Assessment Report (BDAR) to be prepared by an accredited assessor.

The triggers for a BDAR are as follows:

- *Area clearing threshold:* For a minimum lot size of 40ha to less that 1000ha, the BOS will be triggered by clearing of one hectare (ha) or more of native vegetation.
- *NSW Government Biodiversity Values Map (BV Map).* The BOS will be triggered if the land identified for clearing is mapped on the BV Map. Pitkins Swamp Creek in the north of the subject land is mapped on the BV Map (refer to Figure 3)**.**

If the above BOS thresholds are not triggered, a Flora and Fauna Assessment (FFA) can be prepared to assess the impacts on biodiversity of the proposed development. However, if a ‘test of significance' under section 7.3 of the BC Act determines a significant impact on threatened species, the BOS will be triggered and a BDAR must be prepared.

Serious and Irreversible Impacts

If the BOS is triggered, The BC Act requires a consent authority to determine whether the impacts of a Part 4 development is likely to result in a serious and irreversible impact on biodiversity values. An impact is regarded as serious and irreversible (SAII) if it is likely to contribute significantly to the risk of extinction of that particular entity. Approval for the development cannot not be granted if the consent authority determines a likely SAII.

White box yellow box Blakely's red gum woodland is listed as a candidate ecological community for a SAII. If the BOS is triggered and a BDAR prepared, the BDAR must contain an assessment of all candidate SAIIs potentially impacted by the proposed development.

It is understood that Enerparc Australia intends to restrict native vegetation clearing to less than one hectare and outside of the creekline mapping on the BV map. Therefore, it is anticipated the BOS will not be triggered by this development proposal and a FFA will be prepared.

Further details on the methodology and results of the site inspection have been provided within the main body of this letter report.

Yours sincerely,

Nicole McVicar

Senior Ecologist and Accredited BAM Assessor BAAS18077

Methodology

Literature review and database search

A review of the following relevant data, background literature on the subject land and locality, and relevant planning instruments and strategic documents was undertaken:

- Aerial photographs (Google Earth, Near Map)
- Atlas of NSW Wildlife Office of Environment and Heritage (OEH 2018a)
- Commonwealth EPBC Act Protected Matters Search Tool (DotEE 2018a)
- Threatened species profiles (OEH 2018b)
- Final determinations for communities and species by the Scientific Committee (OEH 2018c)
- Commonwealth Species Profile and Threats Database (DotEE 2018b)
- NSW Government Biodiversity Values Map
- NSW Office of Environment and Heritage 2015 State Vegetation Type Map: Border Rivers Gwydir/ Namoi Region VIS_ID 4467

Searches of the Atlas of NSW Wildlife and the online EPBC Act Protected Matters Search Tool were performed on 8 October 2018. This search encompassed all threatened fauna and flora species within 5 km of the subject land. Atlas of NSW Wildlife threatened flora and fauna records are displayed in Figure 1 and **Figure 2.** An Atlas of NSW Wildlife search on potential TECS with 10 km of the subject land was also undertaken.

Site inspection

ELA senior ecologist Nicole McVicar undertook a site inspection over one day on 11 October 2018. During the survey, the weather was wet and windy, with 7 mm of precipitation measured, and the maximum daytime temperature reaching 15°C

The main aim of the inspection was to identify ecological constraints through validation of the extent and condition of the vegetation communities present, confirm the presence of any TECs, and identify any habitat attributes likely to support threatened flora and fauna within the subject land.

Notes and photographs were taken during the site inspection.

Limitations

No measurements of cover abundance for flora species, within vegetation survey plots or otherwise, were undertaken. No targeted flora or fauna survey was undertaken.

This assessment was not intended to provide an inventory of all species present across the subject land but instead an overall assessment of the ecological values of the subject land with particular emphasis on threatened species, TECs and key fauna habitat features. It is important to note that some species may not have been detected on the site during the inspection as they may be cryptic or seasonal and only detectable during flowering or during breeding. In this case the likelihood of their occurrence on site has been assessed based on the presence of potential habitat.

Results

Mapped vegetation communities

OEH mapping (2015) did not indicate the presences of any PCTs/vegetation communities within the subject land, however to the north, south and east of the subject land the mapping indicated the possible presence of the following PCTs/vegetation communities:

North:

- *Tea-tree riparian shrubland/heathland wetland on drainage areas*
- *Candidate Native Grassland*
- *Mountain Gum – Broad – leaved Stringybark shrubby open forest on granites*
- *Narrow-leaved Peppermint – Wattle-leaved Peppermint shrubby open forest*
- *Blakey's Red Gum – Stringybark – Rough-barked Apple open forest*

East:

- *New England Peppermint grassy woodland on granite substrates*

South

- *Broad-leaved Stringybark – Yellow Box shrub/grass open forest*
- *Blakely's Red Gum – Yellow Box grassy woodland*
- *New England Blackbutt Grassy open forest*
- *Ribbon Gum – Rough – barked Apple – Yellow Box grassy woodland*
- *Silvertop Stringybark – Mountain Gum grassy open forest*
- *Tenterfield Woollybutt- Silvertop Stringybark open forest*
- *Candidate Native Grassland*

These mapped PCTs were used to guide the on-site validation of the vegetation within the subject land.

Threatened flora and fauna records

The Atlas of NSW Wildlife search found that five threatened flora species and 18 threatened/migratory fauna species were previously recorded within a 5 km radius of the subject land. No records were returned in the subject land. One record of Brush–tail Phascogale *(Phascolarctos cinereus)* has been identified directly south of the subject land. Atlas of NSW Wildlife threatened flora and fauna records are displayed in Figure 1 and **Figure 2.**

The Atlas of NSW Wildlife search also identified five BC Act listed vegetation communities, of which three are also listed under the EPBC Act as having potential to occur within 10 km of the subject land.

Forty-eight EPBC listed threatened species, (including 22 threatened flora species and 10 threatened bird species, one threatened fish, one threatened frog, four threatened reptiles and 10 threatened mammals), three listed TECs, 15 listed migratory species, and three Wetlands of International Importance were identified in the Commonwealth Protected Matters Search.

ELA validated vegetation communities

The vegetation in the subject land comprised of a mix of exotic/cultivated pasture, native pasture, areas of native tree and shrub plantings, 'disturbed native dam-fringing' vegetation, scattered paddock trees in exotic pasture, scattered trees in native pasture and regrowth areas in native pasture. These are presented below in **Table 1** to **Table 6**, and displayed in Figure 3**.**

Best-fit PCT justification

PCT 510 Blakely's Red Gum – Yellow box grassy woodland of the New England Tableland Bioregion

The subject land was comprised of predominantly cleared land, with scattered canopy trees providing some indication of what vegetation community that once occurred naturally in the landscape. The remaining canopy was dominated by *Angophora floribunda* (Rough-barked Apple) (likely due to their less desirable timber qualities), an abundant species present in a wide range of PCTs in the New England IBRA region and Tenterfield IBRA sub-region. Therefore, the presence alone of *Angophora floribunda* could not be used to accurately determine the best fit PCT.

Where possible vegetation outside and adjacent to the subject land was inspected in order to assign a best – fit PCT. The vegetation directly south of the main paddocks, although cleared and disturbed contained a greater diversity of tree species and landscape features, as did the several road reserves and scattered trees in neighbouring properties. In these areas, the ground cover species were generally consistent with those identified within the native pastures areas within the subject land.

These tree/shrub species were as follows:

- *Eucalyptus blakelyi* (Blakely's Red Gum) (dominant in places)
- *Eucalyptus moluccana* (Grey Box (scattered)
- *Eucalyptus melliodora* (Yellow Box)
- *Eucalyptus conica* (Fuzzy Box) (scattered however quite common)
- *Brachychiton populneus* (Kurrajong)
- *Acacia implexa* (Hickory Wattle)
- *Acacia buxifolia* (Box-leaf Wattle)
- *Exocarpos cupressiformis* (Cherry Ballart)

The BioNet Vegetation Classification System was used to filter potential PCTs based on the IBRA region and sub-region, dominant canopy species, soils, altitude, and landscape position.

PCT 510 was determined at the best-fit PCT, corresponding with the features selected above, despite the level of disturbance observed within and surrounding the subject land. The vegetation description for PCT 510, taken directly from the BioNet Vegetation Classification System is as follows:

Tall open forest or woodland that occurs on undulating areas at intermediate to high altitudes, with local stands in the Horton area east of Mount Kaputar. Similar to ID599 Yellow Box - Blakely's Red Gum grassy woodland of Brigalow Belt South and Nandewar Bioregions, it occupies deep, relatively fertile soils on a number of different geologies, but mainly sedimentary rocks and basalt. Dominated by Rough-barked Apple (Angophora floribunda), Yellow Box (Eucalyptus melliodora) and/or Blakely's Red Gum (Eucalyptus blakelyi). Ribbon Gum (Eucalyptus viminalis), Apple Box (Eucalyptus bridgesiana) and Broad-leaved Stringybark (Eucalyptus caliginosa) are sometimes present, and the vulnerable Eucalyptus rubida subsp. barbigerorum can occur within this unit east of Inverell. The shrub layer is either sparse or absent, with typical species including Acacia implexa, Acacia fimbriata, Cassinia quinquefaria or Olearia elliptica subsp. elliptica. The ground layer is well developed with dominant species including Kangaroo Grass (Themeda australis), Snow Grass (Poa sieberiana), Cymbopogon refractus and Lespedeza juncea subsp. sericea. Less frequent groundcover species include Aristida ramosa, Sorghum leiocladum, Dianella revoluta var. revoluta, Microlaena stipoides var. stipoides, Desmodium brachypodum, Viola betonicifolia, Chrysocephalum apiculatum, Glycine tabacina, Lomandra longifolia, Bothriochloa macra and Carex breviculmis. This association represents part of the TSC Act and EPBC Act listed Box-Gum Woodland EEC/TEC.

Therefore, according to the BioNet Vegetation Classification System, this PCT also corresponds to the TEC *White box yellow box Blakely's red gum woodland*.

PCT 574 Tea-tree riparian shrubland/heathland wetland on drainage areas of Nandewar Bioregion and New England Tableland Bioregion

The BioNet Vegetation Classification System was used to filter potential PCTs based on the IBRA region and sub-region, dominant canopy species, soils, altitude, and landscape position. Considerably more straightforward than assigning PCT 510, this PCT was determined to be consistent with the OEH 2015 mapping to the north of the subject land, being the only riparian PCT occurring in the Tenterfield IBRA sub-region. According to the BioNet Vegetation Classification System, this PCT does not correspond to a TEC.

The PCTs, PCT vegetation zones and vegetation features identified in the subject land, including areas (ha) where relevant are presented below in **Table 1.** Mapping of the PCTs and habitat features is provided in Figure 3**.**

Table 1: ELA validated best-fit PCTs and vegetation features

Best fit PCT/vegetation feature	**Approximate area (ha)**
PCT 510 *Blakely's Red Gum – Yellow box grassy woodland of the New England Tableland Bioregion* Native grassland **TEC**	15.8 ha
PCT 510 *Blakely's Red Gum – Yellow box grassy woodland of the New England Tableland Bioregion* Planted with native pasture groundcover **TEC**	0.6 ha
PCT 510 *Blakely's Red Gum – Yellow box grassy woodland of the New England Tableland Bioregion* Scattered trees and regrowth **TEC**	9.3 ha
PCT 574 *Tea-tree riparian shrubland/heathland wetland on drainage areas of Nandewar Bioregion and New England Tableland Bioregion* Native grassland **Not TEC**	5.8 ha
Exotic/cultivated pasture **Not TEC**	77.1 ha
Angophora subvelutina paddock tree x 2, *Eucalyptus* sp. Paddock tree x 1	N/A

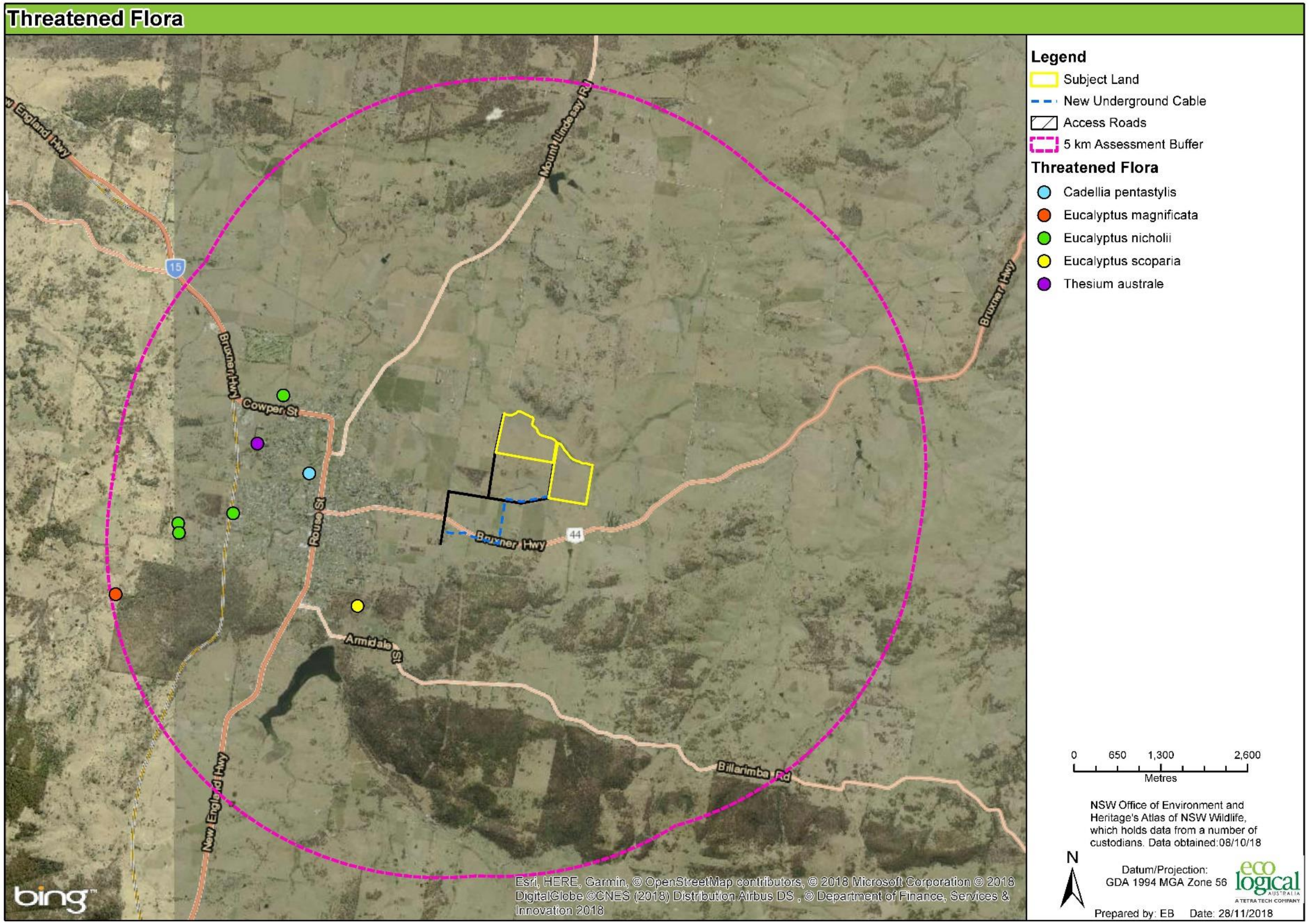


Figure 1. BioNet threatened flora records 5km

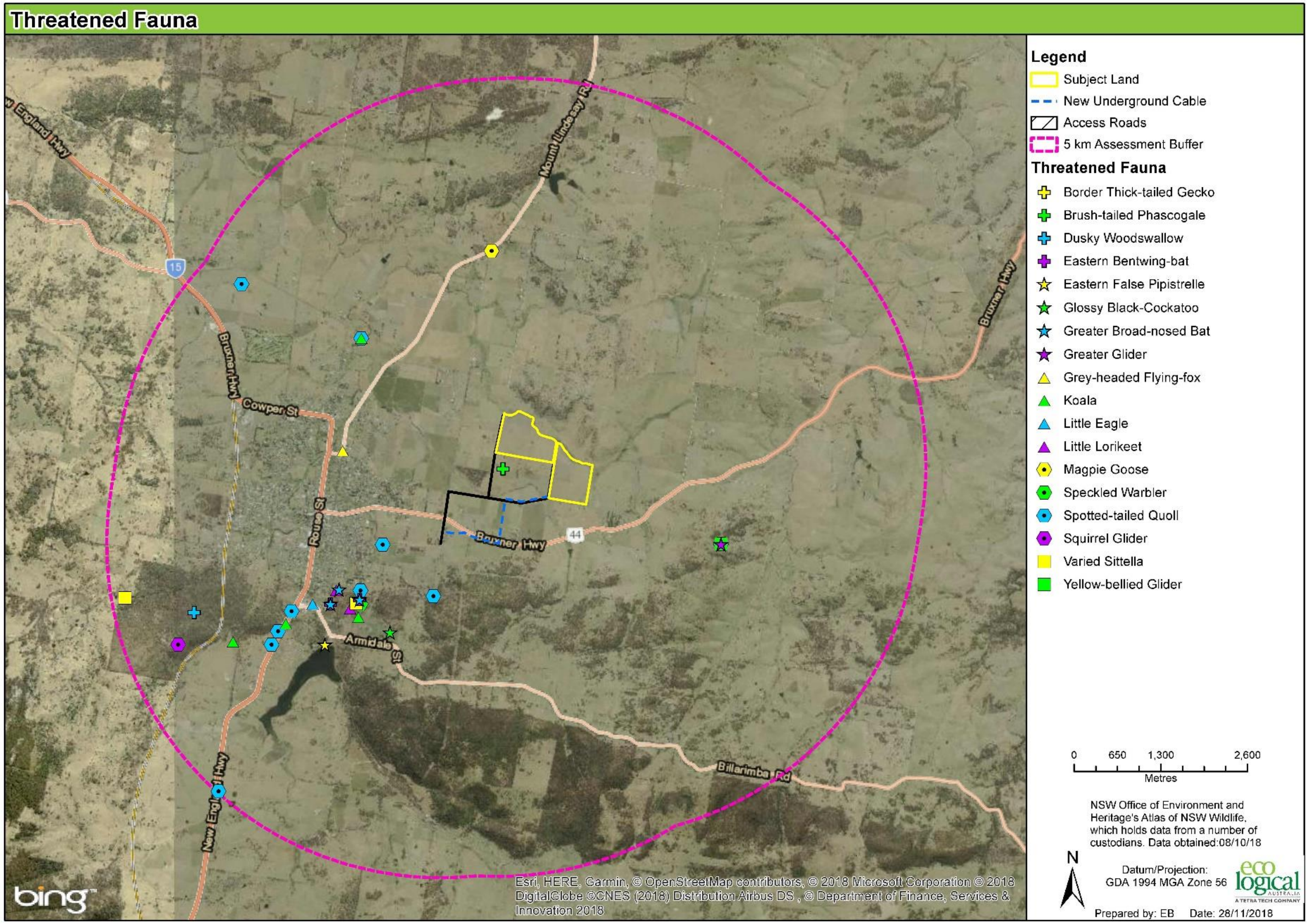


Figure 2. BioNet threatened fauna records 5km

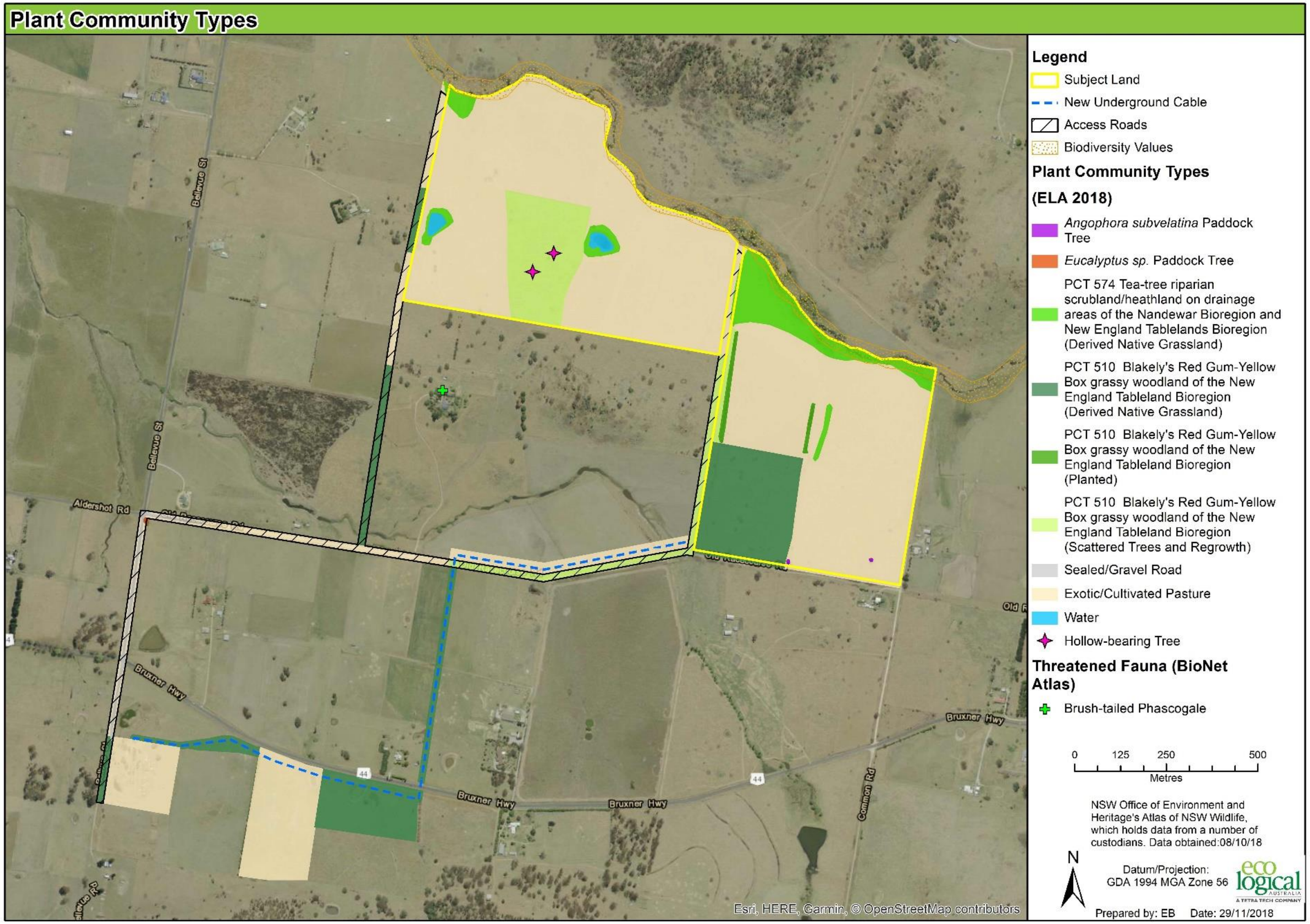


Figure 3. ELA validated PCTs, exotic vegetation and habitat features

Table 2: PCT 510 Native grassland

PCT 510 *Blakely's Red Gum – Yellow box grassy woodland of the New England Tableland Bioregion* Native grassland – classified as TEC
Canopy *nil*
Midstorey *nil*
Groundcover *Poa labillardieri, Geranium solanderi, Cotula australis, Eragrostis curvula (exotic), Lolium sp (exotic)*

Photo 1: PCT 510 Native grassland

Table 3: PCT 510 Planted with native pasture in the groundcover

PCT 510 *Blakely's Red Gum – Yellow box grassy woodland of the New England Tableland Bioregion* Planted – with native pasture in the groundcover- classified as TEC
Canopy *Eucalyptus sp*
Midstorey *Acacia buxifolia, Acacia leucoclada, Callistemon sp*
Groundcover *Poa labillardieri, Geranium solanderi, Eragrostis curvula (exotic)*

Photo 2: PCT 510 Planted

Table 4: PCT 510 Scattered trees and regrowth

PCT 510 *Blakely's Red Gum – Yellow box grassy woodland of the New England Tableland Bioregion* Scattered trees and regrowth – classified as TEC
Canopy *Angophora floribunda*
Midstorey *nil*
Groundcover *Poa labillardieri, Geranium solanderi, Lolium sp, Eragrostis curvula* (exotic)

Photo 3: PCT 510 Scattered trees and regrowth

Table 5: PCT 574 Native grassland

PCT 574 *Tea-tree riparian shrubland/heathland wetland on drainage areas of Nandewar Bioregion and New England Tableland Bioregion* Native grassland – not classified as TEC
Canopy *nil (Salix babylonica, prunus sp* and *Ligustrum lucidum* dominant along creekline outside study area*)*
Midstorey *nil*
Groundcover *Poa labillardieri (dominant), Juncus sp, Geranium solanderi, Eragrostis curvula* (exotic)

Photo 4: PCT 574 Native Grassland

Table 6: Exotic/cultivated pasture

Exotic/cultivated pasture – classified as non-native vegetation - not classified as TEC
Canopy *nil*
Midstorey occasional *Lycium ferocissimum*
Groundcover *Avena sativa* (exotic pasture species - dominant), *Eragrostis curvula, Bromus catharticus, Taraxacum officinale, Chenopodium album, Rubus fruticosus, Stellaria media, Malva neglecta, Carthamus sp, Poa labillardieri* (occasional), *Geranium solanderi (*occasional).

Photo 5: Exotic/cultivated pasture

TECs, threatened species and important habitat features

The subject land provides habitat for the Threatened Ecological Community (TEC) *White box yellow box Blakely's red gum woodland,* listed as an endangered ecological community under the BC Act. This TEC is represented by PCT 510 in different condition states as described in **Table 1**, **Table 2**, **Table 3** and **Table 4**.

It is considered that the *White box yellow box Blakely's red gum woodland* found within the subject land does not meets the criteria for listing under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This is due to the observed lack of presence of key canopy species and floristic abundance in the ground cover layers. Floristic plot data collection should be undertaken to verify this conclusion.

No threatened species, listed under the BC Act or EPBC Act have been identified in the subject land during the literature review and site inspection. One Atlas of NSW Wildlife record of Brush–tail Phascogale *(Phascolarctos cinereus)* has been identified directly south of the subject land.

The two large *Angophora floribunda* (Rough-barked Apple) trees in the subject land contain a number of hollows which may be considered potential habitat for threatened fauna such as Brush–tail Phascogale and microbat species.

Pitkins Swamp Creek may contain potential marginal foraging habitat for threatened microbats species.

It is anticipated that the following threatened flora and fauna species *may* require further assessment, offsetting or 'tests of significance' during preparation of the BDAR or FFA (as discussed, the assessment type will be dependent on the alignment of the finalised development footprint, however it is anticipated that a FFA will be required, rather than a BDAR given that the current intention is to restrict native vegetation clearing to less than one ha and outside of the creekline mapping on the BV map:

Flora

- *Thesium australe* (Austral toadflax) potential habitat in native pastures (BC Act and EPBC Act)
- *Dichanthium setosum* (Bluegrass) potential habitat in native pastures (BC Act and EPBC Act)
- *Lepidium peregrinum* potential habitat (although considered highly marginal) in native pastures (BC Act and EPBC Act)

Fauna

- Brush-tail Phascogale *(Phascogale tapoatafa)* (potential nesting habitat in tree hollows) (BC Act)
- Southern Myotis *(Myotis macropus)* (potential foraging habitat Pitkins Swamp Creek) (BC Act)
- Eastern False Pipistrelle *(Falsistrellus tasmaniensis)* potential roosting habitat in tree hollow and foraging habitat in the subject land (BC Act)
- Eastern Bentwing-bat *(Miniopterus schreibersii oceanensis)* potential foraging habitat in the subject land (BC Act)
- Greater Broad-nosed Bat *(Scoteanax rueppellii)* potential roosting habitat in tree hollow and foraging habitat in the subject land (BC Act)
- Yellow – bellied Sheathtail – bat *(Saccolaimus flaviventris)* potential roosting habitat in tree hollows and foraging habitat in the subject land (BC Act)

Limitations

The impact of the proposed development on threatened species have been given preliminary consideration in this constraints assessment. Further assessment will be required during preparation of the impact assessment (as discussed it is anticipated this will be a FFA) which will be determined by the final development footprint

References

Department of the Environment (DotE) 2018a. *Commonwealth EPBC Act Protected Matters Search Too*l. Searches used a radius of 10 km around the study area, Department of the Environment.

Department of the Environment (DotE) 2018b. Species Profile and Threats Database. Available at: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Office of Environment and Heritage (OEH) 2015. *State Vegetation Type Map: Border Rivers Gwydir/ Namoi Region VIS_ID 4467* Office of Environment and Heritage.

Office of Environment and Heritage (OEH) 2018a. *Atlas of NSW Wildlife*. Searches used a radius of 5km and 10 km around the study area. Office of Environment and Heritage.

Office of Environment and Heritage (OEH) 2018b. *Threatened Species Profiles*. Available online: https://www.environment.nsw.gov.au/threatenedspeciesapp/

Office of Environment and Heritage (OEH) 2018c. *Scientific Community Determinations*. Available online: http://www.environment.nsw.gov.au/determinations/

Appendix B : Biodiversity Assessment

eco logical AUSTRALIA

Biodiversity Assessment

Proposed Solar Farm, Tenterfield

Prepared for
Enerparc Australia Pty Ltd

April 2019

DOCUMENT TRACKING

Item	Detail
Project Name	Biodiversity Assessment for proposed Solar Farm, Tenterfield
Project Number	18 ARM-11475
Project Manager	Robert Cawley (02) 8081 2689 92 Taylor Street, Armidale, NSW, 2350
Prepared by	Liz Brown, Emily Bathgate
Reviewed by	Frank Lemckert
Approved by	Robert Cawley
Status	DRAFT
Version Number	1
Last saved on	3 April 2019
Cover photos	Droughted grassland, Eastern Dwarf Tree Frog (*Litoria fallax)* and granite boulders within the subject site, 26 February 2019, Liz Brown and Claire Lock.

This report should be cited as 'Eco Logical Australia April 2019. *Biodiversity Assessment for proposed Solar Farm, Tenterfield*. Prepared for Enerparc Australia Pty Ltd.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from Eric Tran and Benjamin Hannig (Enerparc Australia Pty Ltd).

Contents

List of figures

List of tables

Abbreviations

Abbreviation	Description
AOBV	Area of Outstanding Biodiversity Value
BAM	Biodiversity Assessment Method
BC Act	*Biodiversity Conservation Act 2016*
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offsets Scheme
BV Map	Biodiversity Value Map
CAA	Controlled Activity Approval
DBH	Diameter-at-breast-height
DECC	Department of Environment and Climate Change
DotEE	Department of the Environment and Energy
DNG	Derived Native Grassland
EEC	Endangered Ecological Community
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
HBT	Hollow-bearing tree
IBRA	Interim Biogeographic Regionalisation of Australia
KFT	Koala feed tree
KTP	Key threatening processes
LGA	Local Government Area
LLS	Local Land Services
MNES	Matters of National Environmental Significance
NRAR	Natural Resources Access Regulator
OEH	NSW Office of Environment and Heritage
PCTs	Plant Community Types
PMST	Protected Matters Search Tool
SEPP 44	*State Environmental Planning Policy 44 - Koala Habitat Protection*
SIS	Species Impact Statement

Abbreviation	Description
TEC	Threatened ecological communities
TSC Act	*Threatened Species Conservation Act 1995*
VIS	NSW Vegetation Information System
WoNS	Weed of National Significance
WMP	Waste Management Plan

1 Introduction

Eco Logical Australia was engaged by Enerparc Australia Pty Ltd (Enerparc) to prepare a biodiversity assessment for the proposed development of a solar farm and associated native vegetation clearing at Tenterfield, NSW. The original objective of this survey was to conduct a site assessment in accordance with the Biodiversity Assessment Methodology (BAM) under the *Biodiversity Conservation Act 2016* (BC Act) via the preparation of a Biodiversity Development Assessment Report (BDAR). However, the results of the current survey and BAM plot data determined that there was not enough native vegetation present (**Figure 2**) to warrant a full BDAR, and a Biodiversity Assessment was considered to be more appropriate for the subject site.

The Tenterfield solar farm (the Proposed Development) would generate electricity through the conversion of solar radiation to electricity using Photovoltaic panels laid out across the northerly portion of the subject site in a series of modules, mounted on steel racks with piled, screwed or ballasted supports. Other infrastructure that is proposed to be present on site includes electrical power conversion units, underground electrical cabling, telecommunications equipment, storage facilities, tracks, roads, security fencing and gates.

Electricity would be fed from the TSF to the TransGrid Substation which is located approximately 1.5 kilometres (km) south-west of the subject site. The proposed route for the grid connection generally follows private property and road reserves associated with Old Racecourse Road, including an under-bored crossing of the Bruxner Highway road reserve. The proposed route of the connection infrastructure is included within the subject site.

Each of the parcels of land associated with the Proposed Development have a 3-year land lease agreement which was negotiated between the landowner and the Proponent. Following the 3-year lease, the option of an additional 25-year lease will follow.

The Proposed Development would be classified as Regionally Significant Development. Consent is required from Roads and Maritime Services (RMS) under section 138 of the Roads Act 1993 (Roads Act) due to the under-boring of the Bruxner Highway for installation of the transmission line cabling. Due to this required consent, Division 4.8 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) categorises the works as Integrated Development and the Proposed Development would be assessed under Part 4 of the EP&A Act.

The Proposed Development has an estimated Capital Investment Value (CIV) of more than $5 million, but less than $30 million. Under the *State Environmental Planning Policy (State and Regional Development) 2011*, electricity generating works (including solar) that are considered private infrastructure and have this estimated CIV range are classified as Regionally Significant Development.

In addition, the project requires consent from Roads and Maritime Services (RMS) under section 138 of the *Roads Act 1993* (Roads Act) in order to under-bore the Bruxner Highway for installation of proposed transmission line cabling. Due to this consent being required, Division 4.8 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) categorises the works as Integrated Development.

Enerparc (the Proponent) is seeking approval for the Integrated Development through the Northern Joint Regional Planning Panel (JRPP), with assessment through the Tenterfield Shire Council.

The objectives of this biodiversity assessment were to:

- Identify and validate vegetation communities within the subject site, including any threatened ecological communities (TECs).
- Identify representative flora species on-site.
- Identify and describe the fauna habitats present in the study area.
- Identify the flora and fauna species of conservation significance which are present or likely to occur in the study area.
- Assess the impacts of the proposal on vegetation, fauna, habitats, and other environmental features as necessary.
- Make recommendations regarding any environmental management and impact mitigation/amelioration measures that can be implemented to limit the effects of the proposal on vegetation, fauna, habitats, and other environmental features as necessary.
- Address the relevant statutory requirements.

1.1 Subject site and study area

Subject site means the area directly affected by the Proposed Development, including the footprint of the Proposed Development and any ancillary works, facilities or accesses that support the construction or operation of the development or activity. The subject site for the purposes of this assessment refers to the area defined in **Figures 1** and **2**, Tenterfield as provided by Enerparc. This site is indicative only, as the final impact area of the Proposed Development will be dependent on the construction methodology.

Study area means the subject site and any additional areas which are likely to be affected by the Proposed Development, either directly or indirectly. The study area for the purposes of this assessment refers to the area of land within a 10 km radius of the subject site.

The Proposed Development is located on land within the Tenterfield Shire LGA, located approximately two km north-east of the town of Tenterfield (Error! Reference source not found.**)** and spans across five parcels of land as identified in Table 1. Additional to the five parcels of land allocated for the solar panels, there is also a transmission line route that is part of the Proposed Development. The proposed transmission line extends along Old Racecourse Road and under the Bruxner Highway to the existing substation on Bellevue Road (**Figure 1**).

Table 1: Solar farm site

Lot / Deposited Plan	Size (ha)
Lot 85 DP 751540	21.2
Lot 87 DP 751540	23.3
Lot 89 DP 751540	18.7
Lot 90 DP 751540	19.9

The proposed solar farm (the subject site) and surrounds are zoned 'RU1 – Primary Production' under the *Tenterfield Local Environmental Plan 2013*. The subject site predominantly consists of highly disturbed, previously cleared agricultural land that is currently used for cattle grazing. Historically this land was sown with the highly invasive African Lovegrass (*Eragrostis curvula*) as a pasture grass for cattle, and some areas have been ploughed and/or burned repeatedly for many years.

The land surrounding the Proposed Development is primarily used for agricultural activities, with associated rural dwellings comprising a mix of involved and non-involved residences, totalling 35 within one kilometre of the solar farm subject site. The closest residence is located approximately 35 m from the eastern boundary of the subject site and the closest residentially zoned land is approximately 1.3 km to the west of the subject site.

General access to the subject site will be via Old Racecourse Road. Most construction vehicles will arrive via the New England Highway, Bruxner Highway, Bellevue Road and Old Racecourse Road, and an alternative entry point will be via Coxalls Road.

1.2 Topography, geology and soils

The subject site has relatively flat to gently sloped topography. State-wide mapped geology shows that the subject site features granite soils derived from the broader Wandsworth Volcanic Group of igneous rocks. The subject site features Ignimbritic Rhyodacite (Dundee Rhyodacite) characterised by blue-grey rocks which have distinct crystals composed of a mix of quartz, plagioclase, biotite, hornblende, clinopyroxene, minor K-feldspar and orthopyroxene, set in a microgranular quartz-feldspar groundmass (DMR 2005).

The presence of granite soils (and absence of basaltic soils) throughout the subject site was confirmed during the current field survey. Areas of scattered granite boulders (of varying sizes from small through to large) occur in portions of the subject site, such as at plot site T10 (**Figure 2**).

2 Planning and legislation

Commonwealth and NSW legislation and policies, as well as local policies apply to the assessment, planning and management of ecological issues within the study area.

The relevant Commonwealth and NSW Acts and policies assessed in this report are as follows:

Table 2: Legislative context

Name	Relevance to the project	Section/s in this report
Commonwealth		
Environment Protection and Biodiversity Conservation Act 1999	The subject site is not located within an area that has been the subject of a Strategic Assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Commonwealth Minister for the Environment will need to be notified of all actions associated with the development that will impact upon Matters of National Environmental Significance (MNES). A MNES assessment to determine if referral is required has been provided. An assessment of Koala habitat within the impact area, as per the *EPBC Act referral guidelines for the vulnerable koala* (DoE 2014) was not undertaken for this project, as no Koala Food Trees (KFTs) remain.	Appendix C, Sections 4.1.1 and 7.1
NSW		
Environmental Planning and Assessment Act 1979	Assessments of significance for impacts to threatened species identified during this proposal have been prepared in accordance with Part 4 of the EP&A Act.	Appendix B, Sections 4 and 7.2
Biodiversity Conservation Act 2016	The subject site is not mapped as having Biodiversity Value under the BC Act. Pitkins Swamp Creek adjoins the northerly boundary of the subject site, but will not be affected by the Proposed Development. The Proposed Development is proceeding as an activity under Part 4 of the EP&A Act. The Biodiversity Offset Scheme (BOS) was initially considered during the current survey. However, the current survey confirmed that the subject site supports a very low level of native vegetation, and the subject site does not occur in a mapped 'area of outstanding biodiversity value' (AOBV). Therefore, the environmental impact of activities will continue to be assessed under s.5.5 of the EP&A Act. The Five Part Tests of significance to determine whether the proposed activity is likely to significantly affect threatened species or ecological communities, or their habitats (under s.7.3 of the BC Act) have determined no likely significant impact, so a Species Impact Statement (SIS) is not required.	Appendix B, Sections 4 and 7.2

Name	Relevance to the project	Section/s in this report
State Environmental Planning Policy (SEPP) 44 - Koala Habitat Protection	The Tenterfield Local Government Area (LGA) is listed in Schedule 1 of SEPP 44, and the land to which the Proposed Development applies is >1 ha. Assessment under SEPP 44 is required under Part 4 of the EP&A Act.	Appendix B, Appendix C, Sections 4.9 and 7.1.1
Water Management Act 2000	Pitkins Swamp Creek riparian zone will not be affected by the Proposed Development. It is recommended that the tributaries of Pitkins Swamp Creek that extend across the northerly portion of the subject site are avoided, in terms of placement and construction of the steel racks which will support the mounted photovoltaic panel modules. In regards to the proposed action, Council as a public authority is exempt from a Controlled Activity Approval (CAA) or any other approval from the Natural Resources Access Regulator (NRAR).	Sections 4.12, 5.1.2, 6.5, 7.2.2

3 Methods

3.1 Database and literature review

A review of relevant information was undertaken prior to the commencement of field survey, which involved:

- Reviewing available literature, legislation, environmental planning instruments, topographic maps and aerial photographs pertaining to the Proposed Development.
- Reviewing State-wide digital geology mapping (DMR 2005).
- Reviewing Border Rivers Gwydir / Namoi regional native vegetation mapping (VIS_ID 4467, OEH 2015).
- Reviewing Tenterfield Shire Council's LEP 2013 online maps, last accessed March 2019.
- Searching the Atlas of NSW Wildlife (BioNet) for threatened flora and threatened fauna species recorded in the locality, last accessed March 2019.
- Searching the EPBC Act Protected Matters Search Tool in the locality of the subject site, last accessed March 2019.
- Reviewing the NSW Government Biodiversity Values Map (www.lmbc.nsw.gov.au).

3.2 Site surveys

A previous survey (ELA 2018) was undertaken within the subject site by Nicole McVicar (ELA ecologist) on the 11th October 2018. This was a preliminary site inspection with the main aim of developing a basic vegetation map for the subject site (including overall constraints and site condition) based on the broad existing vegetation mapping (OEH 2015). The weather was wet and windy, with 7 mm of precipitation measured.

The current survey was undertaken within the subject site by Liz Brown and Claire Lock (ELA ecologists) from the 25 – 27th February 2019. This involved a comprehensive vegetation survey to fully validate the basic vegetation map, confirm the presence of any potential TECs and identify any habitat attributes likely to support threatened flora and fauna within the subject site (**Figure 2**). Weather conditions were generally sunny and occasionally windy, with only one very light rainfall event occurring during the survey.

Vegetation validation and general condition was assessed via a random meander of the subject site along with the completion of BAM full-floristic plots.

A total of 11 full floristic BAM plots (20 x 50 m) were completed to adequately cover each identified vegetation zone in accordance with the BAM. Vegetation surveys validated existing plant community type (PCT) classification of the site, consistent with the NSW BioNet VIS database (OEH 2019b).

Three threatened flora species known to occur within the vicinity of the subject site were surveyed in accordance with the *NSW Guide to Surveying Threatened Plants* (OEH 2016); Wandering Peppercress (*Lepidium peregrinum*), Austral Toadflax (*Thesium australe*) and Bluegrass (*Dichanthium setosum*). Surveys were undertaken by two people through 10 - 40 m parallel transect searches in areas of grassland and along riparian areas providing potential habitat for threatened flora species.

Comprehensive and targeted fauna surveys were not undertaken as part of the current survey.

The data collected during the current survey has been considered in **Appendix A** for evaluation of the likelihood of occurrence of threatened species and communities on (or adjacent to) the subject site.

The results of the BAM plot data collected are discussed in **Section 4**.

3.3 Threatened ecological communities

Identification of possible TECs was based on:

- Relevant listings on the NSW Office of Environment and Heritage (OEH) website (www.environment.nsw.gov.au).
- Relevant listings on the Department of the Environment and Energy – Matters of National Environmental Significance (MNES) Species Profile and Threats Database (SPRAT) website (DotEE 2018b)
- Available vegetation mapping (OEH 2015).

3.4 Habitat survey

Diurnal survey involved observations across the subject site for any signs of animal activity, important habitat features present (i.e. hollow bearing trees) and searches for indirect evidence of fauna, with emphasis on searches for scats, tracks, burrows, diggings and scratchings.

Where possible, physical habitat searches of the subject site were undertaken during the survey. This involved inspection of trees for bird nests and searches for scats, tracks, diggings, sap incisions and scratches (e.g. Koala, gliders), turning over cover, inspecting low hollows and inspecting under bark.

3.5 Limitations

Site vegetation condition at the time of survey were extremely poor (**Plate 1**) due to a prolonged period of drought throughout this region, combined with heavy grazing by cattle (current) as well as a long history of local clearing, ploughing, sowing of exotic and invasive pasture grasses (e.g. African Lovegrass) and patch burning (to control African Lovegrass). The current level of grazing made it impossible to accurately identify certain grass species, which were grazed within a few centimetres of ground level and so had no seeds or structural elements to allow identification. The drought has resulted in the likely death of most groundlayer vegetation, and a very low diversity of native species was recorded during the current survey. The site would be expected to appear markedly different after a good season of rainfall and subsequent plant growth and regeneration from underground rootstocks and the soil seed bank.

Plate 1: Drought affected and heavily grazed vegetation within the subject site.

The floristic audit undertaken detected as many species as possible and provides a species list for the study area. It is highly likely that additional species would be detected during a longer survey over various seasons (e.g. cryptic and/or seasonal species which did not have above-ground components at the time of survey).

Overall, the techniques used in this survey are considered adequate to assess the impacts of the proposal on threatened flora and their habitat, by objectively considering the potential for species to occur when suitable habitat, connectivity and local records occur.

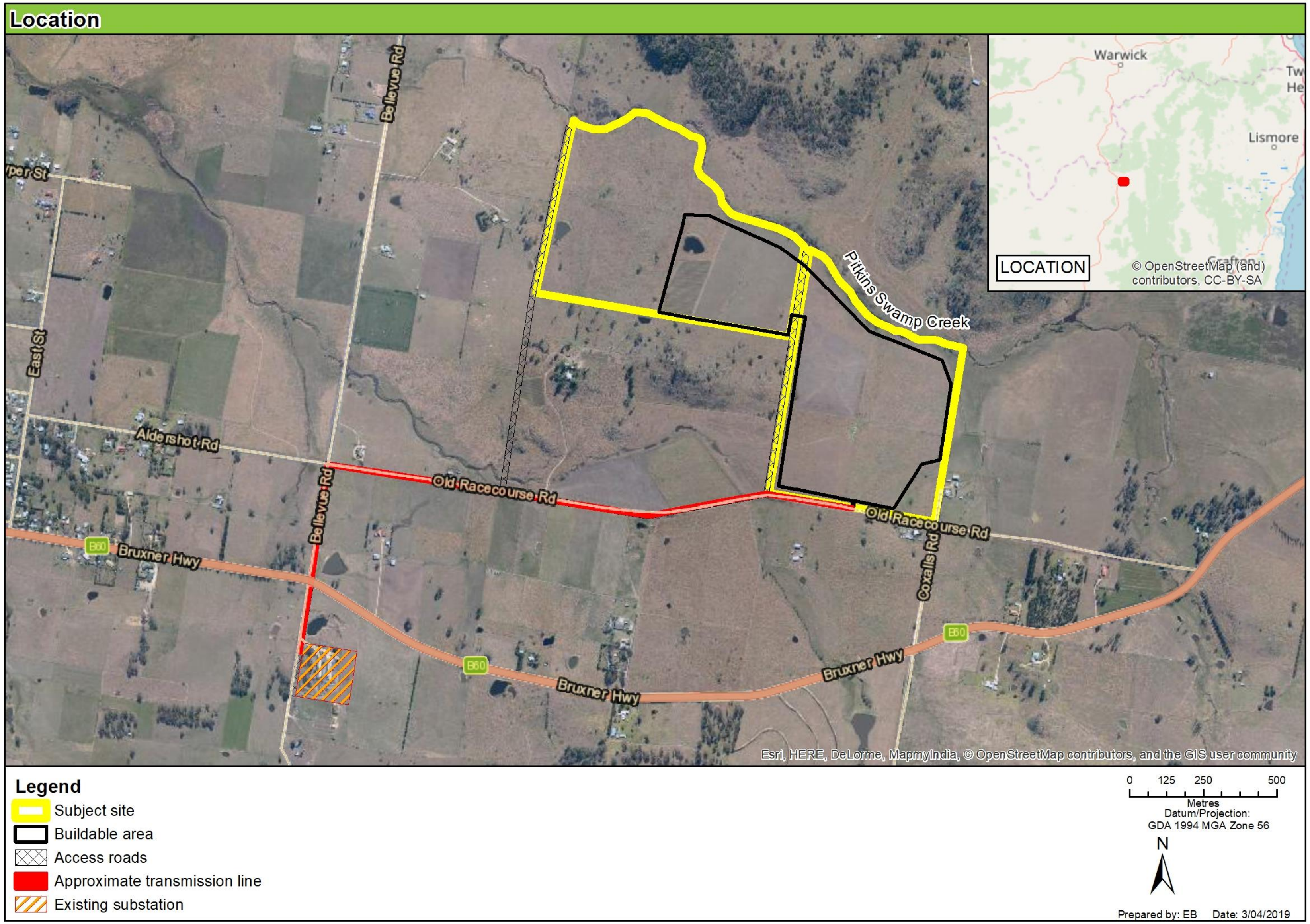


Figure 1: Location of the subject site and study area, Tenterfield

4 Results

4.1 Database and literature review

Appendix A provides a list of threatened and migratory terrestrial species that have been recorded from database searches within a 5 km radius of the subject site. These species have been evaluated to determine their likelihood of occurrence within the study area.

4.2 BAM

The results of the BAM plot data determined that there was insufficient native vegetation present to warrant a full BDAR, and this Biodiversity Assessment was conducted instead.

Benchmark conditions (OEH 2019b) for the vegetation community *Blakely's Red Gum – Yellow Box grassy woodland of the New England Tableland Bioregion* (PCT 510, OEH 2019b), are provided in **Table 3.** These provide a general comparison point for making a decision on whether native vegetation persists within the subject site.

Species richness and cover goals (**Table 3**) show that the vegetation within the subject only support 0.49 ha of PCT 510, with the remainder of the BAM plot data collected falling way short of these benchmark standards. BAM plot data collected during the current survey is provided in **Appendix D**.

Table 3: General benchmark conditions for Blakely's Red Gum – Yellow Box grassy woodland (PCT 510)

OEH - ID	PCT name (OEH 2019b)	Species richness*				Cover* (%)				# large trees	Large tree size
		Tree	Shrub	Grass / grass like	Forb	Tree	Shrub	Grass / grass like	Forb		
PCT 510	Blakely's Red Gum – Yellow Box grassy woodland of the New England Tableland Bioregion	4	6	22	15	47	6	82	13	3	50

* Based on monthly average following average rainfall year.

4.3 Vegetation

4.3.1 Previous vegetation mapping

The available vegetation mapping for the study area is derived from the existing Border Rivers Gwydir / Namoi regional native vegetation mapping layer (OEH 2015). This mapping did not indicate the presence of any PCTs within the subject site, however surrounding mapping indicates the possible presence of several PCTs.

This mapping was used as a guide during the 2018 ELA site survey (**Section 3.2** and **4.3.2**). Wherever possible, vegetation surrounding the subject land was also inspected, in order to assign a best-fit PCT.

4.3.2 Previous site survey (2018)

The wider study area around the subject site, whilst still historically cleared and disturbed, supports a greater diversity of remnant tree species and landscape features (i.e. to the south of the subject site), as did the several road reserves and scattered trees on neighbouring properties.

Remnant tree and shrub species recorded surrounding the subject site included:

- Blakely's Red Gum *(Eucalyptus blakelyi*)
- Grey Box (*E. moluccana)*
- Yellow Box *(E. melliodora*)
- Fuzzy Box *(E. conica*)
- Kurrajong *(Brachychiton populneus*)
- Hickory Wattle *(Acacia implexa*)
- Box-leaf Wattle *(A. buxifolia*)
- Cherry Ballart *(Exocarpos cupressiformis*).

The 2018 survey of the subject site recorded a combination of exotic and/or cultivated paddocks and remnant native vegetation. Potential habitat was identified within the subject land for the following Plant Community Types (PCTs):

- *Tea-tree riparian shrubland/heathland wetland on drainage areas of Nandewar Bioregion and New England Tableland Bioregion* (PCT 574) – potential habitat along Pitkins Swamp Creek, north of the subject site.
- *Blakely's Red Gum – Yellow Box grassy woodland of the New England Tableland Bioregion* (PCT 510) – small remnant patches mapped by OEH immediately west of the proposed transmission line, opposite the substation on Bellevue Road (**Figure 2**).

The BioNet VIS was used to filter potential PCTs based on the IBRA region and sub-region, dominant canopy species, soils, altitude, and landscape position. PCTs 574 and 510 was determined at the best-fit PCT, despite the level of disturbance observed within and surrounding the subject site.

PCT 510 represents part of the *White Box Yellow Box Blakely's Red Gum woodland* listed as an Endangered Ecological Community (EEC) under the BC Act and a TEC under the EPBC Act.

4.3.3 Current site survey (2019)

The subject land supports predominantly exotic vegetation comprising a combination of exotic pasture and/or cultivated paddocks, with a very small area of degraded remnant native vegetation.

The remnant scattered canopy trees provide a limited indication of the vegetation which once occurred naturally in the landscape. The few scattered remnant trees present within the subject site consist of Broad-leaved Apple *(Angophora subvelutina*), Apple Box (*E. bridgesiana*) and one regenerating Blakely's Red Gum. Two of the Broad-leaved Apple trees are hollow-bearing trees (HBTs, **Figure 2**).

A validated vegetation map of the subject site is depicted in **Figure 2** and is detailed below, based on profile information from the NSW BioNet Vegetation Information System (VIS, OEH 2019b).

Mapping units identified within the subject site during the current survey are identified in **Table 3**.

Table 4: Vegetation and site attributes of the subject site, Tenterfield

Mapping unit	Area in hectares (ha)
Exotic grassland	48.97
Exotic grassland (Dam)	3.51
Exotic grassland (Scattered remnant trees)	0.41
Exotic riparian / drainage	0.48
Highly disturbed ploughed grassland	0.36
PCT 510 (Scattered remnant trees and regrowth)	0.49
Planted revegetation (Exotic grassland)	1.03
Dams	0.25
Tracks / roads	0.67
Total	**54.65**

Potential mapped PCT

***Tea-tree riparian shrubland/heathland wetland on drainage areas of Nandewar Bioregion and New England Tableland Bioregion* (PCT 574)**

The sections of Pitkins Swamp Creek along the northerly boundary of the subject site (**Figure 2**) were assessed during the 2018 survey and identified as a potential best-fit PCT. Three BAM plots were conducted within this potential PCT (T01, T04 and T06, **Figure 2**) during current survey. These riparian areas are highly degraded, due to a long history of clearing, weed infestation, cattle access and erosion (**Plate 2**). These areas support predominantly exotic groundlayer and midlayer vegetation, along with scattered Weeping Willow (*Salix babylonica*), but no remnant native trees are present. Scattered, small clumps of *Typha* sp. (Cumbungi) occur, but not in large enough areas to qualify as remnant native vegetation and meet the criteria for PCT 574.

Therefore, no examples of PCT 574 occur along the section of Pitkins Swamp Creek adjacent to the subject site.

Plate 2: Exotic riparian / drainage vegetation along Pitkins Swamp Creek (T06).

Mapped PCT

***Blakely's Red Gum – Yellow Box grassy woodland of the New England Tableland Bioregion* (PCT 510)**

The vegetation validation undertaken during the current survey has identified a small, linear strip of remnant grassland vegetation (0.49 ha) which occurs on a mapped road reserve (**Figure 2**). The road reserve was never made into a road, due to the presence of large, granite boulders.

The presence of Blakely's Red Gum and the native grasses and groudlayer vegetation which persist amongst scattered granite boulders allowed this area to be classified as a variant of the PCT 510 (scattered remnant trees and regrowth) (**Figure 2** and **Plate 3**).

White Box Yellow Box Blakely's Red Gum woodland is listed as a TEC under the EPBC Act and is listed as an EEC under the BC Act. It is considered that the small strip of PCT 510 recorded within the subject site meets the TEC criteria under the EPBC Act (OEH 2018) due to the presence of one regenerating key canopy species (Blakely's Red Gum), grazed Fern-leaved Wattle (*Acacia filicifolia*), and the grazed native grasses Kangaroo Grass (*Themeda triandra*), *Agrostis* sp., Lovegrass (*Eragrostis* sp.), Redleg Grass (*Bothriochloa decipiens*), Common Wheatgrass (*Anthosachne scabra,* syn*. Elymus scaber)*, Blady Grass (*Imperata cylindrica*) and the rushes *Juncus* spp. and Wattle Mat-rush (*Lomandra filiformis*).

Native species persisting around boulders included Common Maidenhair (*Adiantum aethiopicum*), Necklace Fern (*Asplenium flabellifolium*), Native Raspberry (*Rubus parvifolius*), Wombat Berry (*Eustrephus latifolius*), Scrambling Lily (*Geitonoplesium cymosum*) and *Glycine tabacina.*

Plate 3: PCT 510 (Scattered trees and regrowth) within the subject site (T10).

Exotic Grassland

Several condition states of exotic grassland (dominated by exotic grasses and forbs) occur throughout the subject site, as mapped in **Figure 2** and listed below:

- Exotic Grassland (**Plate 1**).
- Exotic Grassland (Dam) – fringing the dry dams on-site (**Plate 4**).
- Exotic Grassland (scattered remnant trees) – supporting low levels of remnant trees.
- Exotic Riparian / Drainage – along small drainage depressions and Pitkins Swamp Creek.
- Highly disturbed ploughed grassland.
- Planted revegetation (Exotic grassland) – small revegetated strips using a mix of Australian native trees and shrubs of unknown origins, planted by landowners and/or Landcare.

The subject site predominantly consists of highly disturbed, previously cleared agricultural land that is currently used for cattle grazing. Historically this land was sown with the highly invasive African Lovegrass as a pasture grass for cattle, and some areas have been ploughed and/or burned repeatedly for many years. Commonly occurring weed species include Plantain (*Plantago lanceolata*), Cudweed (*Gamochaeta* sp.), Catsear (*Hypochaeris radicata*), Parramatta Grass (*Sporobolus africanus*), White Clover (*Trifolium repens*), Great Mullein (*Verbascum thapsus* subsp. *thapsus*), Purpletop (*Verbena bonariensis*), Common Centaury (*Centaurium erythraea*), Spear Thistle (*Cirsium vulgare*), Flaxleaf Fleabane (*Conyza bonariensis*), Deptford Pink (*Dianthus armeria*) and Crowsfoot Grass (*Eleusine indica*).

Plate 4: Exotic Grassland (Dam) vegetation fringing the dry dams within the subject site.

Planted revegetation (Exotic grassland)

Landcare and/or landowner revegetation works have occurred locally on a small scale, with the aim of creating windbreaks and habitat for native fauna, but within the subject site these are not established or highly successful and consist of native trees of mixed, unknown origins over a weed dominated groundlayer with no midstorey present (**Plate 5**).

Plate 5: PCT 510 (Potential DNG) vegetation within the subject site (T03).

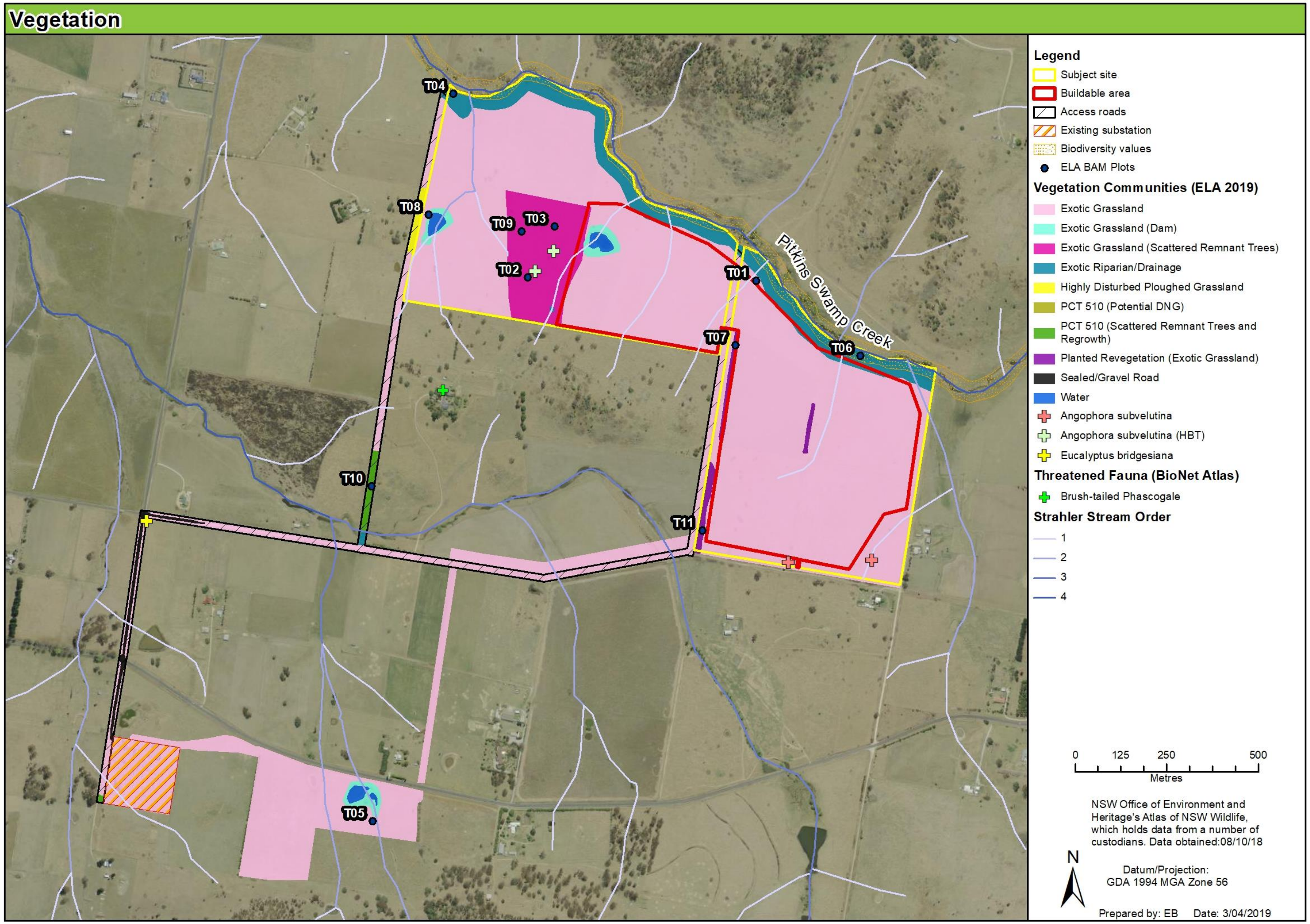


Figure 2: Vegetation mapping within the subject site, Tenterfield

4.4 Remnant trees

Historically, this locality has been predominantly cleared for cattle grazing, and very few remnant mature trees remain in the landscape. The subject site supports three significant trees (i.e. old growth and hollow-bearing), as shown in **Plate 6**.

Plate 6: Example of old-growth Broad-leaved Apple (HBT) within the subject site.

The old-growth trees which will be retained as part of the Proposed Development are:

1. Two Broad-leaved Apple (*Eucalyptus subvelutina*), both HBTs.
2. One roadside Apple Box (*E. bridgesiana*) (**Figure 2**).

4.5 Weed species

Many weeds commonly found in pastures and disturbed edges (roadsides) are present throughout the subject site (**Section 4.3.2**). Weeds of particular importance are discussed below.

Black Knapweed

An unknown *Centaurea* sp. was recorded during the current survey, which was identified as Black Knapweed (*Centaurea x moncktonii*) and subsequently confirmed by Tony Bean of the Queensland Herbarium.

Black Knapweed is a ‘prohibited matter’ under Part 4 of the *Biosecurity Act 2015*, meaning that the Department of Primary Industries (DPI) must immediately be notified if it is found as it is a very high-risk weed that is not yet established in NSW.

DPI was notified, who acted promptly to locate thousands of Black Knapweed plants in the surrounding area during a series of follow-up inspections. DPI is currently undertaking control of this species in this area. Delimitation of the infestation by DPI and Local Land Services (LLS) is ongoing and additional permission may need to be sought regarding earthworks and/or soil movement in the Black Knapweed surveillance area.


Plates 1 and 2: Black Knapweed along the roadside of the study area

Blackberry

Blackberry (*Rubus fruticosus* spp. agg.) is identified in the Northern Tablelands Regional Weeds Plan 2017 – 2022 (LLS Northern Tablelands 2017) as a State and Regional Priority Weed, and is listed as a Weed of National Significance (WoNS) under the *Biosecurity Act 2015*. Blackberry must not be imported into or sold within NSW.

Regional strategic responses for Blackberry are:

- Detailed surveillance and mapping to locate all infestations.
- High level pathways analysis to identify potential introduction areas and preventative options.
- Monitor progress towards eradication.
- The plant should be managed in accordance with a regional best practice guide.

Sweet Briar

Sweet Briar (*Rosa rubiginosa*) is identified in the Northern Tablelands Regional Weeds Plan 2017 – 2022 (LLS Northern Tablelands 2017) as a Regional Priority Weed.

Outcomes to demonstrate compliance with the General Biosecurity Duty (GBD) are:

- Land managers should prevent spread from their land, where feasible.
- Land managers should mitigate the risk of new weeds being introduced to their land.
- Do not buy, sell, grow, carry or release this species into the environment

Coolatai Grass, African Lovegrass and Firethorn

Coolatai Grass (*Hyparrhenia hirta*), African Lovegrass (*Eragrostis curvula*) and all species of Firethorn (*Pyracntha* spp.) are identified in the Northern Tablelands Regional Weeds Plan 2017 – 2022 (LLS

Northern Tablelands 2017) as 'Species of Concern'. These highly invasive species are present throughout the subject site. The study area was historically sown with the African Lovegrass as a pasture grass for cattle, and it now dominates the grassland vegetation of this locality.

Regional strategic responses for these species may include:

- Developing best practice guides to assist land managers to manage the weeds effectively and efficiently.
- Working within existing widespread weed programs for strategic asset protection.
- Prioritising the application of the GBD to assist with management of these species.

Plate 3: African Lovegrass within the subject site

4.6 Threatened flora

No threatened flora species were recorded within the subject site during the current survey.

The absence of basaltic soils on-site means that the three threatened flora species; Wandering Peppercress (*Lepidium peregrinum*), Austral Toadflax (*Thesium australe*) and Bluegrass (*Dichanthium setosum*) known to occur in the vicinity of the subject site would not occur within the Proposed Development footprint. Riparian areas along Pitkins Swamp Creek, the area of Derived Native Grassland and areas of exotic pasture (**Figure 2**) were searched for these species, but none were located.

4.7 Fauna species

The terrestrial bird species observed during the survey are commonly associated with urban habitats and adapt readily to anthropogenic land uses. No terrestrial fauna species were recorded within the subject site.

A population of the common species Eastern Dwarf Tree Frog (*Litoria fallax*) were recorded along Pitkins Swamp Creek during the current survey, inhabiting the taller riparian vegetation in that area.

4.8 Threatened fauna

No threatened fauna species were detected during the current survey, however targeted fauna survey was not undertaken. Comprehensive or targeted fauna survey within the subject site over various seasons would be highly likely to detect additional species.

Threatened, hollow-dependant fauna species with potential to use the subject site habitat resources would include Brush-tailed Phascogale (*Phascogale tapoatafa*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*).

A record of the Brush-tailed Phascogale (Vulnerable under the BC Act) exists approximately 260 m south-west of the proposed buildable area, outside the subject site (**Figure 2**).

4.9 Koala habitat

The subject site does not support preferred Koala Food Trees (KFTs) listed under SEPP 44, and no mature, remnant trees would be cleared under the current proposal. During the current survey, no evidence of Koala (scats, scratchings) was observed, however Koalas may occasionally traverse the subject site.

An assessment of Koala habitat within the impact area was not undertaken for this project as per the *EPBC Act referral guidelines for the vulnerable koala* (DoE 2014), due to the lack of suitable habitat within the subject site and surrounds. Koala records exist within approximately 3 – 5 km of the subject site, in areas supporting suitable feed trees around Tenterfield township. The proposal is not likely to impact on Koalas or interfere with Koala recovery.

4.10 Threatened ecological communities

A very small area of vegetation within the subject site is considered to represent the Endangered Ecological Community (EEC) *Blakely's Red Gum – Yellow Box grassy woodland of the New England Tableland Bioregion* (PCT 510) listed under the BC Act, due its species composition.

This small area of EEC is confined to a strip of land designated as a 'road reserve', which was never developed as such due to the presence of large granite boulders which have served to preserve this remnant in its current form.

4.11 Potentially occurring threatened fauna

All threatened and migratory fauna recorded or predicted to occur in the locality were reviewed for potential to occur as per DECC (2007) requirements (**Appendix A**).

This review determined that six threatened fauna species may potentially occur on-site due to suitable habitat present within the subject site and study area.

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) - NSW Vulnerable
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) - NSW Vulnerable
- Greater Broad-nosed Bat (*Scoteanax rueppellii*) - NSW Vulnerable
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) - NSW Vulnerable.
- Spotted-tailed Quoll (*Dasyurus maculatus*) - NSW Vulnerable and Federally Endangered
- Brush-tailed Phascogale (*Phascogale tapoatafa*) - NSW Vulnerable.

4.12 Aquatic habitat

It is understood that the main channel of Pitkins Swamp Creek riparian zone (**Figures 1** and **2**) and its immediate surrounds will not be affected by the current proposal. The tributaries of Pitkins Swamp Creek in the subject site (**Figure 1**) will also remain unaffected by the proposal (compared to their already degraded current state), as they can continue to flow beneath the raised solar panel modules which are mounted on steel racks. It is recommended that the tributaries of Pitkins Swamp Creek that extend across the northerly portion of the subject site are avoided, in terms of placement and construction of the steel racks which will support the mounted photovoltaic panel modules.

4.13 Connectivity

The subject site consists of few scattered, remnant trees on grazed lands in a highly fragmented landscape, which offers a low level of habitat connectivity. The study area includes areas which support much higher levels of forested native vegetation and the local creek lines meet the needs of regional corridors. More broadly around the study area there are large areas of retained native vegetation that represent significant habitat corridors. The subject site represents minimal value for habitat connectivity and the Proposed Development will have no significant effect on local connectivity, that will be maintained by areas outside of the subject site.

A much larger area of vegetated habitat occurs south of the study area. Curry's Gap State Conservation Area (SCA) and Mount Mackenzie Nature Reserve (NR) occur approximately 7 km to the south-west of the subject site, and form part of a forested band of habitat south of Tenterfield township. Doctor's Nose Mountain NR occurs approximately 5 km to the south-west of the subject site. A Travelling Stock Route (TSR) occurs immediately north of the subject site (**Figure 1**).

Regional corridors are typically >500 m wide and provide a link between major and/or significant areas of habitat in the region. Ideally, corridors are of sufficient size to provide habitat in their own right, and are at least twice the width of the average home range area of fauna species identified as likely to use the corridor (Scotts 2002). Sections of remaining habitat in the study area meet the objectives of a regional corridor as they are of sufficient size to provide habitat at least twice the width of the average home range area of fauna species identified as likely to use the corridor.

Local corridors provide connections between remnant patches of habitat and landscape features. Due to their relatively small area and width (they may be <50 m), these corridors are subject to edge effects (Scotts 2002, Lindenmayer and Fisher 2006).

The corridor which includes the subject site has only loose linkages to the regional corridor via narrow corridors through rural areas and watercourses.

The subject site itself is predominantly cleared of trees (except for a few scattered remnants), and the level of fragmentation in the wider landscape of this locality is high.

The study area is part of a relatively narrow band of vegetation which is limited by edge effects, isolation and proximity to rural-residential areas. However, the remnant trees (including HBTs) of the subject site and surrounds may provide foraging habitat, shelter and a stepping stone for mobile species such as microchiropteran bats and various bird species, and common generalist species.

5 Impact assessment

5.1 Direct impacts

During construction, it is expected that the localised disturbance created by vehicles and machinery may dissuade mobile fauna from visiting the immediate area, however given the extent of similar habitat surrounding the subject, this will not significantly impact upon any species and the disturbance by construction activities it is only short-term. As the noted important fauna habitat features (hollow-bearing trees and large granite boulders) will be retained *in-situ* under the proposal, it is expected that the long-term impact on fauna will be negligible.

5.1.1 Significant trees

No old-growth or hollow-bearing remnant trees will be cleared as part of the proposal. Pre-clearing tree protection standards are provided in **Appendix E**.

5.1.2 Riparian impacts

It is understood that Pitkins Swamp Creek and its immediate surrounds will not be affected by the current proposal. The disturbance to the adjacent habitat would be limited to vehicle and machinery access to the roadside area, and the noise and debris associated with construction. It is recommended that the tributaries of Pitkins Swamp Creek that extend across the northerly portion of the subject site are avoided, in terms of placement and construction of the steel racks which will support the mounted photovoltaic panel modules.

Waste or debris created during construction works could pollute surrounding waterways, for example via strong winds or runoff to Pitkins Swamp Creek during unforeseen extreme weather events. The implementation of an Erosion and Sediment Control Plan will manage this impact.

Given the scale of the proposal and that the area of vegetation which will be affected by the proposed actions is a very small proportion (< 0.1%) of the available habitat within the locality, it can be concluded that the works will not significantly change the habitat values of the locality. The environment to be impacted by the proposed works is already highly disturbed and contains no significant habitat features. Following the completion of construction and restoration works, no long-term or residual impacts are considered likely to occur.

5.2 Indirect impacts

The following indirect impacts (**Table 4**) are generally associated with the nature of the proposed activity in the short and long term.

Table 5: Review of indirect impacts

Threat	Assessment
Mortality via clearing	No hollow-bearing trees would be removed. A low level of groundlayer vegetation (mainly exotic grasses with very low levels of scattered natives) are likely to be cleared during clearing works.

Threat	Assessment
	Negligible risk of fauna mortality during clearing is expected, as few small mammals, reptiles, birds and frogs are expected to be present and will be able to disperse into adjoining habitats as needed.
Erosion, sedimentation, compaction	The construction phase may incrementally increase localised compaction but is unlikely to lead to a significant change to drainage patterns. Standard mechanisms and controls should ensure the prevention of erosion and sedimentation during construction and development.
Anthropogenic impacts	The subject site is located on public roadside and on privately owned property. This is already cleared and degraded pasture and cropped land that has no significant native vegetation or habitat features. Besides the additional noise and greenhouse gas (GHG) emissions during the construction works, no significant increase of anthropogenic impacts within the subject site is expected to occur.
Weed invasion	The study area currently contains a variety of weeds and exotic species, most notably Black Knapweed as a 'prohibited matter', Blackberry as a WoNS and a 'State' and 'Regional Priority Weed', Sweet Briar as a 'Regional Priority Weed' and Coolatai Grass, African Lovegrass and Firethorn as 'Species of Concern' (DPI 2019). These species are established throughout the subject site and within the study area. Regarding Black Knapweed, DPI is currently undertaking control of this species in this area. Delimitation of the infestation by DPI and LLS is ongoing and additional permission may need to be sought regarding earthworks and/or soil movement in the Black Knapweed surveillance area. Soil disturbance associated with the clearing of vegetation may benefit some of the weed species present, but they are already widespread across the subject site. There is a small chance that equipment used in construction will act as vectors for invasive species from previous work sites. Hygiene controls are recommended to minimise this risk.
Disease control	Phytophthora Root Rot (*Phytophthora cinnamomi*) is a soil fungal disease. The fungus can be spread in contaminated soil, tools, footwear, vehicles or muddy storm water. The risk of introducing plant diseases (e.g. *Phytophthora*) during construction and bush regeneration is to be minimised via applying a standard hygiene protocol. This protocol must include provisions addressing: • Sterilisation of all tools and plant equipment prior to taking into the site. • Sourcing all plants and mulch from certified disease-free suppliers. • Procedure for inspecting plants from suppliers for disease (and pests) before planting. • Training of staff in identifying plant diseases.

Threat	Assessment
	• Procedure for quarantine and notification of authorities. • Procedure for decontamination of clothes, personal protection equipment and shoes.

6 Recommendations

To mitigate the potential impacts of the proposal and maintain environmental outcomes, the following recommendations for impact avoidance, mitigation and amelioration are suggested as modifications to the proposal and/or as conditions of consent.

At a minimum, avoiding clearing any significant trees (i.e. old growth, hollow-bearing and Koala feed trees) is an important first step in planning any construction or works design.

6.1 Pre-clearance survey and clearing supervision

The recommended procedures for pre-clearing fauna survey and clearing supervision are not provided as no remnant or HBTs are proposed for clearing as part of the proposal. Pre-clearing tree protection standards are provided in **Appendix E**.

6.2 Retention of coarse woody debris

Retaining coarse woody debris (i.e. logs) *in-situ* as valuable structural habitat resources is highly recommended.

Logs can provide hollows, cracks and crevices of various sizes where fauna may live, breed or shelter. Rather than chipping logs, it is recommended that logs are retained on-site and re-positioned within adjacent bushland areas as habitat resources for ground-dwelling fauna. Logs can be cut into lengths if required (not less than 2 m).

6.3 Defined clearing limits

The HBTs that are nominated to be retained are to be clearly marked in the field. This includes any scattered or roadside remnant trees within the subject site, such as the two remnant Broad-leaved Apple trees which are HBTs (**Figure 2**). The extent of the clearing is to be defined by high-visibility bunting or fencing before the commencement of clearing to prevent inadvertent damage or unnecessary removal of vegetation. These clearing limits (no-go zones) should be marked on a map, and clearly communicated to any contractors or machinery operators, prior to undertaking clearing works. Pre-clearing tree protection standards are provided in **Appendix E**.

6.4 Riparian erosion and sediment control

It is understood that Pitkins Swamp Creek and its immediate surrounds will not be affected by the current proposal. It is recommended that the tributaries of Pitkins Swamp Creek that extend across the northerly portion of the subject site are avoided, in terms of placement and construction of the steel racks which will support the mounted photovoltaic panel modules.

When working in proximity to riparian zones, standard erosion and sediment controls are to be implemented for all construction, particularly around the riparian zones where excavation is required.

During the construction of infrastructure around riparian zones, work in wet or very windy weather should be avoided, and an Erosion and Sediment Control Plan will be implemented to minimise pollution and sedimentation issues which could arise. Care should be taken to avoid unnecessary disturbance of sediment. This could include the use of silt curtains or coir logs if deemed necessary.

6.5 Weed hygiene protocol

Highly invasive weeds can be spread by human vectors such as vehicles and construction equipment travelling between work sites. Given that several highly invasive weeds have been recorded within the subject site, it is possible that these species could be further spread within the study area during the proposed works.

Blackberry is listed as a WoNS under the *Biosecurity Act 2015*, and identified as both a State and Regional Priority Weed. Sweet Briar is listed as a 'Regional Priority Weed' and Coolatai Grass, African Lovegrass and Firethorn as 'Species of Concern' (LLS Northern Tablelands 2017).

Black Knapweed was identified during the current survey, and the DPI notified of this very high-risk weed that is not yet established in NSW. Delimitation of the infestation by DPI and LLS is ongoing and additional permission may need to be sought regarding earthworks and/or soil movement in the Black Knapweed surveillance area.

- Black Knapweed is prohibited matter under the *Biosecurity Act 2015* and was detected within the subject site. As such, restrictions may apply regarding the Proposed Development.
- Surveillance activities by the DPI and LLS are ongoing to delimit the Black Knapweed infestation and support an eradication campaign.
- As the situation unfolds, the client will need to liaise with Tenterfield Shire Council and/or the DPI, who will advise them of relevant restrictions and protocols (e.g. regarding soil movement and machinery hygiene).

Suggested contacts are:

Chris Battersby (Weeds Officer, Tenterfield Shire Council)

council@tenterfield.nsw.gov.au

0402 210 102

Mark Cooper (Tenterfield Shire Council)

0411 864 042

Rod Ensbey (DPI, NSW)

rod.ensbey@dpi.nsw.gov.au

(02) 6640 1648

Consistent with the first priority of the Northern Tablelands Regional Weeds Plan 2017 – 2022 (LLS Northern Tablelands 2017), all equipment which will be used should be visually inspected for plant fragments before entry into the subject site and immediately following exit, with any plants removed and disposed of in a rubbish bin. This will minimise the likelihood of transporting invasive weeds from a previous work site or into the next work site.

Work should be confined to the designated construction zones to minimise the areas which could potentially be impacted by weed invasion.

6.6 Waste management

A Waste Management Plan (WMP) should be prepared and approved by Tenterfield Shire Council prior to the commencement of works, to minimise any pollution issues which may arise.

7 Statutory assessments

7.1 *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

Appendix C details the Matters of National Environmental Significance (MNES) assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The following Federally-listed threatened fauna species were considered potential occurrences in the study area and required assessment:

- Spotted-tailed Quoll (*Dasyurus maculatus*) - Endangered.

Appendix C details the Matters of National Environmental Significance (MNES) assessment for the above. The assessment determined that the proposal is unlikely to significantly affect habitat for any threatened or migratory species or TEC listed on the EPBC Act, or any other MNES. A referral to the Commonwealth under the EPBC Act is therefore not required.

7.1.1 EPBC Act referral guidelines for the vulnerable koala

The subject site does not support preferred KFTs listed under SEPP 44, and no mature, remnant trees would be cleared under the current proposal. During the current survey, no evidence of Koala (scats, scratchings) was observed, however Koalas may occasionally traverse the subject site.

An assessment of Koala habitat within the impact area was not undertaken for this project as per the *EPBC Act Referral Guidelines for the vulnerable koala* (DoE 2014), due to the lack of suitable habitat within the subject site and surrounds. Koala records exist within approximately 3 – 5 km of the subject site, in areas supporting forested vegetation around Tenterfield township. The proposal is not likely to impact on Koalas or interfere with Koala recovery.

7.2 *Biodiversity Conservation Act 2016* (BC Act)

In November 2016 the NSW parliament passed the BC Act. This new legislation repealed the *Threatened Species Conservation Act 1995* (TSC Act). The BC Act introduced a new mandatory framework for addressing impacts on biodiversity from development and clearing, including the Biodiversity Offsets Scheme (BOS) which requires proponents to offset certain biodiversity impacts through the purchase and retirement of biodiversity credits. Should the BOS be triggered by any future development proposal, a Biodiversity Development Assessment Report (BDAR) would be required.

The Biodiversity Offsets Scheme (BOS) and Biodiversity Assessment Method (BAM) may be triggered by the following means:

Triggers for the BOS include:

- Clearing of over 0.5 hectares (ha) for lots between 1 and <40 ha in size
- Land mapped on the Biodiversity Values Map (BV Map).
- Significant impacts to matters listed under the BC Act as assessed using s7.3 of that Act.

These factors are not applicable to the Proposed Development.

7.2.1 Areas of Outstanding Biodiversity Value (AOBV)

The proposed development is not located within an Area of Outstanding Biodiversity Value.

7.2.2 Biodiversity Offset Scheme (BOS)

The proposal is proceeding as an activity under Part 4 of the EP&A Act, however the Biodiversity Offset Scheme (BOS) was initially considered during the current survey. The current survey confirmed that the subject site supports a very low level of native vegetation, and the subject site does not occur in a mapped AOBV. Therefore, the environmental impact of activities were assessed under s.5.5 of the EP&A Act.

The subject site is not mapped as having Biodiversity Value under the BC Act, except for Pitkins Swamp Creek which extends along the northerly boundary of the subject site that is not affected by the current proposal (**Figure 2**).

As the activity is considered not likely to have a significant impact on threatened species/communities/habitats, nor does it occur in an AOBV, the environmental impact of activities will continue to be assessed under s.5.5 of the EP&A Act.

7.2.3 Species subject to Five Part Test assessment

The test for determining whether a proposed development is likely to significantly affect threatened species or ecological communities, or their habitats (Five Part Test), as outlined in the BC Act, was undertaken for threatened species and communities predicted to occur in the study area.

A BioNet search (OEH 2019a) and Protected Matters Search Tool (PMST) search (DotEE 2019) was undertaken, and all threatened fauna recorded or predicted to occur in the locality were reviewed for their potential to occur within the study area (**Appendix A**) as per DECC (2007) requirements. Marine fish, mammals and seabirds were omitted due to lack of suitable habitat in the study area.

As a result of field survey, habitat analysis, database searches and review of previous studies, the following six threatened fauna species (listed in NSW as Vulnerable) are considered to have potential to occur on-site and in the study area and were assessed:

- Spotted-tailed Quoll (*Dasyurus maculatus*)
- Brush-tailed Phascogale (*Phascogale tapoatafa*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*).

The threatened species listed above are assessed under Clause 7.3 of the BC Act in **Appendix B**. None of these species has been determined to be significantly impacted by the proposed development.

The current survey confirmed that the subject site supports a very low level of native vegetation, and the subject site does not occur in a mapped AOBV. The assessment concluded that the proposal is unlikely to have a significant impact on any threatened entity, and a SIS or application of the BOS is therefore not deemed necessary.

8 Conclusion

This report describes the ecological environment of the subject site of the proposed Tenterfield solar farm and assesses the impacts of the Proposed Development.

No threatened flora species were recorded in the area potentially impacted by the Proposed Development. The absence of basaltic soils on-site means that the three threatened flora species; Wandering Peppercress, Austral Toadflax and Bluegrass known to occur in the vicinity of the subject site would not occur within the Proposed Development footprint. Riparian areas along Pitkins Swamp Creek, the areas of PCT 510 and areas of exotic pasture were searched for these species, but none occurred.

It is understood that Pitkins Swamp Creek and its immediate surrounds will not be affected by the current proposal. It is recommended that the tributaries of Pitkins Swamp Creek that extend across the northerly portion of the subject site are avoided, in terms of placement and construction of the steel racks which will support the mounted photovoltaic panel modules.

Black Knapweed is prohibited matter under the *Biosecurity Act 2015* and was detected within the subject site. As such, restrictions may apply regarding works undertaken in the development area. Surveillance activities by the DPI and LLS are ongoing to delimit the Black Knapweed infestation and support an eradication campaign. As the situation unfolds, the client will need to liaise with Tenterfield Shire Council and/or the DPI, who will advise them of relevant restrictions and protocols (e.g. regarding soil movement and machinery hygiene).

The study area is considered to provide habitat of varying degrees of suitability for six listed threatened fauna species. None of these species would depend on habitat within the study area to maintain viable populations.

Recommendations are provided to mitigate potential impacts on the habitat values of the subject site.

Assessment of the project is to proceed under Part 4 of the EP&A Act. An assessment of the area to be impacted indicated that thresholds for implementation of the BOS and BAM were not reached and so impacts were assessed through the application of the Five Part Test of significance process under Clause 7.3 of the BC Act, in accordance with relevant assessment guidelines (DECC 2007). These tests concluded that the proposal is unlikely to have a significant effect on any threatened species. An SIS is not required for the proposal.

Following consideration of the administrative guidelines for determining significance under the Commonwealth EPBC Act, it is concluded that the proposal is unlikely to have a significant impact on any Matters of National Environmental Significance, and a referral to the Commonwealth Environment Minister is therefore not required.

References

Department of Environment and Climate Change NSW (DECC) 2007. *Threatened species assessment guidelines - The assessment of significance*.

Department of the Environment and Energy (DotEE) 2019. *Protected Matters Search Tool*. Available: http://www.environment.gov.au/epbc/pmst/

Department of the Environment (DoE) 2014. *EPBC Act Referral Guidelines for the vulnerable koala* (combined populations of Queensland, New South Wales and the Australian Capital Territory), Commonwealth of Australia, 2014.

Eco Logical Australia (ELA) 2018. *Tenterfield Solar Farm Biodiversity Preliminary Constraints Survey*. Letter report prepared on 30 November 2018 for Enerparc Australia Pty Ltd

NSW Department of Primary Industries (DPI) 2019. NSW WeedWise website. Available: https://weeds.dpi.nsw.gov.au/

Lindenmayer, D. and Fisher, J. 2006. *Habitat fragmentation and Landscape Change: An ecological and conservation synthesis*. CSIRO Publishing.

Local Land Services (LLS) Northern Tablelands 2017. *Northern Tablelands Regional Strategic Weed Management Plan 2017 – 2022*. Developed by the Northern Tablelands Regional Weed Committee on behalf of the Northern Tablelands Local Land Services Board.

NSW Department of Mineral Resources (DMR) 2005. Statewide Digital Geology 1:250 000 (ANZNS0155000670). Metadata: http://canri.nsw.gov.au/nrdd/records/ANZNS0155000670.html

NSW Office of Environment and Heritage (OEH) 2015. *BRG-Namoi Regional Native Vegetation Mapping. Technical Notes* (VIS_ID 4467). Available: https://data.gov.au/data/dataset/b3ca03dc-ed6e-4fdd-82ca-e9406a6ad74a

NSW Office of Environment and Heritage (OEH) 2016. *NSW Guide to Surveying Threatened Plants*. Available: www.environment.nsw.gov.au/resources/threatenedspecies/160129-threatened-plants-survey-guide.pdf

NSW Office of Environment and Heritage (OEH) 2018. Scientific Community Determinations. Available: http://www.environment.nsw.gov.au/determinations/

NSW Office of Environment and Heritage (OEH) 2019a. BioNet. Available: http://www.bionet.nsw.gov.au/

NSW Office of Environment and Heritage (OEH) 2019b. BioNet Vegetation Classification database. Available: https://www.environment.nsw.gov.au/research/Visclassification.htm

Scotts, D. 2002. *Key Habitats and Corridors for Forest Fauna of North-East NSW: A regional landscape to focus conservation, planning, assessment and management*. NSW National Parks and Wildlife Service.

Standards Australia 2009. *Australian Standard®: protection of trees on development sites, AS 4970 – 2009*. Committee EV-018 (formerly BD-068), Aboriculture. 26th August 2009. Standards Australia, Sydney.

Appendix A Likelihood of occurrence

An assessment of the likelihood of occurrence was made for threatened and migratory species identified as occurring or potentially occurring in the locality from the database search. Fish and marine species including seabirds and marine mammals have been omitted from the table due to lack of suitable habitat in the study area.

Five terms for the likelihood of occurrence of species are used in this report. This assessment was based on database or other records, presence or absence of suitable habitat, results of the field survey and professional judgement. The terms for likelihood of occurrence are defined below:

- “yes” = the species was or has been observed on the subject land and/or study area.
- “likely” = a medium to high probability that a species uses the study area or immediate surrounds due to suitable habitat, connectivity and local records.
- “possible” = some suitable habitat (often a remnant or degraded area) for a species occurs on the subject site and/or study area, but is insufficient to meet the species needs for more than short term opportunistic foraging or marginal fringe of home range; or is very degraded/disturbed often with high levels of threat, and hence likelihood of occurrence is low.
- “unlikely” = a very low probability that a species uses the study area or immediate surrounds due to condition, threats, poor connectivity and/or lack of suitability.
- “no” = habitat within the study area or immediate surrounds is completely unsuitable for the species.

KEY

BC Act: E1 = Endangered, E2 = Endangered Population, E4 = Extinct, E4A = Critically Endangered, V = Vulnerable

EPBC Act: M = Migratory, CD = Conservation Dependent, CE = Critically Endangered, E = Endangered, V = Vulnerable, X = Extinct

FM Act: E1 = Endangered, E2 = Endangered Population, E4 = Extinct, E4A = Critically Endangered, V = Vulnerable

ENDANGERED ECOLOGICAL COMMUNITIES

Scientific Name	BC listing equivalent	BC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence	Impact assessment required?
New England Peppermint (Eucalyptus nova-anglica) Grassy Woodlands	*New England Peppermint (Eucalyptus nova-anglica) Woodland on Basalts and Sediments in the New England Tableland Bioregion*	CE	CE	Tablelands and slopes of northeastern NSW. The national ecological community mainly occurs in the New England Tableland Bioregion with minor occurrences extending into adjacent subregions of the NSW North Coast and the Nandewar bioregions. Generally occurs on valley flats and lower slopes subject to cold air drainage at elevations of 900 to 1400 m. Two forms of the ecological community are currently recognised, each associations ed with a particular substrate. One form is on poorly drained loam-clay soils, derived from basalt, fine-grained sedimentary and acid volcanic substrates, and the other form is on coarse sandy soils overlying granitic substrates.	Generally occurs on valley flats and lower slopes subject to cold air drainage at elevations of 900 to 1400 m. Two forms of the ecological community are currently recognised, each associated with a particular substrate. One form is on poorly drained loam-clay soils, derived from basalt, fine-grained sedimentary and acid volcanic substrates, and the other form is on coarse sandy soils overlying granitic substrates.	No	No
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	*White Box Yellow Box Blakely Red Gum Woodland*	E	CE	Tablelands and western slopes of NSW. Relatively fertile soils. Occurs in an arc along the western slopes and tablelands of the Great Dividing Range from Southern Queensland through NSW to central Victoria. In NSW, it occurs in the Brigalow Belt South, Nandewar, New England Tableland, Sydney Basin, NSW North Coast, South Eastern Highlands, South East Corner, NSW South Western Slopes and Riverina Bioregions.	Open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of the following: *Eucalyptus albens* (White Box), *E. melliodora* (Yellow Box) and *E. blakelyi* (Blakely's Red Gum). Modified sites include areas where the main tree species are present ranging from an open woodland formation to a forest structure, and the groundlayer is predominantly composed of	Yes	No – the small area of this EEC / TEC present will not be directly or indirectly impacted by the Proposed Development

Scientific Name	BC listing equivalent	BC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence	Impact assessment required?
				Areas where rainfall is between 400 and 1200 mm per annum, on moderate to highly fertile soils at altitudes of 170 m to 1200 m.	exotic species; and sites where the trees have been removed and only the grassy groundlayer and some herbs remain.		

FLORA

Family	Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence	Impact Assessment Required?
Fabaceae (Mimosoideae)	*Acacia macnuttiana*	MacNutt's Wattle	V	V	Only on the New England Tablelands and just extending onto the North West Slopes.	Dry forest or woodland and heath vegetation, usually on granite or metasediments and often near streams.	No	No
Fabaceae (Mimosoideae)	*Acacia pubifolia*	Velvet Wattle	E1	V	In NSW, known from two main populations, one north of Emmaville and the other near Warrabah National Park.	Dry shrubby woodland on granite and metasediment soils.	No	No
Fabaceae (Mimosoideae)	*Acacia ruppii*	Rupp's Wattle	E1	E	Occurs at altitudes of 50–150 m in the Banyabba–Coaldale area to the north-west of Grafton.	Dry open forest and shrubland in sandstone areas, often near creeks and on roadsides.	No	No
Rutaceae	*Boronia granitica*	Granite Boronia	V	E	Scattered localities on the New England Tablelands and North West Slopes north from the Armidale area to the Stanthorpe district in southern Qld.	On granitic soils amongst rock outcrops, often in rock crevices, and in forests and woodlands on granite scree and shallow soils.	No	No
Surianaceae	*Cadellia pentastylis*	Ooline	V	V	In NSW, found along the western edge of the North West Slopes from north of Gunnedah to west of Tenterfield.	Dry rainforest, semi-evergreen vine thickets and sclerophyll communities. Usually on low- to medium-nutrient soils of sandy clay or clayey consistencies.	No	No
Myrtaceae	*Callistemon pungens*		P	V	In NSW the species occurs from near Inverell to the eastern escarpment in New England National Park.	Rocky watercourses, usually with sandy granite (occasionally basalt) creek beds.	No	No

Family	Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence	Impact Assessment Required?
Poaceae	*Dichanthium setosum*	Bluegrass	V	V	In NSW, found on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes.	Cleared woodland, grassy roadside remnants and highly disturbed pasture, on heavy basaltic black soils and red-brown loams with clay subsoil.	Unlikely	No – basalt soils absent
Orchidaceae	*Diuris pedunculata*	Small Snake Orchid	E1	E	Confined to north east NSW, now mainly found on the New England Tablelands, around Armidale, Uralla, Guyra and Ebor.	Grassy slopes or flats, on peaty soils in moist areas, on shale and trap soils, on fine granite, and among boulders.	No	No
Myrtaceae	*Eucalyptus nicholii*	Narrow-leaved Black Peppermint	V	V	New England Tablelands from Nundle to north of Tenterfield.	Dry grassy woodland, on shallow soils of slopes and ridges.	No	No
Myrtaceae	*Eucalyptus scoparia*	Wallangarra White Gum	E1	V	In NSW it is known from only three locations near Tenterfield.	Open eucalypt forest, woodland and heaths on well-drained granite/rhyolite hilltops, slopes and rocky outcrops, typically at high altitudes.	No	No
Haloragaceae	*Haloragis exalata subsp. velutina*	Tall Velvet Sea-berry	V	V	North coast of NSW and south-eastern Qld.	Damp places near watercourses, and woodland on the steep rocky slopes of gorges.	No	No
Brassicaceae	*Lepidium peregrinum*	Wandering Pepper Cress	E1	E	In NSW occurs in scattered refugia near Tenterfield.	Open riparian forest and tussock grassland on sandy alluvium.	No	No – quality riparian vegetation and sandy alluvium soils absent
Santalaceae	*Thesium australe*	Austral Toadflax	V	V	In eastern NSW it is found in very small populations scattered along the coast, and from the Northern to Southern Tablelands.	Grassland on coastal headlands or grassland and grassy woodland away from the coast.	No	No – basalt soils absent
Apocynaceae	*Tylophora woollsii*	Cryptic Forest Twiner	E1	E	From the NSW north coast and New England Tablelands to southern Qld.	Moist eucalypt forest, moist sites in dry eucalypt forest and rainforest margins.	No	No

FAUNA

Family	Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence	Impact assessment required?
Anseranatidae	*Anseranas semipalmata*	Magpie Goose	V		In NSW, found in central and northern parts of the state, with vagrants as far as south-eastern NSW.	Shallow wetlands, floodplains, grasslands, pastures, dams and crops.	Unlikely	No – insufficient habitat present to meet the species long-term needs
Meliphagidae	*Anthochaera phrygia*	Regent Honeyeater	E4A	CE	Inland slopes of south-east Australia, and less frequently in coastal areas. In NSW, most records are from the North-West Plains, North-West and South-West Slopes, Northern Tablelands, Central Tablelands and Southern Tablelands regions; also recorded in the Central Coast and Hunter Valley regions.	Eucalypt woodland and open forest, wooded farmland and urban areas with mature eucalypts, and riparian forests of *Casuarina cunninghamiana* (River Oak).	No	No
Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	V		In NSW, widespread along coast and inland to the southern tablelands and central western plains, with a small population in the Riverina.	Open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur.	No	No
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V	Recorded from Rockhampton in Qld south to Ulladulla in NSW. Largest concentrations of populations occur in the sandstone escarpments of the Sydney basin and the NSW north-west slopes.	Wet and dry sclerophyll forests, Cyprus Pine dominated forest, woodland, sub-alpine woodland, edges of rainforests and sandstone outcrop country.	No	No
Acanthizidae	*Chthonicola sagittata*	Speckled Warbler	V		From south-eastern Qld, the eastern half of NSW and into Victoria, as far west as the Grampians, mostly on hills and tablelands of the Great Dividing Range and rarely on coast.	*Eucalyptus*-dominated communities with a grassy understorey and sparse shrub layer, often on rocky ridges or in gullies.	Possible	No – insufficient habitat present to meet the species long-term needs
Scincidae	*Coeranoscincus reticulatus*	Three-toed Snake-tooth Skink	V	V	Coast and ranges from the Macleay valley in NSW to south-eastern Qld.	Rainforest and occasionally moist eucalypt forest, on loamy or sandy soils.	No	No
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	V		Distribution in NSW is nearly continuous from the coast to the far west.	Inhabits eucalypt forests and woodlands, mallee and *Acacia* woodland.	Possible	No – insufficient habitat present to

Family	Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence	Impact assessment required?
								meet the species long-term needs
Dasyuridae	*Dasyurus maculatus*	Spotted-tailed Quoll	V	E	Found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Qld.	Rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	Possible	Yes
Accipitridae	*Erythrotriorchis radiatus*	Red Goshawk	E4A	V	In NSW, extends to ~30°S. Recent records confined to the Northern Rivers region north of the Clarence River.	Open woodland and forest, often along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, *Melaleuca* swamp forest and coastal riparian *Eucalyptus* forest.	Unlikely	No - HBTs to be retained as part of the proposal
Vespertilionidae	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V		South-east coast and ranges of Australia, from southern Qld to Victoria and Tasmania. In NSW, records extend to the western slopes of the Great Dividing Range.	Tall (greater than 20m) moist habitats.	Possible	Yes
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	V		In NSW, found from the coast westward as far as Dubbo and Albury.	Dry, open eucalypt forests and woodlands, including remnant woodland patches and roadside vegetation.	Possible	No – HBTs to be retained as part of the proposal
Meliphagidae	*Grantiella picta*	Painted Honeyeater	V	V	Widely distributed in NSW, predominantly on the inland side of the Great Dividing Range but avoiding arid areas.	Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests.	Possible	No – insufficient habitat present to meet the species long-term needs
Accipitridae	*Hieraaetus morphnoides*	Little Eagle	V		Throughout the Australian mainland, with the exception of the most densely-forested parts of the Dividing Range escarpment.	Open eucalypt forest, woodland or open woodland, including sheoak or *Acacia* woodlands and riparian woodlands of interior NSW.	Possible	No – insufficient habitat present to meet the species long-term needs
Psittacidae	*Lathamus discolor*	Swift Parrot	E1	CE	Migrates from Tasmania to mainland in Autumn-Winter. In NSW, the species mostly occurs on the coast and south west slopes.	Box-ironbark forests and woodlands.	Unlikely	No – insufficient habitat present to meet the species long-term needs

Family	Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence	Impact assessment required?
Vespertilionidae	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V		In NSW it occurs on both sides of the Great Dividing Range, from the coast inland to Moree, Dubbo and Wagga Wagga.	Rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland.	Possible	Yes
Myobatrachidae	*Mixophyes balbus*	Stuttering Frog	E1	V	Along the east coast of Australia from southern Qld to north-eastern Victoria.	Rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	No	No
Vespertilionidae	*Nyctophilus corbeni*	Corben's Long-eared Bat	V	V	Distribution coincides approximately with the Murray Darling Basin; the Pilliga Scrub region is the distinct stronghold for this species.	Mallee, *Allocasuarina luehmannii* (Buloke) and box eucalypt- dominated communities, especially box/ironbark/cypress-pine vegetation.	Unlikely	No – insufficient habitat present to meet the species long-term needs
Pseudocheiridae	*Petauroides volans*	Greater Glider	E2	V	This species is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level.	Eucalypt forests and woodlands. Requires large tree hollows for shelter	Unlikely	No – insufficient habitat present to meet the species long-term needs
Petauridae	*Petaurus australis*	Yellow-bellied Glider	V		Along the eastern coast to the western slopes of the Great Dividing Range, from southern Qld to Victoria.	Tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils.	Unlikely	No – insufficient habitat present to meet the species long-term needs
Macropodidae	*Petrogale penicillata*	Brush-tailed Rock-wallaby	E1	V	In NSW they occur from the Qld border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit.	Rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges.	No	No
Dasyuridae	*Phascogale tapoatafa*	Brush-tailed Phascogale	V		In NSW it is mainly found east of the Great Dividing Range although there are occasional records west of the divide.	Dry sclerophyll open forest, heath, swamps, rainforest and wet sclerophyll forest.	Possible	Yes

Family	Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence	Impact assessment required?
Phascolarctidae	*Phascolarctos cinereus*	Koala	V	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. There are sparse and possibly disjunct populations in the Bega District, and at several sites on the southern tablelands.	Eucalypt woodlands and forests.	Unlikely	No – insufficient habitat present to meet the species long-term needs
Potoroidae	*Potorous tridactylus*	Long-nosed Potoroo	V	V	In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm.	Coastal heaths and dry and wet sclerophyll forests.	No	No
Muridae	*Pseudomys novaehollandiae*	New Holland Mouse		V	Fragmented distribution across eastern NSW.	Open heathlands, woodlands and forests with a heathland understorey, vegetated sand dunes.	No	No
Muridae	*Pseudomys oralis*	Hastings River Mouse	E1	E	In NSW, distribution spans the Great Dividing Range, north from Mt Royal in the Hunter Valley at elevations between 300 m and 1100 m.	Dry open forest types with dense, low ground cover.	No	No
Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	Along the eastern coast of Australia, from Bundaberg in Qld to Melbourne in Victoria.	Subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.	No	No
Rostratulidae	*Rostratula australis*	Australian Painted Snipe	E1	E	In NSW most records are from the Murray-Darling Basin. Other recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys.	Swamps, dams and nearby marshy areas.	Unlikely	No – insufficient habitat present to meet the species long-term needs
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V		The Yellow-bellied Sheathtail-bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	Possible	Yes

Family	Scientific Name	Common Name	BC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence	Impact assessment required?
					South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes.	When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees.		
Vespertilionidae	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V		Both sides of the great divide, from the Atherton Tableland in Qld to north-eastern Victoria, mainly along river systems and gullies. In NSW it is widespread on the New England Tablelands.	Woodland, moist and dry eucalypt forest and rainforest.	Possible	Yes
Chelidae	*Wollumbinia belli*	Bell's Turtle	V	V	In NSW, currently found only in the upper reaches of the Namoi and Gwydir River systems, on the escarpment of the North West Slopes.	Shallow to deep pools in upper reaches or small tributaries of major rivers in granite country.	Unlikely	No – insufficient habitat present to meet the species long-term needs

AQUATIC

Family	Scientific Name	Common Name	BC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence	Impact assessment required?
Percichthyidae	*Maccullochella peelii*	Murray Cod		V	Throughout most of the Murray Darling Basin with the exception of some localised extinctions. Some translocated populations exist outside the species' natural distribution in impoundments and waterways (Cataract Dam and the Nepean River system in NSW).	Clear rocky streams to slow flowing, turbid rivers and billabongs. Frequently found in the main river channel and larger tributaries; also in floodplain channels when they contain water.	Unlikely	No – insufficient habitat present to meet the species long-term needs

REFERENCES

Fauna

DoEE, 2017. Species Profile and Threats Database. Available at: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

OEH, 2017. Threatened Species Profiles. Available at: http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse_scientificname.aspx.

Pizzey, G. and Knight, F. (2007). The Field Guide to the Birds of Australia. 8th Edition. Harper Collins, Sydney.

Flora

DoEE, 2017. Species Profile and Threats Database. Available at: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

OEH, 2017. Threatened Species Profiles. Available at: http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse_scientificname.aspx.

The Royal Botanic Gardens and Domain Trust, 2014. PlantNET - The Plant Information Network System of The Royal Botanic Gardens and Domain Trust, Sydney, Australia. Available at: http://plantnet.rbgsyd.nsw.gov.au

Fish / Aquatic

DoEE, 2017. Species Profile and Threats Database. Available at: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

DPI, 2017. Profiles for species, populations & ecological communities. Available at: http://pas.dpi.nsw.gov.au/Species/All_Species.aspx

DPI, 2017. What is currently listed? Available at: http://www.dpi.nsw.gov.au/fisheries/species-protection/conservation/what-current

EECs

DoEE, 2017. Species Profile and Threats Database. Available at: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

OEH, 2017. Threatened Species Profiles. Available at: http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse_scientificname.aspx.

Appendix B Test of Significance for BC Act listed species and communities

Test of Significance (Five Part Test)

Threatened species impact assessment is an integral part of environmental impact assessment. Clause 7.3 of the BC Act requires a Test of Significance or a 'Five Part Test' to be applied to species, populations and ecological communities listed on Schedules 1 and 2 of the BC Act, to determine whether proposed development or activity likely to significantly affect threatened species or ecological communities, or their habitats.

The Test of Significance sets out five factors which, when considered, allow proponents to undertake a qualitative analysis of the likely impacts of an action and to determine whether further assessment is required via a Species Impact Statement (SIS) or whether the proponent wishes to opt-in to the BOS. All factors must be considered and an overall conclusion made based on all factors in combination. An SIS is required if, through application of the Five Part Test, an action is considered likely to have a significant impact on a threatened species, population or ecological community. Alternatively, a proponent may opt-in to the BOS.

The assessment is undertaken for the following six NSW Vulnerable species predicted to occur in the study area in **Appendix A** as follows:

- Spotted-tailed Quoll (*Dasyurus maculatus)*
- Brush-tailed Phascogale (*Phascogale tapoatafa*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*).

Spotted-tailed Quoll and Brush-tailed Phascogale

Spotted-tailed Quoll and Brush-tailed Phascogale were assessed together, due to similar foraging and/or sheltering habitat requirements. Both species are agile climbers which can forage up trees or on the ground. They both use hollow-bearing trees as den or nest sites (OEH 2019).

(a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

The proposal will retain all mature trees, including HBTs, which provide potential foraging and nesting habitat for these species. Given that any local populations would extend well beyond the study area where larger patches of forest exist, and that these are both highly mobile species, the proposal is unlikely to place any local populations at risk of extinction.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

N/A

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

N/A

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat because of the proposed development or activity, and

The proposal will retain all mature trees, including HBTs, which provide potential foraging and nesting habitat for these species. This study area already exists within a highly fragmented ecosystem, and this proposal will not cause any further fragmentation. Both species are capable of crossing gaps, and the proposal will not result in any fragmentation or isolation of habitat.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

The proposal will retain all mature trees, including HBTs, which provide potential foraging and nesting habitat for these species. The local populations of these species would extend well beyond the study area; similar or better-quality forested habitat is present to the south of the subject site. This study area already exists within a highly fragmented ecosystem, and this proposal will not cause any further fragmentation. The grassland habitat to be removed is likely to be of low importance to the long-term survival of these species in the locality.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The proposal will not have an adverse effect on any declared area of outstanding biodiversity value.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The proposal has the potential to contribute the KTPs “Infection of native plants by *Phytophthora cinnamomi*” and “Invasion of native plant communities by exotic perennial grasses”.

Conclusion

On consideration of the factors above, the proposal is unlikely to have a significant impact on Spotted-tailed Quoll or Brush-tailed Phascogale.

Microbats

Eastern False Pipistrelle, Eastern Bentwing-bat, Greater Broad-nosed Bat and Yellow-bellied Sheathtail-bat were assessed as a group, due to similar foraging and/or roosting habitat requirements. They generally roosts in eucalypt hollows or under loose bark on trees. They forage for flying insects above or just below the tree canopy, or along rivers or creeks (OEH 2019).

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

The proposal is considered unlikely to adversely affect the life cycle of the assessed microbat species. The proposal will retain all mature trees, including HBTs, which provide potential foraging and roosting habitat for these species. Pitkins Swamp Creek riparian zone and its tributaries will not be affected by the Proposed Development. The proposal will not impact any potential breeding populations. These species are highly mobile, and it is unlikely the proposal will place any local populations at risk of extinction.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

N/A

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

N/A

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

The proposal will retain all mature trees, including HBTs, which provide potential foraging and roosting habitat for these species. Pitkins Swamp Creek riparian zone and its tributaries will not be affected by the Proposed Development. This proposal will not impact any potential breeding populations. The foraging opportunities for this species would extend well beyond the study area: similar or better-quality forested habitat is present to the south and north of the subject site. The study area is already situated in a highly fragmented ecosystem, and this proposal will not further fragment this ecosystem. These species are highly mobile, and the foraging opportunities extends well outside the study area in areas where native vegetation is retained. Therefore, the exotic grassland habitat to be removed is likely to be of low importance to the long-term survival of these species in the locality.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

No declared area of outstanding biodiversity value is present near the proposed subject site.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The proposal has the potential to contribute the KTPs “Infection of native plants by *Phytophthora cinnamomi*” and “Invasion of native plant communities by exotic perennial grasses”.

Conclusion

After considering the above, it has been determined that the proposal is unlikely to significantly affect the microbat species Eastern False Pipistrelle, Eastern Bentwing-bat, Greater Broad-nosed Bat or Yellow-bellied Sheathtail-bat.

Appendix C EPBC Act Assessment of significance

EPBC Act - Significant Impact Criteria on Matters of National Environmental Significance

The EPBC Act Administrative Guidelines on Significance set out 'Significant Impact Criteria' that are to be used to assist in determining whether a proposed action is likely to have a significant impact on matters of national environmental significance (MNES). MNES listed under the EPBC Act include:

1. Listed threatened species and ecological communities
2. Listed migratory species
3. Wetlands of International Importance
4. The Commonwealth marine environment
5. World Heritage properties
6. National Heritage places
7. Nuclear actions
8. Great Barrier Reef.

Specific 'Significant Impact Criteria' are provided for each MNES except for threatened species and ecological communities in which case separate criteria are provided for species listed as endangered and vulnerable under the EPBC Act.

The relevant Significant Impact Criteria have been applied to one Endangered species to determine the significance of impact of the proposal as follows:

- Spotted-tailed Quoll (*Dasyurus maculatus*) - Endangered

Matters to be addressed	Impact (Commonwealth legislation)
(a) any environmental impact on a World Heritage Property;	N/A. The proposed action does not impact on a World Heritage Property.
(b) any environmental impact on Wetlands of International Importance;	N/A. The proposed action will not affect any part of a Ramsar wetland.
(c) any impact on Commonwealth Listed Critically Endangered or Endangered Species or Communities	The Study Area provides potential foraging habitat for the Endangered species Spotted-tailed Quoll (*Dasyurus maculatus*) *1. lead to a long-term decrease in the size of a population of a species,* The proposed action will see some limited loss of exotic grassland vegetation within the subject site. The study area is located within a highly fragmented ecosystem. This is a highly mobile species and the foraging habitat proposed for removal is a small portion of what is locally available and is not favoured as this species prefers forested environments with high prey densities. No foraging or breeding habitat for this species will be significantly affected, and the proposed actions are unlikely to lead to a long term decrease in population size. Therefore, this loss of habitat is considered unlikely to be significant.

Matters to be addressed	Impact (Commonwealth legislation)
	2. reduce the area of occupancy of an important population The proposed action will see some limited loss of exotic grassland vegetation within the subject site. Given there is larger patches on intact forested vegetation within the study area and locality, this loss is considered unlikely to be significant. Given that the proposed actions will only result in the modification of a small area of potential low-quality foraging habitat, the area of occupancy reduction for this mobile species is negligible. *3. fragment an existing population into two or more populations* The proposal will not further fragment any areas of existing habitat in the locality. This species is considered as highly mobile species, and the proposed modifications within the study area will present no behavioral or physical barriers to the movement of this species across or over the locality. The proposal therefore has no capacity to fragment an existing population. *4. adversely affect habitat critical to the survival of a species* No habitat within the study area is considered to be critical to the survival of this species, given its ecology and the extent of remaining habitat within the range of the population of this species. It is unlikely that the proposed actions will have a substantial indirect impact on habitat within the broader locality. *e. disrupt the breeding cycle of an important population* The proposed actions will not disrupt or remove any potential breeding habitat of this species within the study area. No barrier to migration will be created for this species, therefore the proposal is unlikely to disrupt the breeding cycle of this species. *f. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline* The proposed action would not create an impact to the extent that this species is likely to decline, as it will affect only a relatively small amount (<0.1%) of marginal habitat within the relatively large seasonal ranges of this species. The proposal will only result in minor loss of habitat in the study area, and extensive potential habitat will remain available within the locality. *g. result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat* The proposed action is not likely to result in any relevant invasive species becoming established. Foxes, wild dogs and probably feral cats very likely already occur in the locality, and the proposed action is unlikely to increase local abundance of this species. The proposal is unlikely to introduce any new invasive species to the locality, where a high proportion of exotic plant species already occur. *h. introduce disease that may cause the species to decline* The proposed action is not likely to introduce any diseases that will affect this species. *j. interferes substantially with the recovery of the species.* The proposed actions will only affect a minute amount of the potential ranges of this species, no barriers will be created within the study area. Therefore no

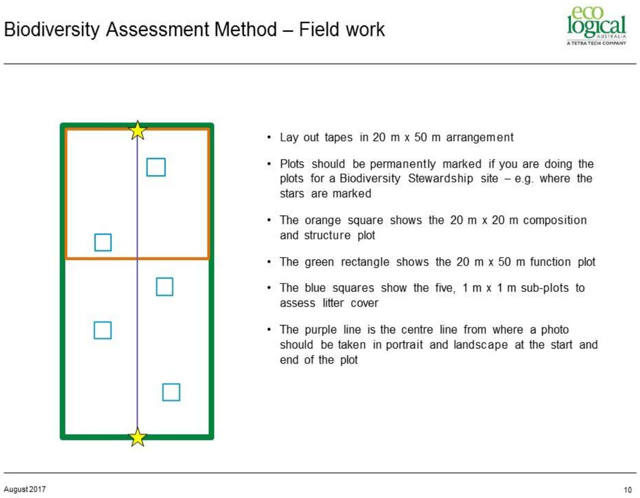
Matters to be addressed	Impact (Commonwealth legislation)
	connectivity will be lost with the rest of the habitat within the study area and the locality, and the recovery of this species will not be substantially impacted. **Conclusion**: Referral not required.
(d) any impact on Commonwealth Listed vulnerable Species;	The habitat present within the subject site is insufficient to meet the needs for any Commonwealth-listed vulnerable species, and is considered to provide only short-term opportunistic foraging opportunities, with all mature trees to be retained (including HBTs). In light of the habitat present, no Commonwealth-listed vulnerable species are likely to breed in the study area and it is considered unlikely that the proposal will result in any significant impact on any of these species.
(e) any environmental impact on Commonwealth Listed Migratory Species	The study area provides potential foraging habitat for certain migratory bird species. However, the habitat present within the subject site is insufficient to meet these species needs for more than short-term opportunistic foraging. In light of the habitat present, migratory bird species are unlikely to breed in the study area and it is considered unlikely that the proposal will result in any significant impact on any migratory bird species.
(f) does any part of the Proposal involve a Nuclear Action;	N/A. The proposal does not involve a Nuclear Action.
(g) any environmental impact on a Commonwealth Marine Area;	N/A. The proposed action will not impact on a Commonwealth Marine Area.
(h) In addition, any direct or indirect impact on Commonwealth lands	N/A. The proposed action will not directly or indirectly impact on Commonwealth land.

Appendix D BAM plot data

Eco Logical Australia – BAM Plot Data Sheet

Plot descriptors

Plot number / name	T01
Project number	11475
Date (DD/MM/YY)	25/02/2019
Recorder(s)	Liz Brown, Claire Lock
Zone (In Collector, 56, 55)	56
Easting (Unless recorded in Collector)	408128
Northing (Unless recorded in Collector)	6786621
Plot orientation	130'SE
Slope (degrees and direction)	1
Photo numbers - portrait and landscape from each end (Unless recorded in Collector)	1,2



Vegetation Zone Identification

Plant Community Type (PCT) - Refer to PCT database	N/A
PCT Number	N/A
Large Tree Benchmark	N/A
Ancillary Code / Condition Description	Exotic grassland (heavily grazed)
Vegetation Zone Identification	Exotic grassland
Condition (e.g. Low, Moderate, Good, Degraded, DNG etc.)	Degraded
Habitat Features (e.g. caves, rock faces, bridges/culverts)	Creek line adjacent (Pitkins Swamp Creek)
General notes	Grazed, cattle access, drought affected. Willow infested
Fauna species	N/A

Plot statistics **Greyed out fields are autopopulated**

Growth form groups	Total number of species	Total Cover
Tree (TG)	0	0.0
Forb (FG)	0	0.0
Shrub (SG)	0	0.0
Grass & grasslike (GG)	2	0.2
Other (OG)	1	0.1
Fern (EG)	0	0.0
High Threat Weeds	2	35.1

Litter sub plots		5 m	15 m	25 m	35 m	45 m
Litter cover %	86.2	90	65	97	99	80
Bare ground cover % (OPTIONAL)	12.8	5	35	3	1	20
Cryptogam cover % (OPTIONAL)	0	0	0	0	0	0
Rock cover % (OPTIONAL)	0	0	0	0	0	0

Stem size classes (DBHOB)	
5-9 cm	
10-19 cm	
20-29 cm	
30-49 cm	
50-79 cm	
80 cm +	
Number of large trees	0

Other Integrity Attributes		<100 mm	100-200mm	>200mm
Number of trees with hollows	0			
Regeneration (stems <5 cm)	0			
Total length fallen logs >10 cm width (m)	0			

Physiography (Unless recorded in Collector)

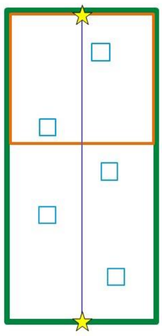
Morphological Type / Landform Element (detailed)	Slope - unspecified - Hillslope
Landform Pattern	
Microrelief	
Lithoogy	
Soil texture	Clay loam
Soil colour (Maunsell soil colour chart)	Light grey - brown

Eco Logical Australia – BAM Plot Data Sheet

Plot descriptors

Plot number / name	T02
Project number	11475
Date (DD/MM/YY)	25/02/2019
Recorder(s)	Liz Brown, Claire Lock
Zone (In Collector, 56, 55)	56
Easting (Unless recorded in Collector)	407805
Northing (Unless recorded in Collector)	6786628
Plot orientation	20'NE
Slope (degrees and direction)	3
Photo numbers - portrait and landscape from each end (Unless recorded in Collector)	1,2

Biodiversity Assessment Method – Field work



- Lay out tapes in 20 m x 50 m arrangement
- Plots should be permanently marked if you are doing the plots for a Biodiversity Stewardship site – e.g. where the stars are marked
- The orange square shows the 20 m x 20 m composition and structure plot
- The green rectangle shows the 20 m x 50 m function plot
- The blue squares show the five, 1 m x 1 m sub-plots to assess litter cover
- The purple line is the centre line from where a photo should be taken in portrait and landscape at the start and end of the plot

August 2017 10

Vegetation Zone Identification

Plant Community Type (PCT) - Refer to PCT database	N/A
PCT Number	N/A
Large Tree Benchmark	N/A
Ancillary Code / Condition Description	Exotic grassland (Scattered remnant trees)
Vegetation Zone Identification	Exotic Grassland
Condition (e.g. Low, Moderate, Good, Degraded, DNG etc.)	Degraded
Habitat Features (e.g. caves, rock faces, bridges/culverts)	Dry dam to east, 2 x HBTs
General notes	Heavily grazed, drought affected, burning evidence.
Fauna species	Fox sighted

Plot statistics **Greyed out fields are autopopulated**

Growth form groups	Total number of species	Total Cover				
Tree (TG)	1	5.0				
Forb (FG)	6	0.7				
Shrub (SG)	0	0.0				
Grass & grasslike (GG)	0	0.0				
Other (OG)	1	0.1				
Fern (EG)	0	0.0				
High Threat Weeds	2	50.1				
Litter sub plots		**5 m**	**15 m**	**25 m**	**35 m**	**45 m**
Litter cover %	87.8	95	80	90	79	95
Bare ground cover % (OPTIONAL)	12.2	5	20	10	21	5
Cryptogam cover % (OPTIONAL)	0	0	0	0	0	0
Rock cover % (OPTIONAL)	0	0	0	0	0	0
Stem size classes (DBHOB)						
5-9 cm						
10-19 cm						
20-29 cm						
30-49 cm						
50-79 cm						
80 cm +	1					
Number of large trees						
Other Integrity Attributes		**<100 mm**	**100-200mm**	**>200mm**		
Number of trees with hollows	2			2		
Regeneration (stems <5 cm)	0					
Total length fallen logs >10 cm width (m)	15					

Physiography (Unless recorded in Collector)

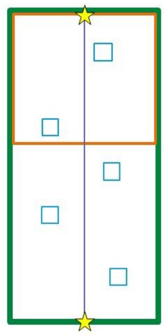
Morphological Type / Landform Element (detailed)	
Landform Pattern	
Microrelief	
Lithoogy	Igneous - Granite
Soil texture	Clay loam
Soil colour (Maunsell soil colour chart)	Medium to light brown

Eco Logical Australia – BAM Plot Data Sheet

Plot descriptors

Plot number / name	T03
Project number	11475
Date (DD/MM/YY)	25/02/2019
Recorder(s)	Liz Brown, Claire Lock
Zone (In Collector, 56, 55)	56
Easting (Unless recorded in Collector)	407581
Northing (Unless recorded in Collector)	6786768
Plot orientation	40'NE
Slope (degrees and direction)	4
Photo numbers - portrait and landscape from each end (Unless recorded in Collector)	1,2

Biodiversity Assessment Method – Field work



- Lay out tapes in 20 m x 50 m arrangement
- Plots should be permanently marked if you are doing the plots for a Biodiversity Stewardship site – e.g. where the stars are marked
- The orange square shows the 20 m x 20 m composition and structure plot
- The green rectangle shows the 20 m x 50 m function plot
- The blue squares show the five, 1 m x 1 m sub-plots to assess litter cover
- The purple line is the centre line from where a photo should be taken in portrait and landscape at the start and end of the plot

August 2017 10

Vegetation Zone Identification

Plant Community Type (PCT) - Refer to PCT database	N/A
PCT Number	N/A
Large Tree Benchmark	N/A
Ancillary Code / Condition Description	Exotic grassland (Scattered remnant trees)
Vegetation Zone Identification	Exotic grassland
Condition (e.g. Low, Moderate, Good, Degraded, DNG etc.)	Degraded
Habitat Features (e.g. caves, rock faces, bridges/culverts)	Dry dam to east, 2 x HBTs
General notes	Heavily grazed, drought affected
Fauna species	N/A

Plot statistics **Greyed out fields are autopopulated**

Growth form groups	Total number of species	Total Cover				
Tree (TG)	0	0.0				
Forb (FG)	3	0.4				
Shrub (SG)	0	0.0				
Grass & grasslike (GG)	0	0.0				
Other (OG)	2	0.2				
Fern (EG)	0	0.0				
High Threat Weeds	1	40.0				
Litter sub plots		**5 m**	**15 m**	**25 m**	**35 m**	**45 m**
Litter cover %	97.8	99	98	99	95	98
Bare ground cover % (OPTIONAL)	2.2	1	2	1	5	2
Cryptogam cover % (OPTIONAL)	0	0	0	0	0	0
Rock cover % (OPTIONAL)	0	0	0	0	0	0
Stem size classes (DBHOB)						
5-9 cm						
10-19 cm						
20-29 cm						
30-49 cm						
50-79 cm						
80 cm +						
Number of large trees	0					
Other Integrity Attributes		**<100 mm**	**100-200mm**	**>200mm**		
Number of trees with hollows	0					
Regeneration (stems <5 cm)	0					
Total length fallen logs >10 cm width (m)	0					

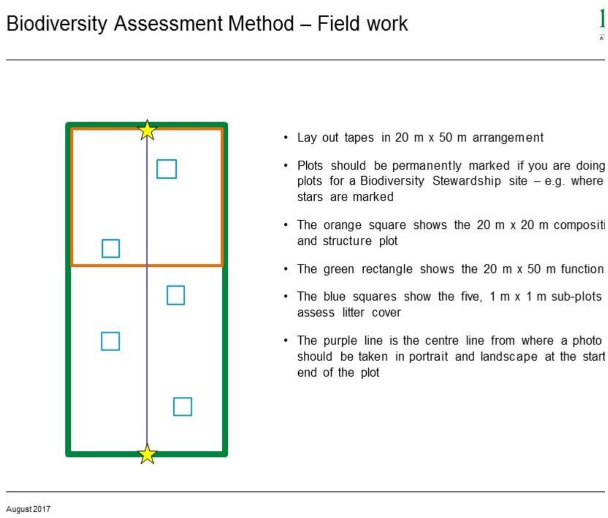
Physiography (Unless recorded in Collector)

Morphological Type / Landform Element (detailed)	
Landform Pattern	
Microrelief	
Lithoogy	Igneous - Granite
Soil texture	Clay loam
Soil colour (Maunsell soil colour chart)	Medium brown

Eco Logical Australia – BAM Plot Data Sheet

Plot descriptors

Plot number / name	T04
Project number	11475
Date (DD/MM/YY)	25/02/2019
Recorder(s)	Liz Brown, Claire Lock
Zone (In Collector, 56, 55)	56
Easting (Unless recorded in Collector)	407304
Northing (Unless recorded in Collector)	6787129
Plot orientation	102
Slope (degrees and direction)	1
Photo numbers - portrait and landscape from each end (Unless recorded in Collector)	1,2



Vegetation Zone Identification

Plant Community Type (PCT) - Refer to PCT database	N/A
PCT Number	N/A
Large Tree Benchmark	N/A
Ancillary Code / Condition Description	Exotic Riparian / Drainage
Vegetation Zone Identification	Exotic grassland
Condition (e.g. Low, Moderate, Good, Degraded, DNG etc.)	Degraded
Habitat Features (e.g. caves, rock faces, bridges/culverts)	Creek line adjacent (Pitkins Swamp Creek)
General notes	Weed infested, grazed, native tree/shrubs absent, eroded
Fauna species	N/A

Plot statistics **Greyed out fields are autopopulated**

Growth form groups	**Total number of species**	**Total Cover**				
Tree (TG)	0	0.0				
Forb (FG)	3	0.3				
Shrub (SG)	1	8.0				
Grass & grasslike (GG)	2	0.3				
Other (OG)	0	0.0				
Fern (EG)	0	0.0				
High Threat Weeds	3	40.1				
Litter sub plots		**5 m**	**15 m**	**25 m**	**35 m**	**45 m**
Litter cover %	92	100	100	100	95	65
Bare ground cover % (OPTIONAL)	7.8	0	0	0	4	35
Cryptogam cover % (OPTIONAL)	0	0	0	0	0	0
Rock cover % (OPTIONAL)	0	0	0	0	0	0
Stem size classes (DBHOB)						
5-9 cm						
10-19 cm						
20-29 cm						
30-49 cm						
50-79 cm						
80 cm +						
Number of large trees	0					
Other Integrity Attributes		**<100 mm**	**100-200mm**	**>200mm**		
Number of trees with hollows	0					
Regeneration (stems <5 cm)	0					
Total length fallen logs >10 cm width (m)	0					

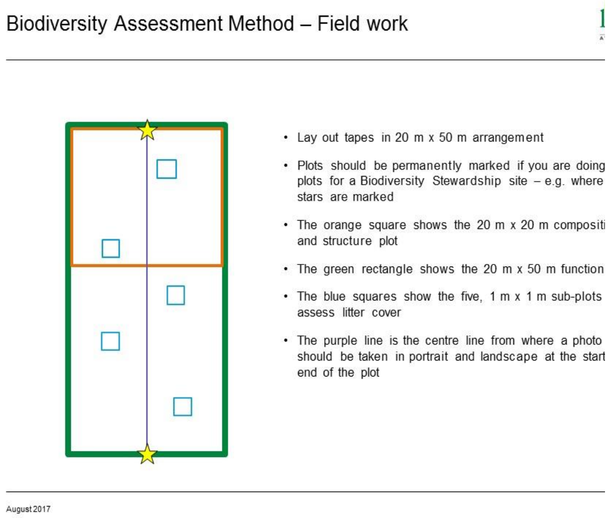
Physiography (Unless recorded in Collector)

Morphological Type / Landform Element (detailed)	
Landform Pattern	
Microrelief	
Lithoogy	
Soil texture	Clay
Soil colour (Maunsell soil colour chart)	Brown - grey

Eco Logical Australia – BAM Plot Data Sheet

Plot descriptors

Plot number / name	T05
Project number	11475
Date (DD/MM/YY)	25/02/2019
Recorder(s)	Liz Brown, Claire Lock
Zone (In Collector, 56, 55)	56
Easting (Unless recorded in Collector)	407085
Northing (Unless recorded in Collector)	6785146
Plot orientation	301'NW
Slope (degrees and direction)	0
Photo numbers - portrait and landscape from each end (Unless recorded in Collector)	1,2



Vegetation Zone Identification

Plant Community Type (PCT) - Refer to PCT database	N/A
PCT Number	N/A
Large Tree Benchmark	N/A
Ancillary Code / Condition Description	Exotic grassland
Vegetation Zone Identification	Exotic grassland
Condition (e.g. Low, Moderate, Good, Degraded, DNG etc.)	Degraded
Habitat Features (e.g. caves, rock faces, bridges/culverts)	Dry dam adjacent
General notes	Weedy, grazed, *E. curvula slashed. Couch and Kikuyu
Fauna species	N/A

Plot statistics **Greyed out fields are autopopulated**

Growth form groups	Total number of species	Total Cover				
Tree (TG)	0	0.0				
Forb (FG)	0	0.0				
Shrub (SG)	0	0.0				
Grass & grasslike (GG)	0	0.0				
Other (OG)	0	0.0				
Fern (EG)	0	0.0				
High Threat Weeds	2	92.0				
Litter sub plots		**5 m**	**15 m**	**25 m**	**35 m**	**45 m**
Litter cover %	99.6	100	100	100	99	99
Bare ground cover % (OPTIONAL)	0.4	0	0	0	1	1
Cryptogam cover % (OPTIONAL)	0	0	0	0	0	0
Rock cover % (OPTIONAL)	0	0	0	0	0	0
Stem size classes (DBHOB)						
5-9 cm						
10-19 cm						
20-29 cm						
30-49 cm						
50-79 cm						
80 cm +						
Number of large trees	0					
Other Integrity Attributes		**<100 mm**	**100-200mm**	**>200mm**		
Number of trees with hollows	0					
Regeneration (stems <5 cm)	0					
Total length fallen logs >10 cm width (m)	0					

Physiography (Unless recorded in Collector)

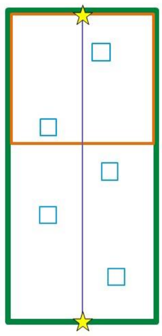
Morphological Type / Landform Element (detailed)	
Landform Pattern	
Microrelief	
Lithoogy	Igneous - Granite
Soil texture	Clay loam
Soil colour (Maunsell soil colour chart)	Grey-brown

Eco Logical Australia – BAM Plot Data Sheet

Plot descriptors

Plot number / name	T06
Project number	11475
Date (DD/MM/YY)	25/02/2019
Recorder(s)	Liz Brown, Claire Lock
Zone (In Collector, 56, 55)	56
Easting (Unless recorded in Collector)	408414
Northing (Unless recorded in Collector)	6786417
Plot orientation	121'SE
Slope (degrees and direction)	0
Photo numbers - portrait and landscape from each end (Unless recorded in Collector)	1,2

Biodiversity Assessment Method – Field work



- Lay out tapes in 20 m x 50 m arrangement
- Plots should be permanently marked if you are doing the plots for a Biodiversity Stewardship site – e.g. where the stars are marked
- The orange square shows the 20 m x 20 m composition and structure plot
- The green rectangle shows the 20 m x 50 m function plot
- The blue squares show the five, 1 m x 1 m sub-plots to assess litter cover
- The purple line is the centre line from where a photo should be taken in portrait and landscape at the start and end of the plot

August 2017 10

Vegetation Zone Identification

Plant Community Type (PCT) - Refer to PCT database	N/A
PCT Number	N/A
Large Tree Benchmark	N/A
Ancillary Code / Condition Description	Exotic Riparian / Drainage
Vegetation Zone Identification	Exotic grassland
Condition (e.g. Low, Moderate, Good, Degraded, DNG etc.)	Degraded
Habitat Features (e.g. caves, rock faces, bridges/culverts)	Dry creek line adjacent (Pitkins Swamp Creek)
General notes	Weedy, eroded, cattle access, sparse Willow cover
Fauna species	Litoria fallax abundant in Typha sp.

Plot statistics **Greyed out fields are autopopulated**

Growth form groups	Total number of species	Total Cover
Tree (TG)	0	0.0
Forb (FG)	6	6.4
Shrub (SG)	1	10.0
Grass & grasslike (GG)	8	44.2
Other (OG)	0	0.0
Fern (EG)	1	1.0
High Threat Weeds	7	39.7

Litter sub plots		5 m	15 m	25 m	35 m	45 m
Litter cover %	80.8	30	85	99	95	95
Bare ground cover % (OPTIONAL)	19.2	70	15	1	5	5
Cryptogam cover % (OPTIONAL)	0	0	0	0	0	0
Rock cover % (OPTIONAL)	0	0	0	0	0	0

Stem size classes (DBHOB)	
5-9 cm	
10-19 cm	
20-29 cm	
30-49 cm	
50-79 cm	
80 cm +	
Number of large trees	0

Other Integrity Attributes		<100 mm	100-200mm	>200mm
Number of trees with hollows	0			
Regeneration (stems <5 cm)	0			
Total length fallen logs >10 cm width (m)	5			

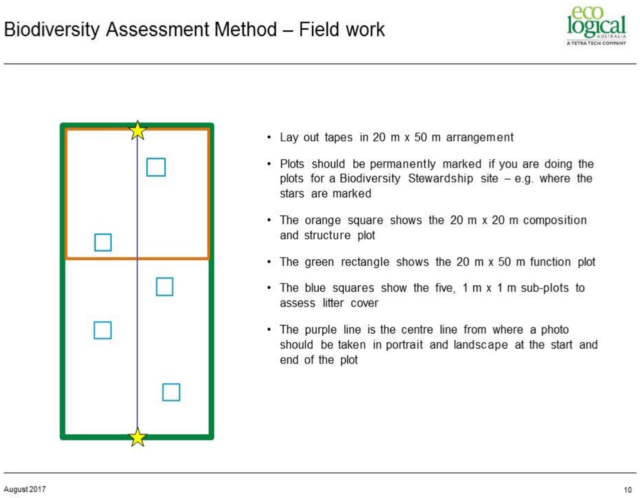
Physiography (Unless recorded in Collector)

Morphological Type / Landform Element (detailed)	
Landform Pattern	
Microrelief	
Lithoogy	Igneous - Basalt
Soil texture	Clay
Soil colour (Maunsell soil colour chart)	Brown - grey

Eco Logical Australia – BAM Plot Data Sheet

Plot descriptors

Plot number / name	T07
Project number	11475
Date (DD/MM/YY)	26/02/2019
Recorder(s)	Liz Brown, Claire Lock
Zone (In Collector, 56, 55)	56
Easting (Unless recorded in Collector)	408073
Northing (Unless recorded in Collector)	6786443
Plot orientation	182'SW
Slope (degrees and direction)	3
Photo numbers - portrait and landscape from each end (Unless recorded in Collector)	1,2



Vegetation Zone Identification

Plant Community Type (PCT) - Refer to PCT database	N/A
PCT Number	N/A
Large Tree Benchmark	N/A
Ancillary Code / Condition Description	Planted revegetation (exotic grassland)
Vegetation Zone Identification	Exotic grassland
Condition (e.g. Low, Moderate, Good, Degraded, DNG etc.)	Degraded
Habitat Features (e.g. caves, rock faces, bridges/culverts)	
General notes	Non-endemic Acacia and Eucalyptus sp. *E. curvula
Fauna species	N/A

Plot statistics **Greyed out fields are autopopulated**

Growth form groups	Total number of species	Total Cover				
Tree (TG)	4	50.0				
Forb (FG)	2	0.2				
Shrub (SG)	2	25.0				
Grass & grasslike (GG)	0	0.0				
Other (OG)	0	0.0				
Fern (EG)	0	0.0				
High Threat Weeds	1	85.0				
Litter sub plots		**5 m**	**15 m**	**25 m**	**35 m**	**45 m**
Litter cover %	74	35	95	65	90	85
Bare ground cover % (OPTIONAL)	25.6	65	5	35	8	15
Cryptogam cover % (OPTIONAL)	0	0	0	0	0	0
Rock cover % (OPTIONAL)	0	0	0	0	0	0
Stem size classes (DBHOB)						
5-9 cm	1					
10-19 cm	1					
20-29 cm	1					
30-49 cm	0					
50-79 cm	0					
80 cm +	0					
Number of large trees	26					
Other Integrity Attributes		**<100 mm**	**100-200mm**	**>200mm**		
Number of trees with hollows	0					
Regeneration (stems <5 cm)	2					
Total length fallen logs >10 cm width (m)	0					

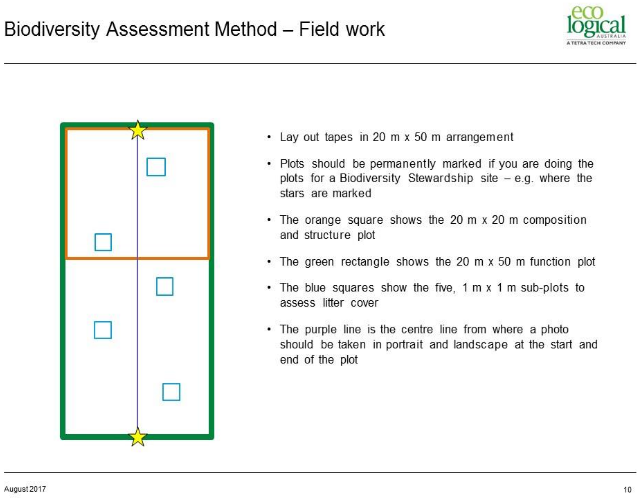
Physiography (Unless recorded in Collector)

Morphological Type / Landform Element (detailed)	Slope - unspecified - Hillslope
Landform Pattern	Low hill
Microrelief	
Lithoogy	Igneous - Granite
Soil texture	Clay loam
Soil colour (Maunsell soil colour chart)	Brown-grey

Eco Logical Australia – BAM Plot Data Sheet

Plot descriptors

Plot number / name	T08
Project number	11475
Date (DD/MM/YY)	26/02/2019
Recorder(s)	Liz Brown, Claire Lock
Zone (In Collector, 56, 55)	56
Easting (Unless recorded in Collector)	407240
Northing (Unless recorded in Collector)	6786799
Plot orientation	169'S
Slope (degrees and direction)	6
Photo numbers - portrait and landscape from each end (Unless recorded in Collector)	1,2



Vegetation Zone Identification

Plant Community Type (PCT) - Refer to PCT database	N/A
PCT Number	N/A
Large Tree Benchmark	N/A
Ancillary Code / Condition Description	Exotic grassland (Dam)
Vegetation Zone Identification	Exotic grassland
Condition (e.g. Low, Moderate, Good, Degraded, DNG etc.)	Degraded
Habitat Features (e.g. caves, rock faces, bridges/culverts)	Dry dam
General notes	Mainly exotics around dam. *E. curvula dominant, few Juncus
Fauna species	N/A

Plot statistics **Greyed out fields are autopopulated**

Growth form groups	Total number of species	Total Cover
Tree (TG)	0	0.0
Forb (FG)	4	0.5
Shrub (SG)	0	0.0
Grass & grasslike (GG)	0	0.0
Other (OG)	0	0.0
Fern (EG)	0	0.0
High Threat Weeds	2	60.3

Litter sub plots		5 m	15 m	25 m	35 m	45 m
Litter cover %	61.8	20	30	65	99	95
Bare ground cover % (OPTIONAL)	38.2	80	70	35	1	5
Cryptogam cover % (OPTIONAL)	0	0	0	0	0	0
Rock cover % (OPTIONAL)	0	0	0	0	0	0

Stem size classes (DBHOB)	
5-9 cm	0
10-19 cm	0
20-29 cm	0
30-49 cm	0
50-79 cm	0
80 cm +	0
Number of large trees	0

Other Integrity Attributes		<100 mm	100-200mm	>200mm
Number of trees with hollows	0			
Regeneration (stems <5 cm)	0			
Total length fallen logs >10 cm width (m)	0			

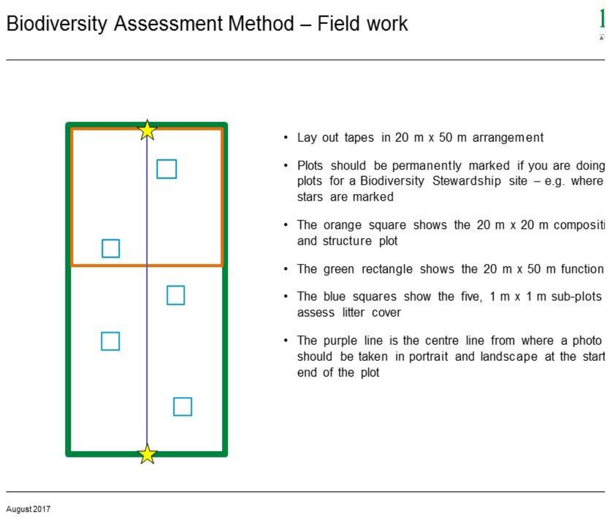
Physiography (Unless recorded in Collector)

Morphological Type / Landform Element (detailed)	Simple slope - Bank
Landform Pattern	
Microrelief	
Lithoogy	Igneous - Granite
Soil texture	Sandy loam
Soil colour (Maunsell soil colour chart)	Brown-grey around dam, yellow-brown in dam

Eco Logical Australia – BAM Plot Data Sheet

Plot descriptors

Plot number / name	T09
Project number	11475
Date (DD/MM/YY)	27/02/2019
Recorder(s)	Liz Brown, Claire Lock
Zone (In Collector, 56, 55)	56
Easting (Unless recorded in Collector)	407496
Northing (Unless recorded in Collector)	6786751
Plot orientation	162'S
Slope (degrees and direction)	20
Photo numbers - portrait and landscape from each end (Unless recorded in Collector)	1,2



Vegetation Zone Identification

Plant Community Type (PCT) - Refer to PCT database	Exotic grassland
PCT Number	N/A
Large Tree Benchmark	N/A
Ancillary Code / Condition Description	Exotic grassland (scattered remnant trees)
Vegetation Zone Identification	Exotic Grassland
Condition (e.g. Low, Moderate, Good, Degraded, DNG etc.)	Degraded
Habitat Features (e.g. caves, rock faces, bridges/culverts)	Dry dam to east, 2 x HBTs
General notes	*E. curvula paddock, burning evidence, heavily grazed
Fauna species	N/A

Plot statistics **Greyed out fields are autopopulated**

Growth form groups	Total number of species	Total Cover
Tree (TG)	0	0.0
Forb (FG)	2	0.2
Shrub (SG)	0	0.0
Grass & grasslike (GG)	0	0.0
Other (OG)	0	0.0
Fern (EG)	0	0.0
High Threat Weeds	1	60.0

Litter sub plots		5 m	15 m	25 m	35 m	45 m
Litter cover %	99.2	100	99	99	99	99
Bare ground cover % (OPTIONAL)	0.8	0	1	1	1	1
Cryptogam cover % (OPTIONAL)	0	0	0	0	0	0
Rock cover % (OPTIONAL)	0	0	0	0	0	0

Stem size classes (DBHOB)	
5-9 cm	0
10-19 cm	0
20-29 cm	0
30-49 cm	0
50-79 cm	0
80 cm +	0
Number of large trees	0

Other Integrity Attributes		<100 mm	100-200mm	>200mm
Number of trees with hollows	0			
Regeneration (stems <5 cm)	0			
Total length fallen logs >10 cm width (m)	0			

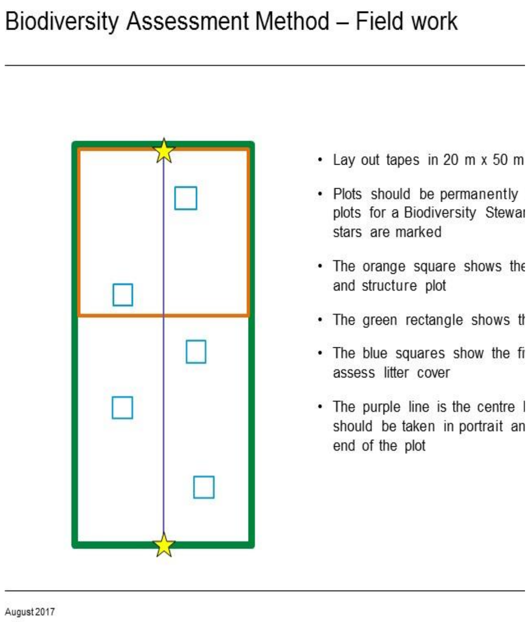
Physiography (Unless recorded in Collector)

Morphological Type / Landform Element (detailed)	Slope - unspecified - Hillslope
Landform Pattern	
Microrelief	
Lithoogy	Igneous - Granite
Soil texture	Clay loam
Soil colour (Maunsell soil colour chart)	Dark brown - grey

Eco Logical Australia – BAM Plot Data Sheet

Plot descriptors

Plot number / name	T10
Project number	11475
Date (DD/MM/YY)	27/02/2019
Recorder(s)	Liz Brown, Claire Lock
Zone (In Collector, 56, 55)	56
Easting (Unless recorded in Collector)	407081
Northing (Unless recorded in Collector)	6786057
Plot orientation	168'SE
Slope (degrees and direction)	4
Photo numbers - portrait and landscape from each end (Unless recorded in Collector)	1,2



Vegetation Zone Identification

Plant Community Type (PCT) - Refer to PCT database	Blakely's Red Gum – Yellow box grassy woodland of the New England Tableland Bioregion
PCT Number	510
Large Tree Benchmark	3 (50 threshold size)
Ancillary Code / Condition Description	PCT 510 (Scattered regeneration of trees/shrubs)
Vegetation Zone Identification	Derived native grassland (DNG)
Condition (e.g. Low, Moderate, Good, Degraded, DNG etc.)	Moderate
Habitat Features (e.g. caves, rock faces, bridges/culverts)	Scattered granite boulders of mixed sizes
General notes	*E. curvula (burnt) and Themeda triandra grassland
Fauna species	N/A

Plot statistics **Greyed out fields are autopopulated**

Growth form groups	Total number of species	Total Cover
Tree (TG)	1	2.0
Forb (FG)	11	1.2
Shrub (SG)	3	6.2
Grass & grasslike (GG)	8	30.4
Other (OG)	3	0.4
Fern (EG)	3	0.6
High Threat Weeds	2	10.5

Litter sub plots		5 m	15 m	25 m	35 m	45 m
Litter cover %	68	70	80	75	20	95
Bare ground cover % (OPTIONAL)	10	0	10	25	10	5
Cryptogam cover % (OPTIONAL)	0	0	0	0	0	0
Rock cover % (OPTIONAL)	22	30	10	0	70	0

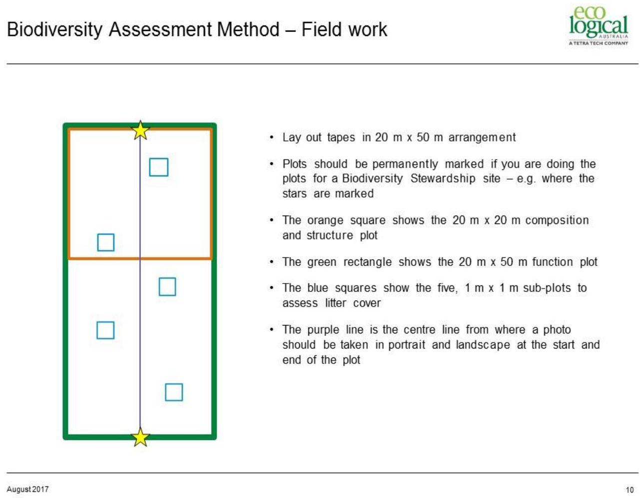
Stem size classes (DBHOB)	
5-9 cm	1
10-19 cm	0
20-29 cm	0
30-49 cm	0
50-79 cm	0
80 cm +	0
Number of large trees	1

Other Integrity Attributes		<100 mm	100-200mm	>200mm
Number of trees with hollows	0			
Regeneration (stems <5 cm)	0			
Total length fallen logs >10 cm width (m)	0			

Eco Logical Australia – BAM Plot Data Sheet

Plot descriptors

Plot number / name	T11
Project number	11475
Date (DD/MM/YY)	27/02/2019
Recorder(s)	Liz Brown, Claire Lock
Zone (In Collector, 56, 55)	56
Easting (Unless recorded in Collector)	407978
Northing (Unless recorded in Collector)	6785929
Plot orientation	355'S
Slope (degrees and direction)	0
Photo numbers - portrait and landscape from each end (Unless recorded in Collector)	1,2



Vegetation Zone Identification

Plant Community Type (PCT) - Refer to PCT database	N/A
PCT Number	N/A
Large Tree Benchmark	N/A
Ancillary Code / Condition Description	Planted revegetation (exotic grassland)
Vegetation Zone Identification	Exotic grassland
Condition (e.g. Low, Moderate, Good, Degraded, DNG etc.)	Degraded
Habitat Features (e.g. caves, rock faces, bridges/culverts)	N/A
General notes	Three rows Landcare reveg Eucalyptus, Acacia sp.
Fauna species	N/A

Plot statistics **Greyed out fields are autopopulated**

Growth form groups	**Total number of species**	**Total Cover**
Tree (TG)	2	6.0
Forb (FG)	2	0.4
Shrub (SG)	0	0.0
Grass & grasslike (GG)	4	10.4
Other (OG)	0	0.0
Fern (EG)	0	0.0
High Threat Weeds	3	60.7

Litter sub plots		**5 m**	**15 m**	**25 m**	**35 m**	**45 m**
Litter cover %	96.6	100	90	99	95	99
Bare ground cover % (OPTIONAL)	3.4	0	10	1	5	1
Cryptogam cover % (OPTIONAL)	0	0	0	0	0	0
Rock cover % (OPTIONAL)	0	0	0	0	0	0

Stem size classes (DBHOB)	
5-9 cm	0
10-19 cm	0
20-29 cm	0
30-49 cm	0
50-79 cm	0
80 cm +	0
Number of large trees	0

Other Integrity Attributes		**<100 mm**	**100-200mm**	**>200mm**
Number of trees with hollows	0			
Regeneration (stems <5 cm)	20			
Total length fallen logs >10 cm width (m)	0			

Physiography (Unless recorded in Collector)

Morphological Type / Landform Element (detailed)	Slope - unspecified - Hillslope
Landform Pattern	
Microrelief	
Lithoogy	Igneous - Granite
Soil texture	Clay loam
Soil colour (Maunsell soil colour chart)	Brown-grey

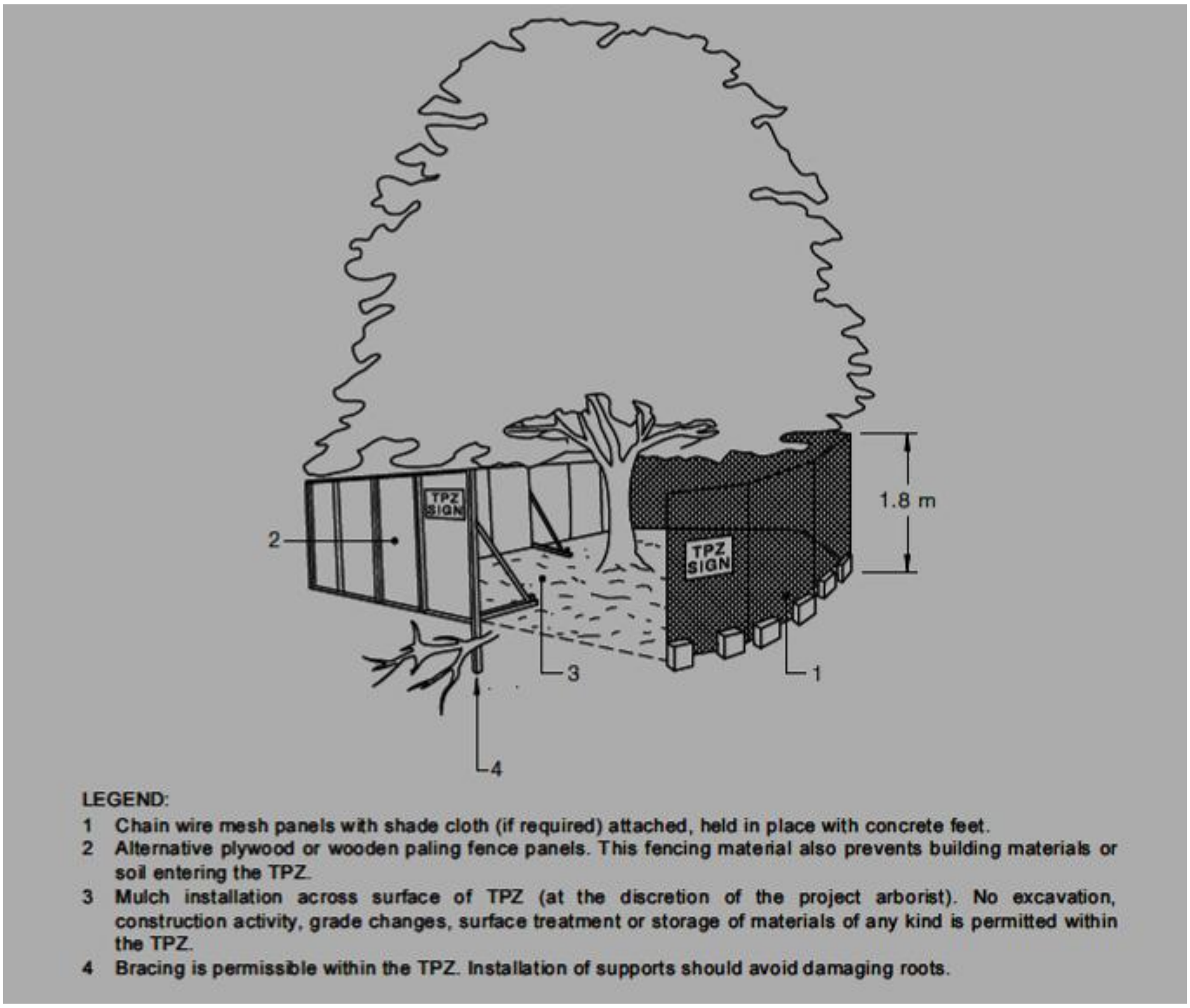
Appendix E Tree protection zones

Tree Protection Zones (TPZ) are the principal means of protecting trees on development sites, and constitute an area isolated from construction disturbance, allowing the tree to remain viable.

TPZs should be clearly delineated around each tree for retention, in line with Australian Standard AS 4970 – 2009 (Standards Australia 2009).

The TPZ is an area (above and below ground) to be isolated from construction disturbance. It is calculated as a distance from the trunk where it is potentially subject to damage by development (Standards Australia 2009). TPZ fencing should be erected before any machinery or materials are brought onto the site.

The Structural Root Zone (SRZ) is the area around the base of a tree required for the tree's stability in the ground. The woody root growth and soil cohesion in this area are necessary to hold the tree upright. The SRZ is nominally circular with the trunk at its centre and is expressed by its radius in metres. The SRZ considers a tree's structural stability only, not the root zone required for a tree's vigour and long-term viability, which is usually a much larger area (Standards Australia 2009).



Source: Australian Standard: Protection of trees on development sites, AS 4770-2009.

HEAD OFFICE
Suite 2, Level 3
668-672 Old Princes Highway
Sutherland NSW 2232
T 02 8536 8600
F 02 9542 5622

SYDNEY
Suite 1, Level 1
101 Sussex Street
Sydney NSW 2000
T 02 8536 8650
F 02 9542 5622

HUSKISSON
Unit 1, 51 Owen Street
Huskisson NSW 2540
T 02 4201 2264
F 02 9542 5622

CANBERRA
Level 2
11 London Circuit
Canberra ACT 2601
T 02 6103 0145
F 02 9542 5622

NEWCASTLE
Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
T 02 4910 0125
F 02 9542 5622

NAROOMA
5/20 Canty Street
Narooma NSW 2546
T 02 4302 1266
F 02 9542 5622

COFFS HARBOUR
35 Orlando Street
Coffs Harbour Jetty NSW 2450
T 02 6651 5484
F 02 6651 6890

ARMIDALE
92 Taylor Street
Armidale NSW 2350
T 02 8081 2685
F 02 9542 5622

MUDGEE
Unit 1, Level 1
79 Market Street
Mudgee NSW 2850
T 02 4302 1234
F 02 6372 9230

PERTH
Suite 1 & 2
49 Ord Street
West Perth WA 6005
T 08 9227 1070
F 02 9542 5622

WOLLONGONG
Suite 204, Level 2
62 Moore Street
Austinmer NSW 2515
T 02 4201 2200
F 02 9542 5622

GOSFORD
Suite 5, Baker One
1-5 Baker Street
Gosford NSW 2250
T 02 4302 1221
F 02 9542 5622

DARWIN
16/56 Marina Boulevard
Cullen Bay NT 0820
T 08 8989 5601
F 08 8941 1220

BRISBANE
Suite 1, Level 3
471 Adelaide Street
Brisbane QLD 4000
T 07 3503 7192
F 07 3854 0310

ADELAIDE
2, 70 Pirie Street
Adelaide SA 5000
T 08 8470 6650
F 02 9542 5622

1300 646 131
www.ecoaus.com.au

Appendix C : Heritage Assessment

Mr. Benjamin Hannig
Enerparc Australia Pty Ltd
223 Liverpool St
DARLINGHURST, NSW 2010

ECO LOGICAL AUSTRALIA PTY LTD
ABN 87 096 512 088
www.ecoaus.com.au

REF/Job No: 18ARM - 11475

29 October 2018

Dear Mr Hannig,

RE: Aboriginal Heritage Due Diligence Assessment – Tenterfield Solar Farm, Tenterfield NSW

Eco Logical Australia (ELA) has been engaged by Enerparc Australia to conduct an Aboriginal Heritage Due Diligence Assessment to support any approvals needed for the proposed Tenterfield Solar Farm in Tenterfield, NSW.

This assessment follows the due diligence Code of Practice as set out in the Office of Environment and Heritage's (OEH) *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (hereafter referred to as 'CoP') (DECCW 2010).

This due diligence process aims to determine whether Aboriginal objects will be harmed by the proposed works, as required under Part 6 of the NSW *National Parks and Wildlife Act 1974* (NSW). The CoP sets out the reasonable and practicable steps which individuals and organisations need to take in order to:

1. Identify whether or not Aboriginal objects are, or are likely to be, present in an area;
2. Determine whether or not their activities are likely to harm Aboriginal objects (if present); and
3. Determine whether an Aboriginal Heritage Impact Permit (AHIP) from the OEH or further assessment is required.

Study area location

The study area measures approximately 86 hectares in size and falls within the boundaries of Tenterfield Shire Council (TSC), Parish of Tenterfield, County of Clive (**Figure 1**). The study area comprises portions of Lot 85, 87, 89, and 90 of DP 751540.The zoning of the land comprises RU1 (Primary Production).

Legislative framework for due diligence

Aboriginal objects and places in NSW are afforded protection under the *National Parks and Wildlife Act 1974* (NSW) regardless of whether or not they are registered on the Aboriginal Heritage Information Management System (AHIMS) register. Strict penalties apply for harm to an Aboriginal object or place without a defence under the Act. Under Section 87 of the Act there are five defences to causing harm to an Aboriginal object:

- The harm was authorised under an AHIP;
- By exercising due diligence and be able to demonstrate this;
- The actions compiled with a code of practice as described in the *National Parks and Wildlife Regulation 2009*, for example, undertaking test excavation in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW*;

- It was a low-impact activity or omission under the regulation and where you don't know that an Aboriginal object is already present; and
- Was an exemption under Section 87A, for example emergency fire-fighting act or bush fire hazard reduction work within the meaning of the *Rural Fires Act 1997*.

If an AHIP application is required, the OEH necessitate that it is supported by an Aboriginal Cultural Heritage Assessment (ACHA) prepared in line with the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2010), and a copy of an approval for the development or infrastructure under Part 4 or Part 5 of the *Environmental Planning and Assessment Act 1979* (NSW).

Purpose and aim of the due diligence

The aims of this Aboriginal archaeological due diligence assessment are to:

- Undertake a search of the Aboriginal Heritage Information Management System (AHIMS) register maintained by the OEH to establish if there are any previously recorded Aboriginal objects or places within the study area;
- Undertake a search of the NSW State Heritage Inventory, the Australian Heritage Database, and the Tenterfield Local Environment Plan 2013 Schedule 5 (Environmental Heritage) in order to determine if there are any sites of Aboriginal significance or sensitivity located within the study area;
- Undertake a desktop review of relevant previous archaeological assessments to understand the local archaeological context and assist in predicting the likely occurrence of unrecorded archaeological sites or objects;
- Undertake a site inspection to identify any Aboriginal sites and areas of sensitive landforms; and
- Prepare a letter style Aboriginal due diligence assessment determining if known objects or additional unrecorded objects are present within the study area, as well indicate whether further assessment and/or an AHIP is required.

No assessment for historical archaeology has been undertaken as part of this assessment.

No consultation has been undertaken as part of this due diligence. The local Aboriginal Land Council and other stakeholder groups can provide a cultural assessment for the area.

This assessment has been prepared by Andrew Crisp (BA Honours [Archaeology] University of Sydney) with input from Daniel Claggett (MA [Maritime Archaeology] Flinders University of South Australia) and reviewed by Tyler Beebe, Senior Archaeologist with ELA (BA [Anthropology *cum laude*] Hamline University, MA [Cultural and Environmental Heritage] Australian National University).

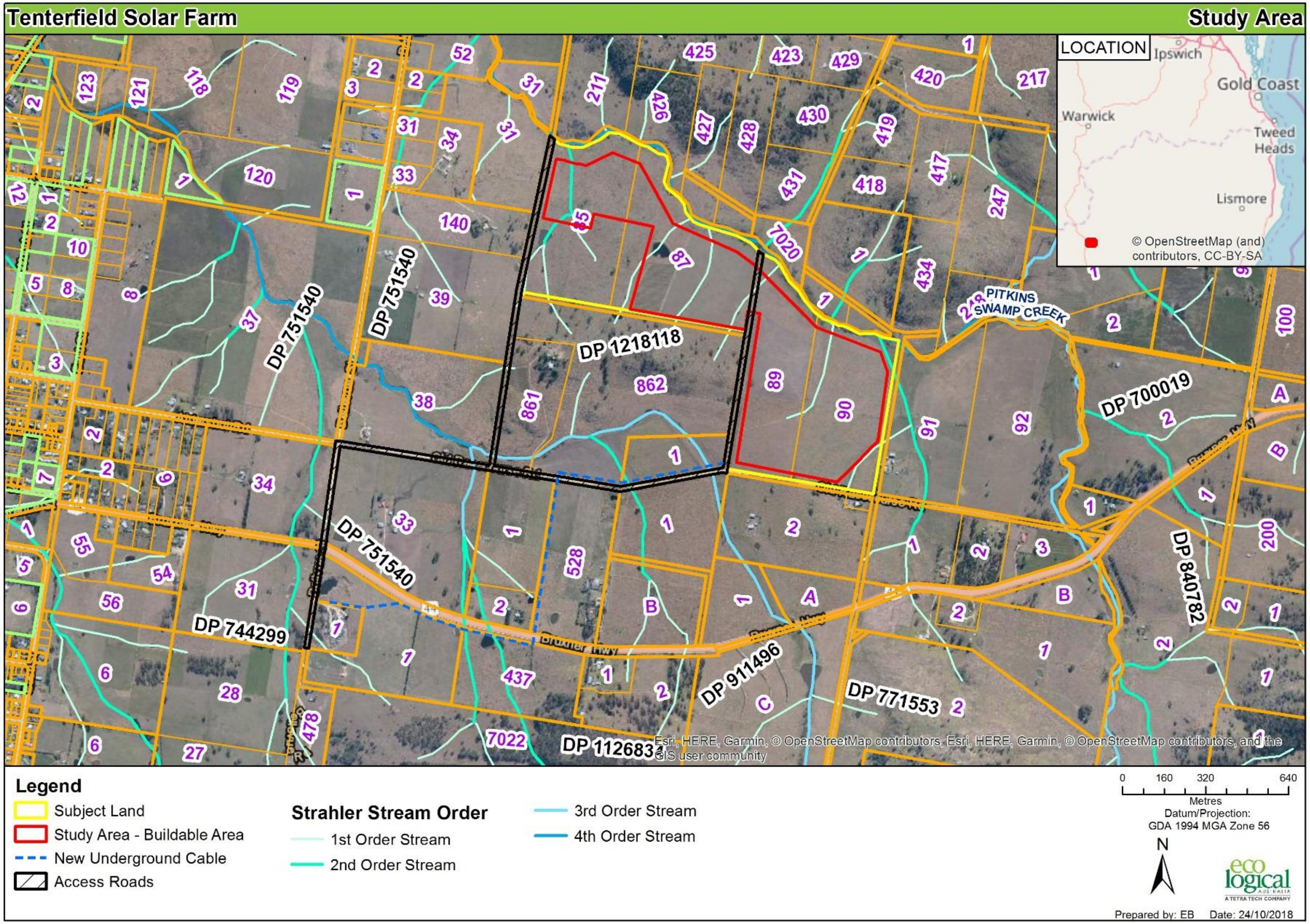


Figure 1: Study area location

Previously Recorded Aboriginal sites

Heritage Database Searches

Searches of the Australian Heritage Database, the State Heritage Inventory (SHI) and Tenterfield Local Environmental Plan (LEP) 2013 utilising the terms “Tenterfield, NSW”, and “Tenterfield Local Government Area, NSW” were conducted on 24 September 2018 in order to determine if any places of Aboriginal significance are located within proximity to the study area.

There are no places on the Australian Heritage Database or the LEP of Aboriginal heritage significance within the study area.

AHIMS Search

An extensive search of the AHIMS database was conducted on 4 October 2018 covering Datum: GDA Zone 56, Eastings: 397350 – 417350 (20 km), Northings: 6776856 **-** 6796856 (20 km) with no buffer, (**Attachment A**, Figure 2). A total of thirteen Aboriginal sites and zero Aboriginal Places were identified during this search. A breakdown of the Extensive AHIMS results are presented in **Table 1** below.

Table 1: Types of Aboriginal sites recorded within approximately 10 km of the study area

Site feature	Number of sites	Percentage of all sites
Artefact	7	53.86%
Potential Archaeological Deposit (PAD)	2	15.38%
Conflict	1	7.69%
Modified Tree (Carved or Scarred)	1	7.69%
Grinding Groove	1	7.69%
Art (Pigment or Engraved)	1	7.69%
Total number of sites	**13**	**100%**

There are no registered AHIMS sites located within the study area boundary.

Geology, soils, topography and hydrology

There are currently no soil/geology profiles that encompass the study area. Based on studies conducted within the vicinity of the study area it can be determined that the underlying geology of area is made up of Permian deposits of Sandy Flat Adamellite with deposits of Dundee Adamellite Porphyrite being located to the west. Both are igneous derived materials (granites) with the Dundee Adamellite containing more imbedded quartz than Sandy Flat Adamellite.

The soils in the study area are derived from the granite geology of the area. Most of these soils tend to have a high proportion of quarzitic sandy material. Soil depths are variable depending on the topography. Based on the geology and soil types located within the vicinity of the study area, it is likely that lithic raw material suitable for the creation of stone artefacts would have been available (Davies Heritage 2001).

There are two creeks that run to the north and south of the study area (Figure 3). To the north is Pitkins Swamp Creek, and to the south flows an unnamed stream. Both are third or fourth order creeks, which contain water year-round and are a permanent landscape feature. Permanent bodies of fresh water often serve as a focal point for Aboriginal occupation year-round, providing abundant fresh water, plant, and animal resources in the area.

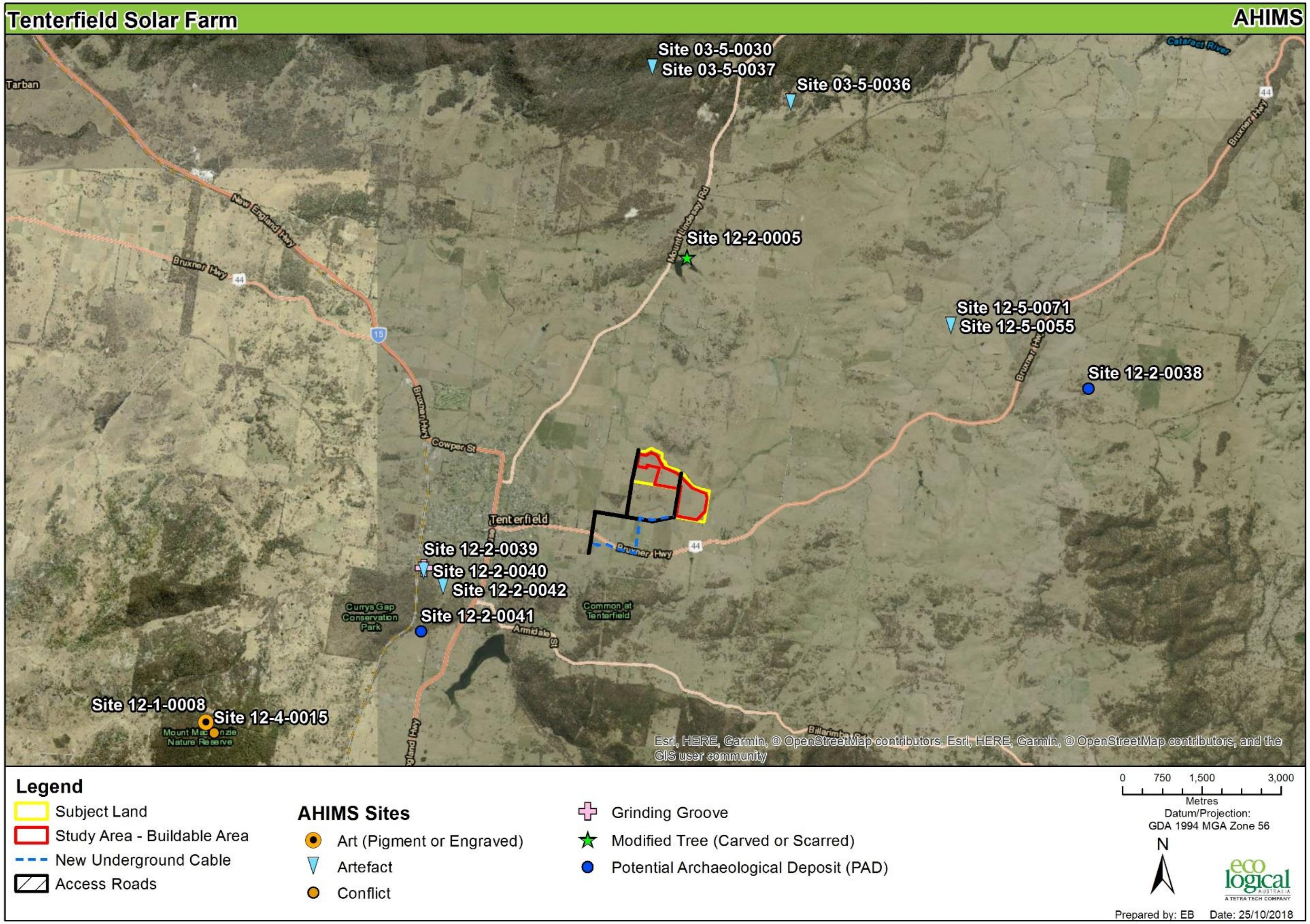


Figure 2: AHIMS sites in the vicinity of the study area

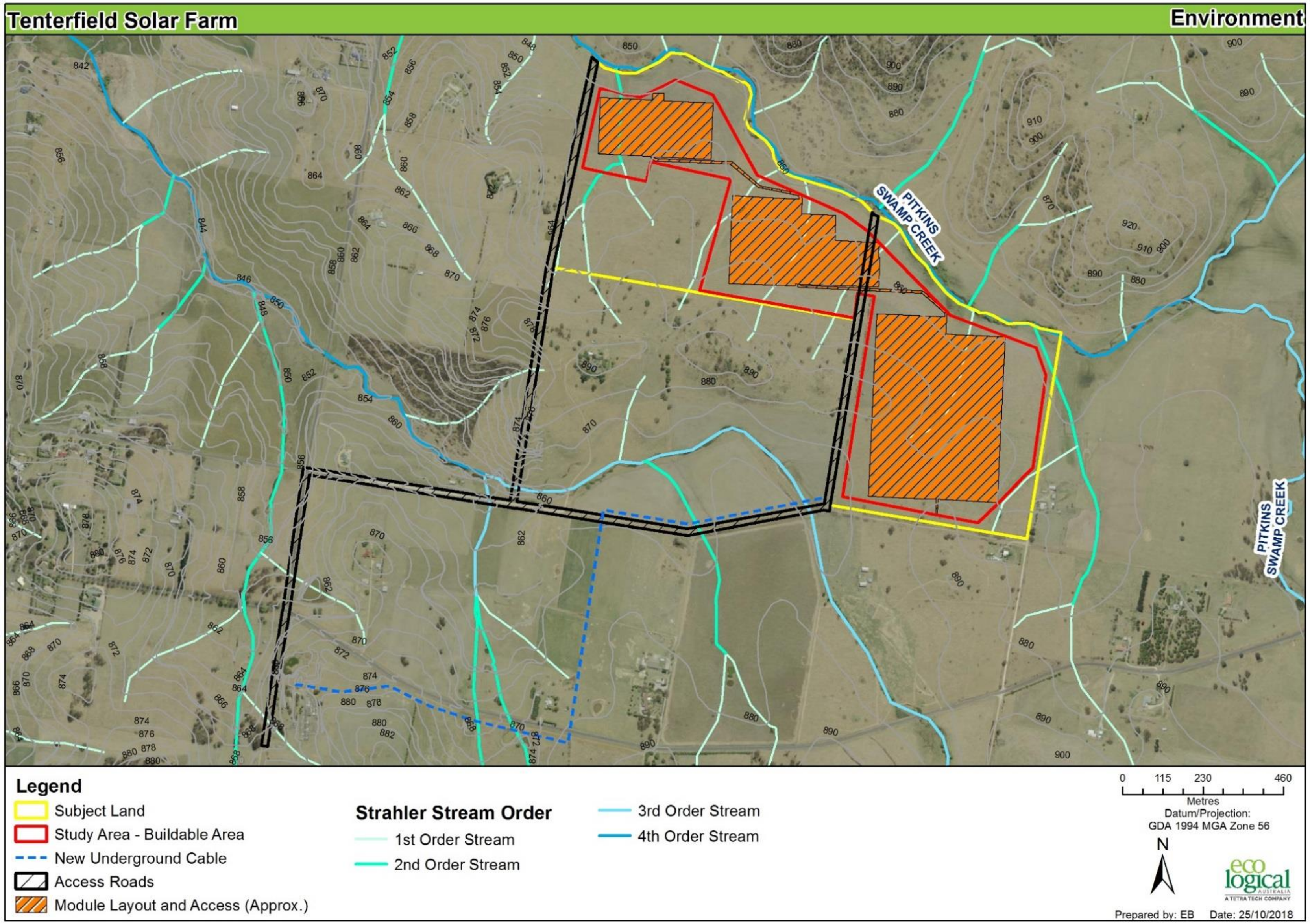


Figure 3: Hydrology of the site area

Previous Aboriginal Archaeological Studies

Local Archaeological Context

Due to the lack of archaeological research within the immediate vicinity of the study area, there are few previous studies to draw from. However, there have been multiple archaeological surveys/heritage assessments of the winder Tenterfield area conducted from which to extrapolate.

Studies conducted over the current study area

Byrne, D. 1983 *An Investigation of the Aboriginal Archaeological Record in the Tenterfield E.I.S. Area*. Unpublished Report to the Forestry Commission of New South Wales.

Byrne (1983) undertook an investigation of the Aboriginal archaeological record in Forestland State Forest (to the south of the current study area). A total of 19 sites were recorded during the survey. Byrne noted in the investigation that there is a tendency for artefacts recorded in the plateau areas of the forest to be most dense close to swamps.

Griffiths, J.P. 1995 *An Investigation of Aboriginal Sites and Relics of a Proposed Optic Fibre Cable Route from Deepwater to Tenterfield*. Unpublished report to Telstra Australia

Griffiths (1995) undertook a survey of a proposed optic fibre cable route between Deepwater and Tenterfield (south-west of the current study area). The survey found no new Aboriginal sites, relics or areas of potential.

Davies Heritage Consultants Pty Ltd. 2001. *Indigenous Cultural Heritage Assessment of Terrain to be Impacted by Road Works at McClifty's Study Area, Between Glen Innes and Tenterfield, Northern New South Wales.* Report prepared for NSW Roads and Traffic Authority.

Davies Heritage was engaged by the NSW Roads and Traffic Authority to conduct an Aboriginal Cultural Heritage Assessment (ACHA) of a 5.34 km section of terrain to be impacted by an upgrade of the New England Highway. Based on predictive modelling and prior archaeological research in the vicinity of the study area it was considered that the study area contained low to moderate archaeological potential. The main site types predicted to occur within the study area were stone artefact scatters, quarries and scarred trees.

Archaeological fieldwork was conducted on the 27th February 2001. Two scarred trees were identified during the survey, and it was concluded that there was potential for subsurface archaeological material to be present. However, the absence of any firm indications of subsurface materials being present led to the conclusion that further archaeological work was not necessary.

Australian Museum Business Services. 2013. *Tenterfield LGA Aboriginal Heritage Study.* Report prepared for Tenterfield Shire Council.

An Aboriginal Heritage Study of the Tenterfield LGA was undertaken by the Australian Museum Business Services in April 2013. The study involved consultation with local Aboriginal community so as to ensure that their views and opinions were included in the identification and recording of any objects or places of Aboriginal cultural or archaeological significance within the study area.

It was noted in the study that the Tenterfield Aboriginal community would prefer not to have detailed information about Aboriginal site locations included in a publicly available documents. It was therefore understood that not all heritage sites should be mapped or identified in detail, but that general areas important to the community, or where archaeological sites are present, should be indicated. The AMBS report (2013) indicated that there are areas of Aboriginal heritage sensitivity within the LGA that Council should be made aware of when considering applications for development and sensitivity mapping was developed illustrating these areas.

Communication between ELA Archaeologist Andrew Crisp and Tenterfield Shire Council Senior Planner Tamai Davidson occurred on Monday 22 October to discuss the heritage sensitivity mapping. Tamai Davidson confirmed that the mapping could not be released to ELA for review, however, from further discussion of the study area the only area of heritage sensitivity identified by Tenterfield Shire Council was “stream and gully lines”. These “stream and gully lines” were understood by ELA to represent similar predictive modelling to that outlined in the CoP which describes areas of sensitivity ‘within 200m of waters’ (DECCW 2010). A review of the available data confirms that no other heritage sites are in proximity to the development site.

Predictive Model

Based on the material evidence and range of archaeological sites across the region, it is possible that Aboriginal people have utilised the land and resources within the Tenterfield region. The predictive model outlined in **Table 2** below has been developed for the study area based on the AHIMS search results, landscape modelling, and regional and local Aboriginal archaeological context outlined above.

Table 2: Predictive model

Site Type	Description
Artefact (Open Camp Sites / Stone Artefact Scatters / Isolated Finds)	Open camp sites represent past Aboriginal subsistence and stone knapping activities, and include archaeological remains such as stone artefacts and hearths. This site type usually appears as surface scatters of stone artefacts in areas where vegetation is limited and ground surface visibility increases. Such scatters of artefacts are also often exposed by erosion, agricultural events such as ploughing, and the creation of informal, unsealed vehicle access tracks and walking paths. These types of sites are often located on dry, relatively flat land along or adjacent to rivers and creeks. Camp sites containing surface or subsurface deposit from repeated or continued occupation are more likely to occur on elevated ground near the most permanent, reliable water sources. Flat, open areas associated with creeks and their resource-rich surrounds would have offered ideal camping areas to the Aboriginal inhabitants of the local area. Isolated finds may represent a single item discard event or be the result of limited stone knapping activity. The presence of such isolated artefacts may indicate the presence of a more extensive, in situ buried archaeological deposit, or a larger deposit obscured by low ground visibility. Isolated artefacts are likely to be located on landforms associated with past Aboriginal activities, such as ridgelines that would have provided ease of movement through the area, and level areas with access to water, particularly creeks and rivers. Artefact scatters and isolated artefacts are common site types often found in association with fresh water, and/or food resource gathering areas. The close proximity of the study area to first through to fourth order tributaries of Tenterfield and Pitkins Swamp creeks indicates that previously unrecorded artefact scatters, or isolated artefacts have the potential to occur in the study area.
Potential Archaeological Deposit (PAD)	Potential Archaeological Deposits (or PADs) are areas where there is no surface expression of stone artefacts, but due to a landscape feature there is a strong likelihood that the area will contain buried deposits of stone artefacts. Landscape features which may feature in PADs include proximity to waterways, particularly terraces and flats near 3rd order streams and above, ridge lines and ridge tops and sand dune systems.

Site Type	Description
	The close proximity of the study area to first through to fourth order tributaries of Tenterfield and Pitkins Swamp creeks indicates that there is potential for archaeological deposits to exist within the study area.
Modified tree (scarred or carved trees)	Tree bark was utilised by Aboriginal people for various purposes, including the construction of shelters (huts), canoes, paddles, shields, baskets and bowls, fishing lines, cloaks, torches and bedding, as well as being beaten into fibre for string bags or ornaments (sources cited in Attenbrow 2002: 113). The removal of bark exposes the heart wood of the tree, resulting in a scar. Trees may also have been scarred in order to gain access to food resources (e.g. cutting toe-holds so as to climb the tree and catch possums or birds), or to mark locations such as tribal territories. Such scars, when they occur, are typically described as scarred trees. These sites most often occur in areas with mature, remnant native vegetation. The locations of scarred trees often reflect an absence of historical clearance of vegetation rather than the actual pattern of scarred trees. Carved trees are different from scarred trees, and the carved designs may indicate totemic affiliation (Attenbrow 2002: 204); they may also have been carved for ceremonial purposes or as grave markers. Due to the predominantly cleared nature of the study area for pastoral agricultural activities, there is low potential for scarred or carved trees to exist. Any remaining mature trees within the study area should be inspected for cultural scarring.
Ceremonial Ring (bora grounds)	Ceremonial rings (bora grounds) are locations that have spiritual or ceremonial values to Aboriginal people. This site type is most often cited as being used for male initiation ceremonies (Gardner 1978 [1842-54]:243, McPherson 1974 [1860]:255; Mathews 1894). They usually consist of a circular clearing defined by a raised earth circle, connected to a second, smaller circle by a pathway, and were often accompanied by ground drawings or mouldings of people, animals or deities, and geometric designs carved on nearby trees. Unfortunately, the raised earth features are easily destroyed by agricultural and pastoral activities, vegetation growth and weathering (McBryde 1974:29-31,53; Connah et al. 1977:133-4). These sites may have also sometimes been used for corroborees (dances), fights or judicial meetings, although this may have only occurred in the Contact period (McBryde 1974:30-31,53-54; Connah et al. 1977:134; Moran 2004:54-55; Gardner 1978 [1842-54]:243). Ceremonial rings have been recorded on AHIMS in Tenterfield LGA, however, due to the disturbance associated with pastoral activities there is low potential for ceremonial rings to be present in the study area.
Art (shelter sites with art)	Art sites have been identified in association with shelters, in areas where suitable rock outcrops and boulders form surfaces suitable for painting. Many of the rock art sites in Tenterfield LGA share similar characteristics, including use of red ochre, and use of motifs such as human figures, bird tracks, and branching motifs possibly representing cycad leaves (McBryde 1974: 109-112; Kerr et al. 1999:22-23; NPWS 2003:8). The study area does not contain suitable rock outcrops or boulders. There is low potential for art sites to be located in the study area.

Site Type	Description
Stone Arrangements	Stone arrangements usually consist of low stone cairns or heaps of stones, although some also include circles and pathways. They are often found in close spatial association with bora grounds. The function of this site type is uncertain; however, they are thought to be ceremonial in nature (McBryde 1974:31,54-55; Connah et al. 1977:134). Stone arrangements are often isolated from known camp sites. Due to the disturbance associated with pastoral activities there is low potential for stone arrangements to be present in the study area.
Quarries	Aboriginal quarry sites are sources of raw materials, primarily for the manufacture of stone tools, but also for ochre procurement. They are only found where raw materials (stone or ochre) occur within the landscape, and where these have been exploited in the past. Such sites are often associated with stone tool artefact scatters and stone knapping areas. Loose or surface exposures of stone or cobbles may be coarsely flaked for removal of portable cores. Raw materials can be sourced to these sites and provide evidence for Aboriginal movement and/or exchange. Quarries have been recorded on the AHIMS in Tenterfield LGA. No surface outcrops occur within the study area, therefore, there is little to no potential for this site type to occur in the study area.
Burials	Aboriginal burial of the dead often took place relatively close to camp site locations. This is due to the fact that most people tended to die in or close to camp (unless killed in warfare or hunting accidents), and it is difficult to move a body long distances. Soft, sandy soils on, or close to, rivers and creeks, allowed for easier movement of earth for burial; however, bodies were also placed in caves or rock shelters, or wrapped in bark and put in a tree. Aboriginal burial sites can be marked by mounds or carved trees (McBryde1974:146-149). They may also be identified through historic records, or oral histories. European-style graves became more common in the post-contact period on reserves and pastoral stations, although these are often unmarked (NPSW 2010:7; Byrne 2007:18, 22). Burials have been recorded on the AHIMS in the Tenterfield LGA. There is low potential for burials to be located in the study area.

Due Diligence Assessment Process

Due diligence is defined in the CoP as '*taking reasonable and practical steps to determine whether a person's actions will harm an Aboriginal object and, if so, what measures can be taken to avoid that harm*'. The following section relates to the generic due diligence process as applied to the study area.

Step 1 – Will the activity disturb the ground surface or any culturally modified trees?

Yes, the proposed development will require grading, trenching and excavation works which will result in ground disturbance.

There are no recorded culturally modified trees within the study area.

Step 2 – Are there any a) relevant confirmed site records on AHIMS, other sources of information, or b) landscape features that are likely to indicate presence of Aboriginal objects?

Consequently, if your proposed activity is:

- **Within 200m of waters, or**
- **located within a sand dune system, or**
- **located on a ridge top, ridge line or headland, or**
- **located within 200m below or above a cliff face, or**
- **within 20m of or in a cave, rock shelter, or a cave mouth;**
- **and is on land that is not disturbed land then you must go to step 3.**

"Land is disturbed if it has been the subject of a human activity that has changed the land's surface, being changes that remain clear and observable.

*Examples include ploughing, construction of rural infrastructure (such as dams and fences), construction of roads, trails and tracks (including fire trails and tracks and walking tracks), clearing vegetation, construction of buildings and the erection of other structures, construction or installation of utilities and other similar services (such as above or below ground electrical infrastructure, water or sewerage pipelines, stormwater drainage and other similar infrastructure) and construction of earthworks" (*DECCW 2010).

The majority of the study area contains land which could be considered 'disturbed' under the CoP parameters described above.

A search of the AHIMS register identified zero AHIMS sites within the study area boundary or within approximately 2 km of the study area.

The study area is located within 200 m of multiple tributaries including two fourth order creeks.

Step 3 – Can harm to Aboriginal objects listed on AHIMS or identified by other sources of information and/or can the carrying out of the activity at the relevant landscape features be avoided?

No registered AHIMS sites are located within the study area. There is low sensitivity for further archaeological material to be located within the majority of the study area. A small proportion of the development footprint is within 50 m of third and fourth order streams. It is recommended that these areas to be avoided through redesign.

Step 4 – Does the desktop and visual assessment confirm that there are Aboriginal objects or that they are likely?

A site inspection was conducted on Tuesday 16 and Wednesday 17 October 2018 by ELA Archaeologist Andrew Crisp. The site inspection did not identify any Aboriginal artefacts or sites and confirmed that the majority of the study area has low potential for Aboriginal archaeological sites.

The site inspection was split between surveying the location of the proposed solar farm (Lot 90, 89, 87 and 85 DP751540) and the associated infrastructure (underground 22 kV cable and access roads). The survey results are presented below according to these two survey portions.

Solar Farm

Lot 90 DP751540

Lot 90 DP751540 is a large pastoral paddock that slopes predominantly from the south (**Figure 4**, **Figure 5** and **Figure 6**), adjacent to Old Racecourse Road, to the north (**Figure 7**, **Figure 8** and **Figure 9**) toward Pitkins Swamp Creek. Two first order drainage lines cross this lot, one in the south-eastern corner which drains to the north-east under Coxalls Road and the other along the western boundary which drains to the north into Pitkins Swamp Creek.

Orderly cultivated exotic grasses across this lot in addition to an unsealed vehicle track produced moderate surface visibility. Zero Aboriginal sites were located within Lot 90 DP751540. Moderate levels of ground disturbance from ploughing and pastoral activities were identified in Lot 90.

Lot 89 DP751540

Lot 89 DP751540 is largely analogous to Lot 90 DP751540 directly to the east. Lot 89 DP751540 contains three paddocks, the northern paddock closest to Pitkins Swamp Creek (**Figure 10**, **Figure 11** and **Figure 12**), the central paddock which covers the gentle northern and eastern draining slopes from the low spur (**Figure 13** and **Figure 14**) and the southern paddock which includes the southern draining slopes and the upper most reaches of a first order drainage line (**Figure 15**).

The northern most paddock (**Figure 10**, **Figure 11** and **Figure 12**) is located on low lying, waterlogged land adjacent to Pitkins Swamp Creek with the landscape gently rising to the south from the east-west fence line separating the northern and central paddocks (**Figure 11**).

Low grasses across this lot in addition to a number of small exposures caused by cattle and vehicle movements produced moderate surface visibility. Zero Aboriginal sites were located within Lot 89 DP751540. Moderate levels of ground disturbance from ploughing and pastoral activities were identified in Lot 89.

Lot 87 DP751540

Lot 87 DP751540 is comprised of portions of three pastoral paddocks which slope gently down toward the north before extending into a low lying flood plain adjacent to Pitkins Swamp Creek to the north of the study area. Three roughly parallel first order tributaries approximately 100 m apart drain north through Lot 87 gently incising the hillslope landform (**Figure 16**, **Figure 17** and **Figure 18**). A dam has been constructed within the western most drainage line in Lot 87 (**Figure 19** and **Figure 20**). The north western portion of Lot 87 within the study area includes a small low lying triangular paddock and another gentle hillslope draining to the north (**Figure 20** and **Figure 21**).

Low grasses across this lot in addition to a number of small exposures caused by cattle and vehicle movements produced moderate surface visibility. Zero Aboriginal sites were located within Lot 87 DP751540. Moderate levels of ground disturbance from ploughing, dam construction and pastoral activities were identified in Lot 87.

Lot 85 DP751540

Lot 85 DP751540 is made up of portions of two pastoral paddocks which slope gently toward the north before extending into a low lying flood plain adjacent to Pitkins Swamp Creek to the north of the study area (**Figure 22**, **Figure 23**, **Figure 24** and **Figure 25**). Approximately 50 m from the western boundary of Lot 85 a second order drainage line which flows northwards into Pitkins Swamp Creek.

Low grasses across this lot in addition to a number of small exposures caused by cattle and vehicle movements produced moderate surface visibility. Zero Aboriginal sites were located within Lot 85 DP751540. Moderate levels of ground disturbance from ploughing and pastoral activities were identified in Lot 85.

Associate Infrastructure

Underground 22 kV Cable Easement

The proposed easement of the underground 22kV cable can be broken down into three portions:

- Portion One: East-west oriented alignment (**Figure 26** and **Figure 27**) north of Old Racecourse Rd that connects to the proposed solar farm;
- Portion Two: North-south oriented alignment (**Figure 28**) between Old Racecourse Rd and Bruxner Highway; and
- Portion Three: East-west oriented alignment (**Figure 29**) to south of Bruxner Highway that connects to the electrical substation.

Portion One is located on a predominantly flat landform and shows significant disturbance as a result of agricultural activities such as vegetation clearance and ploughing (**Figure 26**). Portion Two extends across a predominantly flat landform containing multiple large pastoral paddocks (**Figure 28**), Portion Two will follow the pre-existing alignment of overhead power lines and associated power poles. Portion Three extends across a gently sloping landform downwards from east to west and contains cleared pastoral land and existing unsealed vehicle access (**Figure 29**).

Low grasses across the easement in addition to extensive exposures caused by ploughing, cattle and vehicle movements produced moderate surface visibility. Zero Aboriginal sites were located within the proposed easement.

Access Roads

The development includes the construction of new, as well as upgrading and/or utilisation of existing roads. The portions that include Bellevue Road and Old Racecourse Rd show complete disturbance as they are either sealed or well established unsealed carriageways and require no further investigation.

The portions of the proposed access roads that required closer inspection include the two north-south oriented vehicle access roads running north of Old Racecourse Rd (please refer to **Figure 1** and Figure 3). The east vehicle track runs adjacent to the western boundary of Lot 89 DP751540 while the western vehicle track runs adjacent to the western boundary of Lot 85 DP751540. For reasons of clarity each track will be discussed in terms of being either the east or west vehicle track.

The east vehicle track shows moderate disturbance in the form of mounding along most of its length (**Figure 30**) while the west vehicle track crosses a third order creek line directly north of Old Racecourse Rd before traversing a steep hill/crest (**Figure 31**). Both proposed vehicle tracks terminate on the banks of Pitkins Swamp Creek to the north. Zero Aboriginal sites were located within the proposed road easements.

Figure 4: View north-west from southern end of Lot 90 DP751540

Figure 5: View north-east from southern end of Lot 90 DP751540

Figure 6: View east from southern end of Lot 90 DP751540

Figure 7: View north-west from northern end of Lot 90 DP751540

Figure 8: View north-east from northern end of Lot 90 DP751540

Figure 9: View east from northern end of Lot 90 DP751540

Figure 10: View west from the northern end of Lot 90 toward the northern paddock of Lot 89

Figure 11: View north-west across the northern paddock of Lot 89 toward Pitkins Swamp Creek

Figure 12: View north across the northern paddock of Lot 89 toward Pitkins Swamp Creek

Figure 13: View south-west from Lot 90 toward the low spur in the central paddock of Lot 89

Figure 14: View north across Lot 89 from low spur line down toward Pitkins Swamp Creek

Figure 15: View south across southern paddock of Lot 89 from low spur line down toward Old Racecourse Road

Figure 16: View west-south-west across Lot 87

Figure 17: View west across Lot 87

Figure 18: View west-north-west across Lot 87

Figure 19: View from the southern boundary of the study area in Lot 87 toward the north-west

Figure 20: View from dam embankment toward the north-west and Pitkins Swamp Creek

Figure 21: View north across the north-west corner of Lot 87 toward Pitkins Swamp Creek

Figure 22: View from adjacent to western boundary of Lot 85 north toward Pitkins Swamp Creek

Figure 23: View from adjacent to western boundary of Lot 85 north-east toward Pitkins Swamp Creek

Figure 24: View from adjacent to western boundary of Lot 85 east across ephemeral second order drainage line

Figure 25: View from adjacent to western boundary of Lot 85 east-south-east upslope toward the low spur line outside the study area

Figure 26: View of eastern end of cable easement to the north of Old Racecourse Rd. View east

Figure 27: Indicative portion of east-west portion of cable easement north of Old Racecourse Rd. View east

Figure 28: Indicative portion of north-south portion of cable easement between Old Racecourse Rd and Bruxner Highway. View south

Figure 29: Indicative portion of east-west portion of cable easement south of Bruxner Highway. View east

Figure 30: Indicative view of proposed vehicle track to the west of Lot 89. View south toward Old Racecourse Rd

Figure 31: Indicative view of western most vehicle track from Old Racecourse Rd. Note the third order creek line in foreground. View north

Survey results

Following an analysis of the desktop assessment and observations made during the archaeological field survey the portion of the study area which incorporates the proposed solar farm (Lot 90, 89, 87 and 85 DP751540) can be considered to represent an area of low archaeological potential as a result of physical impacts caused by pastoral activities including vegetation clearing, ploughing, vehicle movement and dam/fence construction.

Similarly the terrain within the proposed route for the underground 22 kV cable through observations made during the archaeological field survey has been identified as moderately to highly disturbed by pastoral activities and represents low archaeological potential.

The proposed vehicle access tracks are the only portions of the proposed development that present potential heritage impacts. The northern most extremities of the proposed vehicle access tracks abut the banks of a fourth order stream, Pitkins Swamp Creek (Figure 3). These northern ends of the vehicle access tracks extend beyond the northern most edge of the proposed solar farm modules by at least 50 m. The terrain within 50 m of Pitkins Swamp Creek is considered to represent moderate potential for subsurface archaeological deposits and as such all efforts should be made to avoid impacting this buffer along the fourth order stream. Similarly the proposed western access track crosses over a reasonably undisturbed portion of an unnamed third order stream line directly north of Old Racecourse Road. Either side of this third order stream line represents moderate potential for subsurface archaeological deposits and as such all efforts should be made to avoid impacting this buffer along the third order stream.

The site inspection identified the majority of the study area represents low potential for Aboriginal archaeological sites with the exception of the portions of the proposed vehicle access tracks discussed above. If redesign and/or utilisation of existing access tracks (e.g. along Old Racecourse Road from the west or Coxalls Road from the east) is not feasible than further heritage investigation will be required.

Conclusions

The purpose of the Aboriginal heritage due diligence is to identify if there are registered Aboriginal sites and/or sensitive landforms which may indicate the presence of Aboriginal sites and may therefore require further assessment and approval under Part 6 of the *National Parks and Wildlife Act 1974*.

ELA has undertaken an extensive search of the AHIMS database maintained by the OEH and a review of available background reports including an Aboriginal heritage study of the Tenterfield LGA (AMBS 2013).

A site inspection undertaken by ELA Archaeologist Andrew Crisp on 16 and 17 October 2018 identified moderate ground surface visibility across most of the study area due to exposures in the pasture grass. No Aboriginal heritage sites were identified over the course of the site inspection. The inspection confirmed that the majority of the study area shows moderate disturbance as a result of pastoral activities. The only portions of the study area which represent moderate archaeological potential are the northern most reaches of the proposed vehicle access tracks abutting the banks of Pitkins Swamp Creek as well as the proposed western access track which will impact a third order stream line to the north of Old Racecourse Road.

Recommendations

Based on the findings of this due diligence and the requirement of the NP&W Act the following is recommended.

Recommendation 1 – Vehicle tracks: redesign and/or avoidance of impacts within 50 m of third or fourth order stream lines

- The preferred course of action would to avoid the development altogether of the western vehicle access track north of Old Racecourse Road due to the potential to impact on the unnamed third order stream directly adjacent to the existing road as well as the potential to impact the banks of Pitkins Swamp Creek to the north. Similarly the northern 50 m of the eastern access track should be avoided so as not to impact on the banks of Pitkins Swamp Creek and associated creek terraces.
- If Recommendation 1 is not feasible please initiate actions outline in Recommendation 2 below.

Recommendation 2 – ACHA, Aboriginal community consultation and test excavation

- Based on the sensitive nature of the landscape adjacent to the identified third and fourth order stream lines an Aboriginal Cultural Heritage Assessment (ACHA) should be prepared which would include an impact assessment of the proposed development. The ACHA would entail Aboriginal community consultation following the *'Aboriginal cultural heritage consultation requirements for proponents 2010'* (DECCW 2010) to identify Aboriginal cultural heritage values through consultation with Aboriginal stakeholders.
- Further archaeological assessment including detailed field survey with Aboriginal stakeholders and archaeological test excavation should be undertaken to inform archaeological values across the developable area. The ACHA can be prepared in advance of any DA and inform areas of opportunity and constraint for development.

Recommendations 3 – AHIP application

- The ACHA can be used to support a future Aboriginal Heritage Impact Permit (AHIP) application to the OEH if Aboriginal sites cannot be avoided by future development. The OEH require that AHIP applications are supported by an approval under Part 4 or Part 5 of the *Environmental Planning and Assessment Act 1979* (such as a DA) as a supporting document.

Recommendation 4 – General measures

- Aboriginal objects are protected under the NPW Act regardless of whether or not they are registered on AHIMS. If suspected Aboriginal objects, such as stone artefacts are located during future works, works must cease in the affected area and an archaeologist called in to assess the finds. If the finds are found to be Aboriginal objects, the OEH must be notified under section 89A of the NPW Act. Appropriate management and avoidance or approval under a section 90 AHIP should then be sought if Aboriginal objects are to be moved or harmed.
- In the extremely unlikely event that human remains are found, works should immediately cease and the NSW Police should be contacted. If the remains are suspected to be Aboriginal, the OEH may also be contacted at this time to assist in determining appropriate management.

Please contact me if you require further information in regard to Aboriginal heritage assessment on 02 9259 3703.

Yours sincerely,

Andrew Crisp

ELA Archaeologist

References

AMBS (2013) *Tenterfield LGA Aboriginal Heritage Study*. Report to Tenterfield Shire Council

Attenbrow V. (2002). Sydney's Aboriginal Past – Investigating the archaeological and historical records. University of New South Wales Press

Byrne, D. (1983) *An Investigation of the Aboriginal Archaeological Record in the Tenterfield E.I.S. Area*. Unpublished Report to the Forestry Commission of New South Wales.

Connah, G E, Davidson, I & Rowland, M J (1977) "Prehistoric Settlement". In D A M Lea, J J J Pigram and L M Greenwood (Eds), *An Atlas of New England*, Vol. 2 - The Commentaries, pp127-136. Department of Geography, University of New England, Armidale.

Davies Heritage Consultants Pty Ltd (2001). *Indigenous Cultural Heritage Assessment of Terrain to be Impacted by Road Works at McClifty's Study Area, Between Glen Innes and Tenterfield, Northern New South Wales*. Report prepared for NSW Roads and Traffic Authority.

Department of Environment, Climate Change and Water (DECCW), 2010. *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW*, Hurstville, NSW.

Department of Environment, Climate Change and Water (DECCW), 2010. *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW*, Hurstville, NSW.

Griffiths, J.P. (1995) *An Investigation of Aboriginal Sites and Relics of a Proposed Optic Fibre Cable Route from Deepwater to Tenterfield*. Unpublished report to Telstra Australia

McBryde, I (1974) *Aboriginal Prehistory in New England: An archaeological survey of northeastern New South Wales*. Sydney University Press, University of Sydney.

Office of Environment and Heritage (OEH). 2011a. *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*.

Attachment A – Basic and AHIMS searches on 4 October 2018

Office of Environment & Heritage

AHIMS Web Services (AWS)

Search Result

Purchase Order/Reference : 11475

Client Service ID : 374244

Eco Logical Australia Pty Ltd - Sydney

Date: 04 October 2018

PO Box 12 668 Old Princes Hwy
Sutherland New South Wales 1499

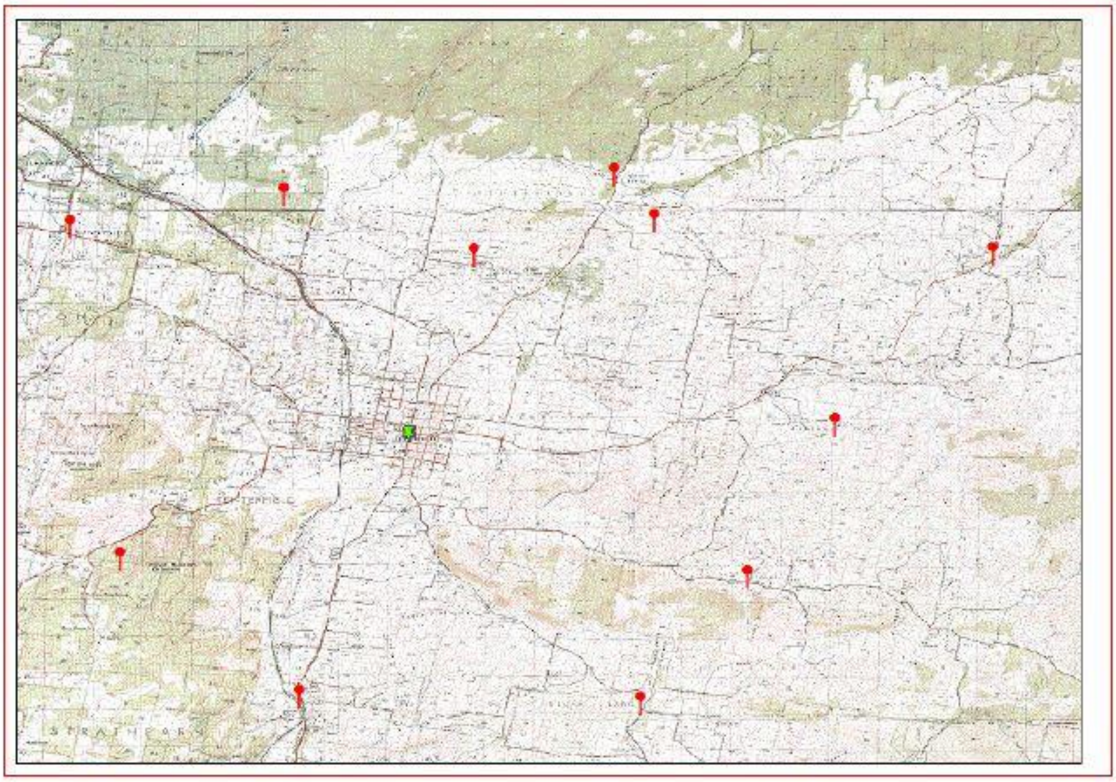
Attention: Daniel Claggett

Email: daniel.claggett@ecoaus.com.au

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 56, Eastings : 397350 - 417350, Northings : 6776856 - 6796856 with a Buffer of 0 meters, conducted by Daniel Claggett on 04 October 2018.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

13	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

Office of Environment & Heritage

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 11475

Client Service ID : 374244

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
12-4-0015	Mount Mackenzie Massacre	AGD	56	399250	6781800	Open site	Valid	Conflict : -	Massacre	
	Contact	Recorders	Ms.Adrienne Howe-Piening					Permits		
12-2-0005	Leach's Gully;	AGD	56	408200	6790800	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	
	Contact	Recorders	ASRSYS					Permits		
12-2-0038	Lismore-Tenterfield PAD 5	GDA	56	415800	6788314	Open site	Valid	Potential Archaeological Deposit (PAD) : -		
	Contact	Recorders	OzArk Environmental and Heritage Management,Mr.Ben Churcher					Permits		
03-5-0030	Tenterfield-Dumaresq IF 13	GDA	56	407548	6794386	Open site	Valid	Artefact : -		
	Contact	Recorders	OzArk Environmental and Heritage Management,Mr.Ben Churcher					Permits		
03-5-0036	Tenterfield Dumaresq IF 9	GDA	56	410170	6793721	Open site	Valid	Artefact : -		
	Contact	Recorders	OzArk Environmental and Heritage Management,Mr.Ben Churcher					Permits		
03-5-0037	Tenterfield Dumaresq IF 13 (Duplicate copy of # 03-5-0030)	GDA	56	407548	6794386	Open site	Valid	Artefact : -		
	Contact	Recorders	OzArk Environmental and Heritage Management,Mr.Ben Churcher					Permits		
12-5-0071	house Creek 1	AGD	56	413200	6789500	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Ray Fife					Permits		
12-2-0039	Tenterfield 1 GG	GDA	56	403219	6784922	Open site	Valid	Grinding Groove : -		
	Contact	Recorders	Ms.Vanessa Hardy					Permits		
12-2-0040	Tenterfield 2 Artefact	GDA	56	403219	6784866	Open site	Valid	Artefact : -		
	Contact	Recorders	Ms.Vanessa Hardy,Everick Heritage Consultants Pty Ltd,Doctor.Morgan Disspain					Permits		
12-2-0041	Tenterfield PAD 1	GDA	56	403167	6783720	Open site	Valid	Potential Archaeological Deposit (PAD) : -		
	Contact	Recorders	Ms.Vanessa Hardy					Permits		
12-2-0042	Tenterfield 3 Artefacts	GDA	56	403589	6784563	Open site	Valid	Artefact : -		
	Contact	Recorders	Everick Heritage Consultants Pty Ltd,Doctor.Morgan Disspain					Permits		
12-5-0055	House Creek 1	AGD	56	413200	6789500	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Ray Fife					Permits	1098,1099,1100,1121	
12-1-0008	Rocklea Mt Mackenzie	AGD	56	399100	6782000	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	Contact	Recorders	J Sommerlad					Permits		

Report generated by AHIMS Web Service on 04/10/2018 for Daniel Claggett for the following area at Datum :GDA, Zone : 56, Eastings : 397350 - 417350, Northings : 6776856 - 6796856 with a Buffer of 0 meters. Additional Info : Aboriginal Due Diligence Assessment.. Number of Aboriginal sites and Aboriginal objects found is 13

Appendix D : Visual Assessment Method

1.1 Landscape Character – Impact Assessment Methodology

Landscape character can be defined as a distinct and recognisable pattern of elements that occur consistently across a particular landscape known discretely as a Landscape Character Unit (LCU). It refers to the physical characteristics of landscape based on features such as location, land use, vegetation cover and landform.

The first step in undertaking a landscape character assessment is to identify the LCUs that are associated with the Landscape Character Assessment Area (2 km buffer). Once identified, the following assessment method was adopted:

- Description of the existing landscape character area which defines its sensitivity to change or 'visual sensitivity';
- Description of the potential visual changes to a LCU that would result as a consequence of the proposal along with a "magnitude of change" rating;
- An assessment of impact, taking into account the relationship between visual sensitivity (the ability of a landscape character area to absorb a development) and magnitude of change;
- The identification of any mitigation measures that would reduce the visual impact identified; and then,
- Results of mitigation strategies were assessed to provide a final assessment of potential residual effects of the Proposed Development, using the same criteria outlined above.

The impact to landscape character is determined by balancing the visual sensitivity of the LCU and the magnitude of impact as a result of the construction, operation and decommissioning of the Proposed Development. The correlation between the sensitivity of landscape character and the magnitude of change to determine the level of impact is summarised in Table 1.

Table 1: Visual impact assessment matrix

Potential level		Magnitude of change			
		Very High	High	Moderate	Low or insignificant
Visual sensitivity	Very High	Very High Impact	High Impact	High Impact	Moderate Impact
	High	High Impact	High Impact	Moderate Impact	Low Impact
	Moderate	Moderate Impact	Moderate Impact	Moderate Impact	Low Impact
	Low or insignificant	Moderate Impact	Low Impact	Low Impact	Low or Insignificant Impact

1.1.1 Sensitivity Criteria

Each LCU is assessed for its sensitivity based on a review and analysis of the elements that make up its characteristic attributes. The visual sensitivity of landscape character in rural areas can largely be defined by considering aspects such as relative naturalness, key cultural attributes and uniqueness. The more disturbed or common a landscape, the less value is placed on it and consequently the less 'visually sensitive' it is to change. The visual sensitivity of a landscape character unit is evaluated according to the five-point scale presented in Table 2.

Table 2: Visual sensitivity criteria used for Landscape Character

Visual Sensitivity levels	Landscape Character
Insignificant	Contains predominantly industrial or intensive agricultural infrastructure.
Low	General widespread rural landscape with low to moderate levels of native vegetation, and no identified special landscape features or interesting topographic features.
Moderate	Rural land with high levels of native vegetation or undisturbed native woodland with attractive landscape features such as watercourses or interesting topographic features.
High	Landscapes with well-preserved natural areas, highly valued for conservation or values relating to cultural heritage.
Very High	Iconic and dramatic natural landscapes such as those protected as World Heritage Areas or National Parks. Highly valued iconic cultural landscapes may also be included.

Magnitude of Visual Change Criteria

The magnitude of visual change considers the extent to which the existing landscape features or experience of that landscape would be modified as a consequence of the visual impacts of the Proposed Development. The magnitude of change likely to occur as a result of the construction, operation and decommissioning of the Proposed Development is evaluated according to a five-point scale as outlined in Table 3.

Table 3: Magnitude of visual change definitions used for Landscape Character

Magnitude of Visual Change	Landscape Character
Insignificant	Minor scales of landscape/landform change and vegetation removal, existing urban use, intensive agriculture or industrial infrastructure may be present.
Low	Moderate level of landscape/landform change and minor vegetation removal, existing industrial or intensive agriculture use may be present.
Moderate	Moderate scale of landscape/landform change and/or vegetation removal, minor water courses possibly impacted, existing industrial or intensive agriculture on or adjoining site.
High	Large scale landscape/landform change and/or vegetation removal, minor water courses possibly affected, no existing industrial or intensive agriculture on or visible from site.
Very High	Highly significant scale landscape/landform change, possibly major vegetation and water course impacts, no existing industrial or intensive agriculture on or visible from site.

1.2 Visual Amenity – Impact Assessment Methodology

The visual amenity of an area broadly refers to how potential viewers respond to or value a particular landscape. To assess the impact of the Proposed Development on visual amenity, receptors and/or sensitive viewpoints within the potential area of impact (5 km Visual Amenity Assessment Area) are identified. The assessment then examines the potential impact for each identified viewpoint by balancing the visual sensitivity of the receptor and the magnitude of visual change as a result of the construction, operation and decommissioning of the Proposed Development. The correlation between visual sensitivity and the magnitude of visual change used to determine the level of impact is summarised in the visual impact assessment matrix previously presented in Table 1.

1.2.1 Assessment of Visual Impact

Potential visual impacts of the solar farm on surrounding view locations would result primarily from a combination of the potential visibility of the Proposed Development and the characteristics of the landscape between, and surrounding, the view locations and the Proposed Development. The potential degree of visibility and resultant visual impact would be partly determined by a combination of factors including:

- Category and type of situation from which people could view the solar farm (examples of view location categories include residents or motorists);
- Visual sensitivity of view locations surrounding the solar farm;
- Potential number of people with a view toward the proposed solar farm from any one location;
- Distance between view locations and the solar farm; and
- Duration of time people could view the solar farm from any particular static or dynamic view location.

An underpinning rationale for this visual assessment is that if people are not normally present at a particular location, such as agricultural areas, or they are screened by landform or vegetation, then there is likely to be no visual impact at that location.

If, on the other hand, a small number of people are present for a short period of time at a particular location then there is likely to be a low visual impact at that location, and conversely, if a large number of people are present then the visual impact is likely to be higher.

Although this rationale can be applied at a broad scale, this assessment also considers, and has determined, the potential visual impact for individual view locations that would have a higher degree of sensitivity to the solar farm development, including the potential impact on individual residential dwellings situated in the surrounding landscape.

1.2.2 Viewpoint Selection

A desktop assessment of potential sensitive receptors within the 5 km Visual Amenity Assessment Area identified a selection of public and private viewpoints that together would represent the overall visual amenity impacts of the Proposed Development. The desktop assessment included the generation of maps showing Zones of Visual Influence (ZVI) of the Proposed Development which illustrate areas of potential visibility within the 5 km Visual Amenity Assessment Area. ZVI's are generated using Geographic Information System (GIS) software and a Digital Elevation Model (DEM).

A preliminary "bare-earth" ZVI based on a Digital Terrain Model (DTM) was produced prior to the commencement of fieldwork in order to inform the maximum extent and nature of areas within the nominated 5 km viewshed of the Proposed Development.

It should be noted that bare-earth ZVI's are naturally very conservative as they do not take into account the screening effects of local features such as subtle variations in landform, vegetation cover or existing development and infrastructure. In addition, the following assumptions were made when generating the ZVI's:

- The solar array was assumed to cover the entire Development Footprint (in reality, final design constraints will confine built infrastructure to approximately half of this area); and
- The solar array is assumed to be installed at a maximum height of 2.5 m above the natural surface area.

Therefore, based on the ZVI modelling and the conservative assumptions underlying the model, it is considered that the bare-earth ZVI represents a 'worst-case' scenario, which provides a useful tool for assessing the maximum potential visual impacts associated with the Proposed Development.

1.2.3 Viewpoint assessment methodology

Potential viewpoints were identified based on site inspection and further desktop analyses. The site inspection involved:

- Assessment of the potential extent of visibility of the Proposed Development;
- Determination and confirmation of the various view locations from which the Proposed Development is potentially visible; and
- Preparation of a record for each viewpoint assessed.

The results of the site inspection were corroborated with the development of further ZVI scenarios based on potential visual screening associated with existing vegetation and other structures within the existing landscape as identified within the Digital Surface Model (DSM ZVI).

Once all potential viewpoints were identified, the following assessment approach for each viewpoint was adopted:

- An assessment of the visual sensitivity;
- A description of the likely visual change and an assessment of the magnitude of visual change;
- An overall assessment of the potential impact;
- The identification of any mitigation measures that would reduce the visual impact identified;
- An assessment of mitigation strategies to provide a final assessment of potential residual effects of the Proposed Development, using the same criteria outlined above.

A viewpoint analysis was prepared for potentially highly and moderately impacted residences using the DSM which incorporates the screening effects of existing vegetation and development. Similar to the preparation of ZVI maps, this modelling approach uses DEM data to consider what can be seen from each assessed residence.

Visual Sensitivity Criteria

Sensitivity in relation to visual amenity is dependent on a combination of the location, context and the importance of the viewshed held by the viewer. The sensitivity level attributed to Visual Amenity is determined by considering the distance of a sensitive receptor from the Proposed Development, the potential for views, and whether it is a public or private viewpoint. Residential viewpoints are considered more sensitive than public viewpoints. The sensitivity of visual amenity receptors are evaluated according to the five point scale provided in Table 4.

Table 4: Visual sensitivity criteria used for Visual Amenity

Visual Sensitivity levels	Visual Amenity
Insignificant	Residential viewpoints within 5 km with no, or very limited potential views; or Public viewpoints within 2 km with limited potential views and a low number of viewers.
Low	Residential viewpoints over 2 km away with the potential for some views; or Public viewpoints over 3 km viewed by a high number of viewers; or Public viewpoints within 1 km viewed by a low number of viewers, or by transient viewers (such as road users).
Moderate	Residential viewpoints within 1-2 km with potential for some views of the Proposed Development; or Public viewpoints between 1-3 km viewed by a high number of viewers; or Public viewpoints within 1 km viewed by moderate number of viewers with potential extensive views of the Proposed Development; or by transient viewers (such as road users).
High	Residential viewpoints less than 1 km away with some views of the Proposed Development. Public viewpoints within 1 km viewed by a high number of viewers with views of the Proposed Development.
Very High	Residential viewpoints within 1 km with extensive or intrusive views of the Proposed Development; or Public viewpoints within 1 km, viewed by a high number of viewers with extensive views of the Proposed Development.

Magnitude of Change Criteria

The magnitude of visual change for visual amenity considers the degree of change, particularly with respect to changes from characteristically ‘rural’ views to those which contain infrastructure. The magnitude of visual change for each viewpoint is evaluated according to the five-point scale provided in Table 5.

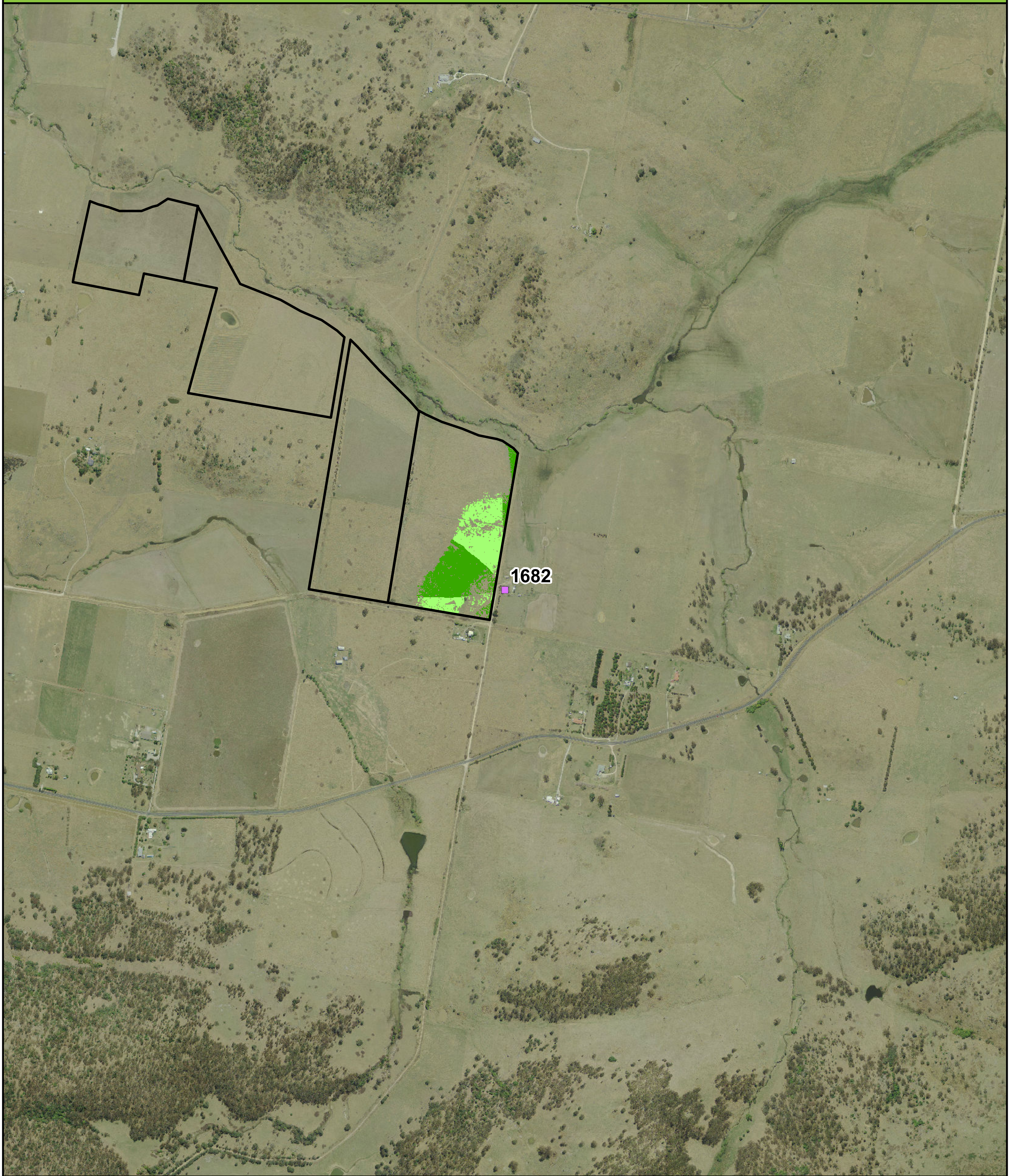
Table 5: Magnitude of visual change definitions used for Visual Amenity

Magnitude of Visual Change	Visual Amenity
Insignificant	Minor scale of change, not significantly different in scale or type to existing views and/or landscape character.
Low	Low to moderate scale change, not significantly different in scale or type to existing views and/or landscape character.
Moderate	Moderate visual change to views as a result of landscape change and construction of infrastructure where it was previously a rural landscape.
High	High visual change to views as a result of landscape change and construction of infrastructure where it was previously a rural landscape
Very High	Significant visual change to views as a result of substantial landscape change within close proximity.

Appendix E : Viewpoint maps

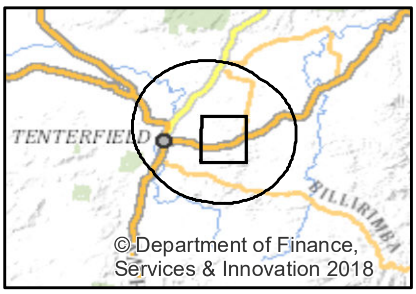
Tenterfield Observer Point Analysis

House ID: 1682



Legend

- House
- Solar farm area
- Visible (surface model)
- Visible (Terrain model)



0 0.5 1
Kilometres

Datum/Projection:
GDA 1994 MGA Zone 56

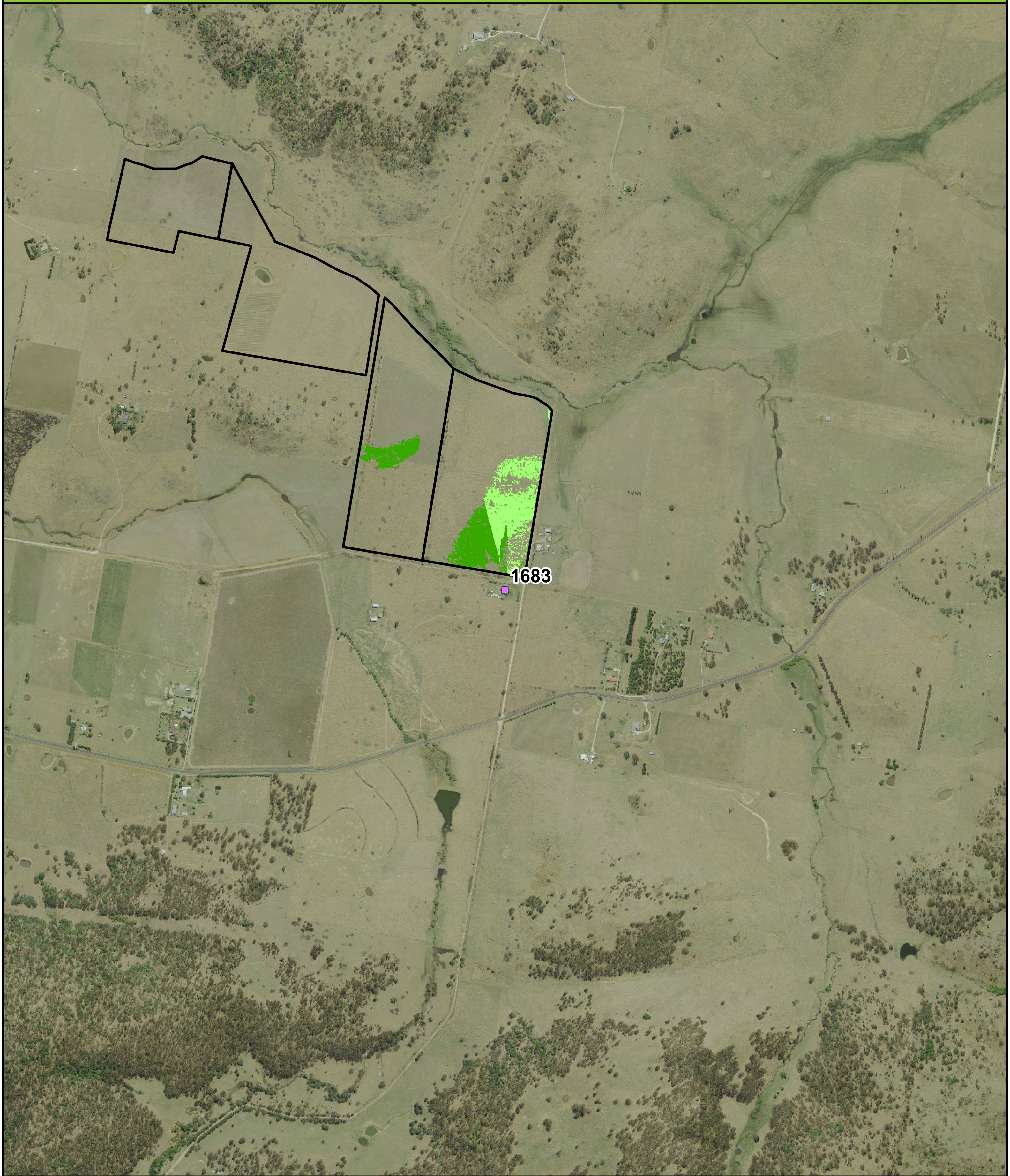
N

eco logical AUSTRALIA
www.ecoaus.com.au

Prepared by: MS Date: 20/11/2018

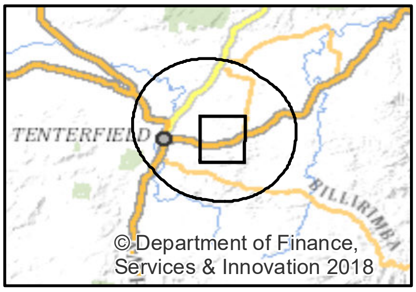
Tenterfield Observer Point Analysis

House ID: 1683



Legend

- House
- Solar farm area
- Visible (surface model)
- Visible (Terrain model)



© Department of Finance, Services & Innovation 2018

0 0.5 1
Kilometres

Datum/Projection:
GDA 1994 MGA Zone 56

N

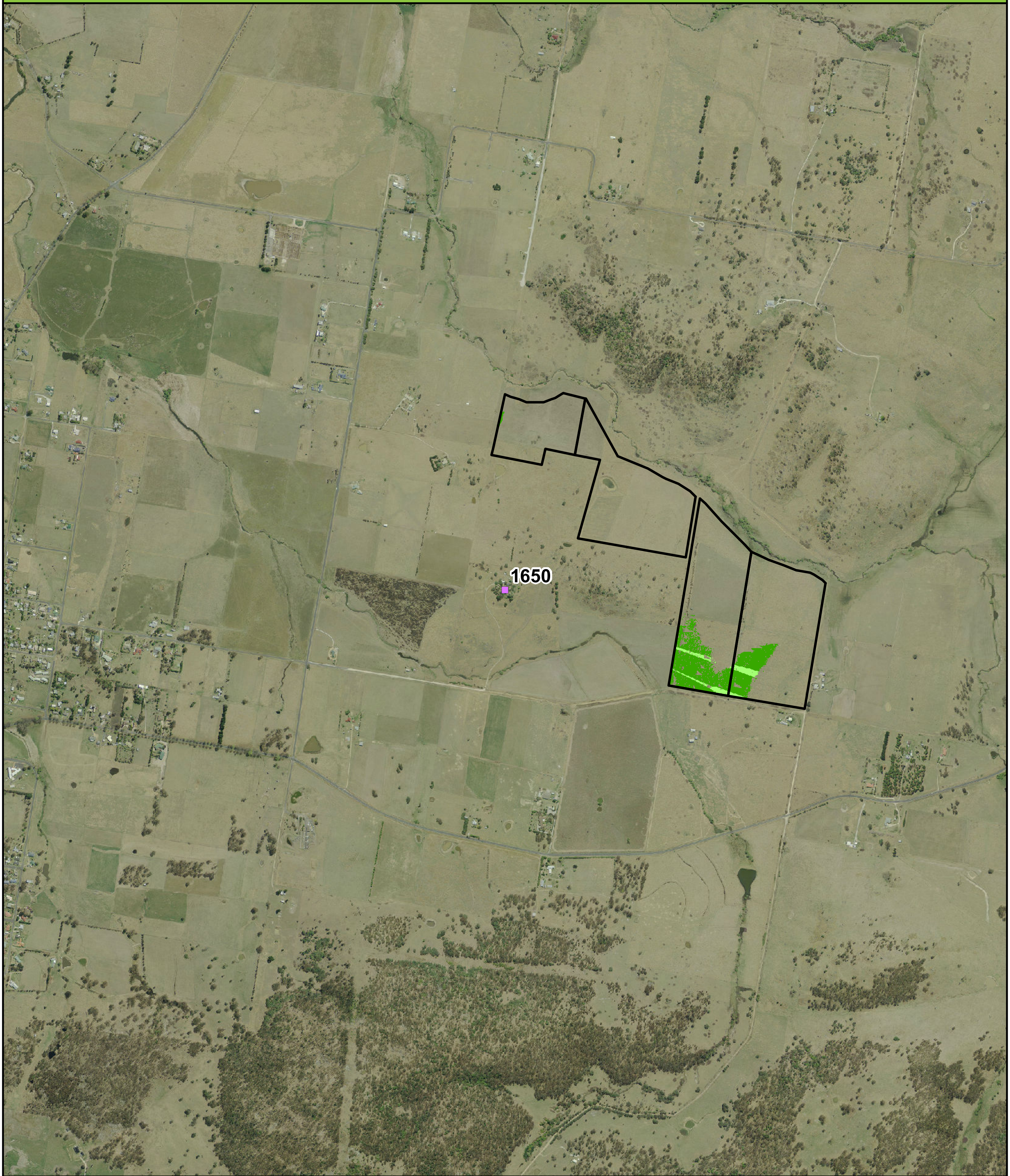
eco logical AUSTRALIA

www.ecoaus.com.au

Prepared by: MS Date: 20/11/2018

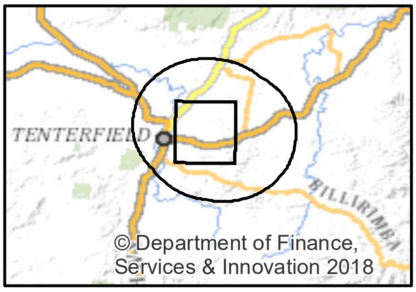
Tenterfield Observer Point Analysis

House ID: 1650



Legend

- House
- Solar farm area
- Visible (surface model)
- Visible (Terrain model)



0 0.5 1

Kilometres

Datum/Projection:
GDA 1994 MGA Zone 56

N

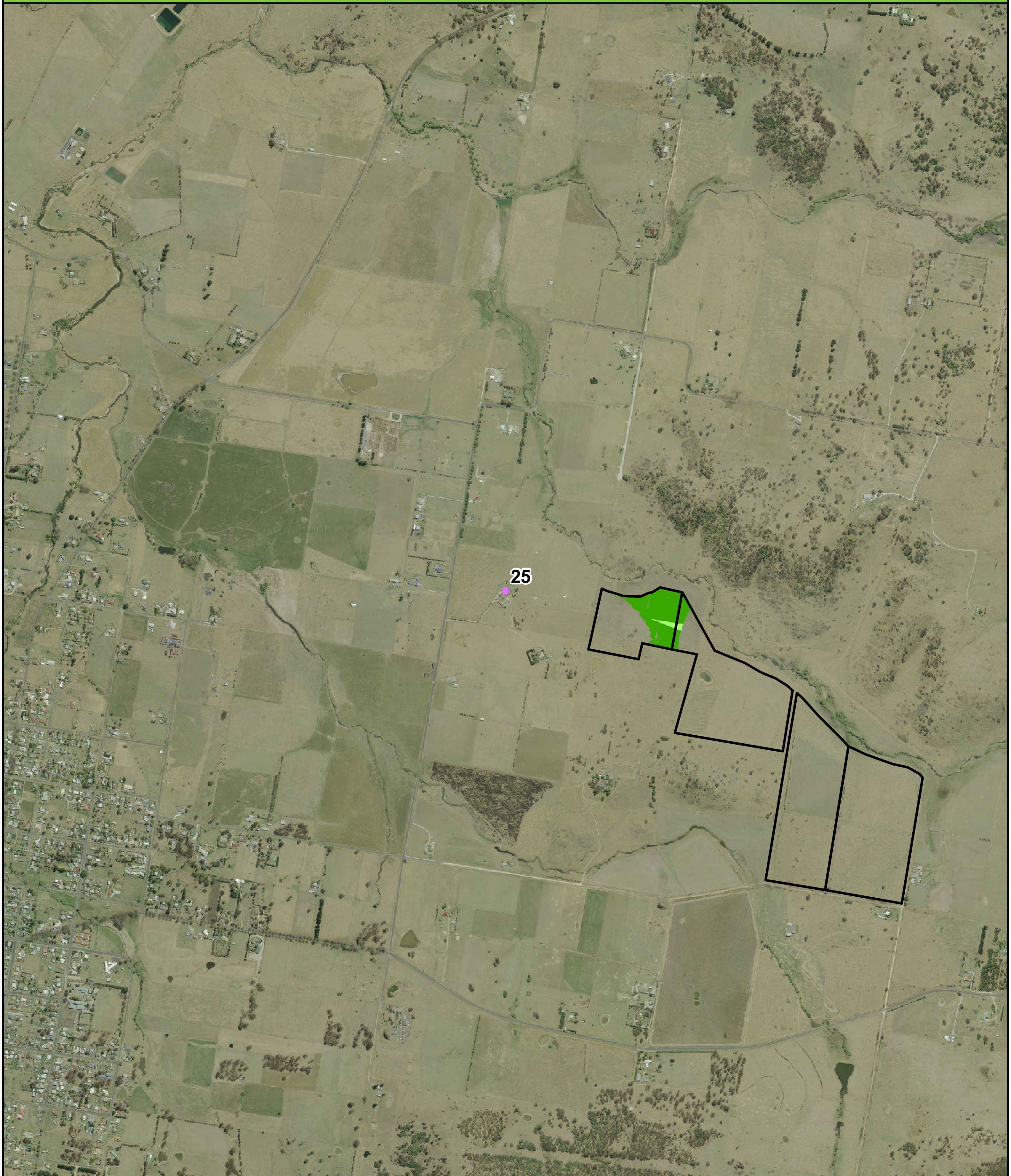
eco logical AUSTRALIA

www.ecoaus.com.au

Prepared by: MS Date: 20/11/2018

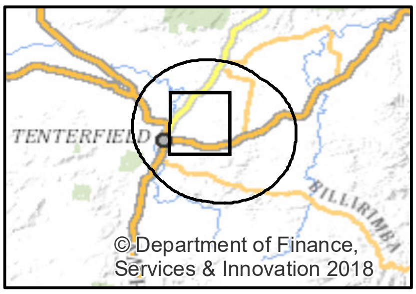
Tenterfield Observer Point Analysis

House ID: 25



Legend

- House
- Solar farm area
- Visible (surface model)
- Visible (Terrain model)



0 0.5 1
Kilometres

Datum/Projection:
GDA 1994 MGA Zone 56

N

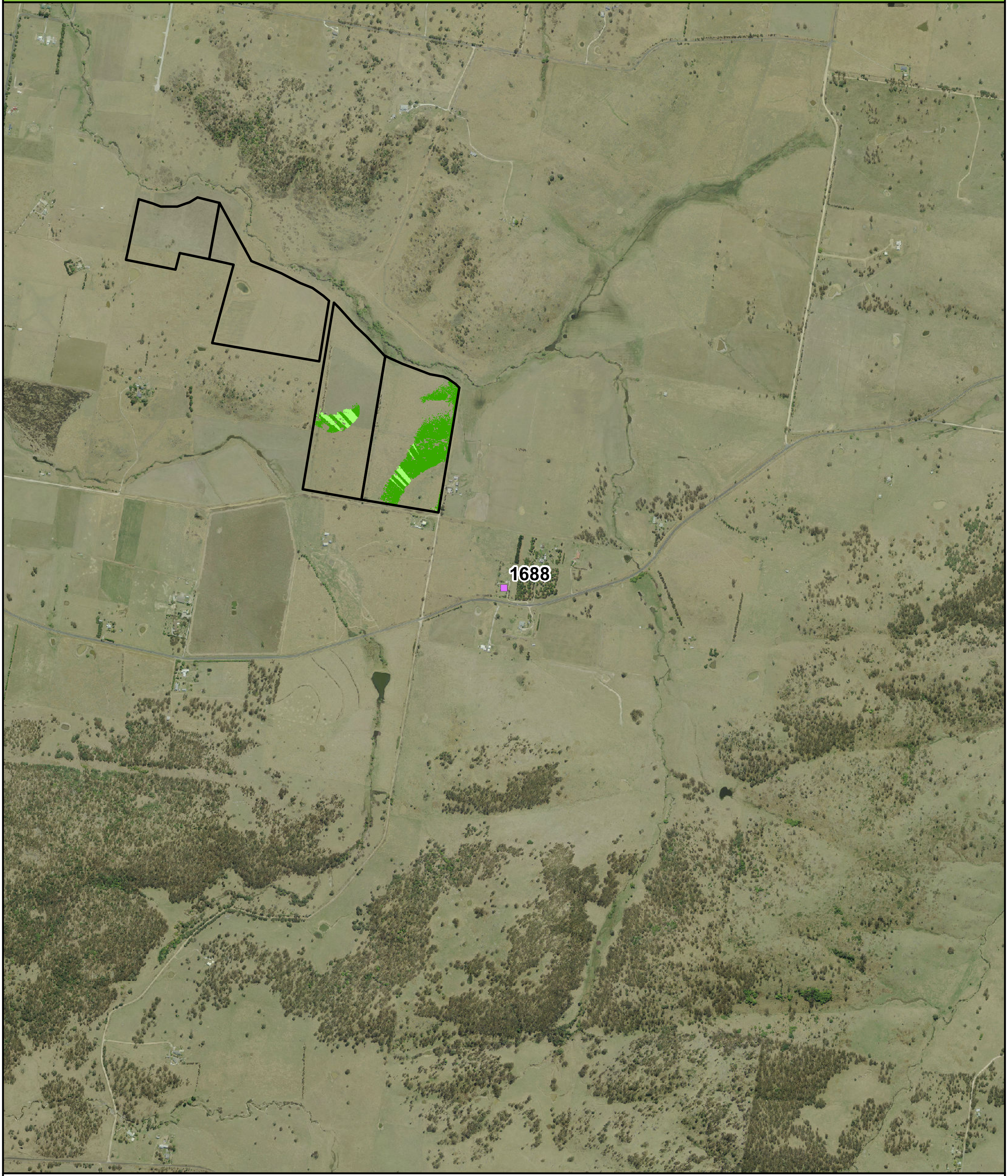
eco logical AUSTRALIA

www.ecoaus.com.au

Prepared by: MS Date: 20/11/2018

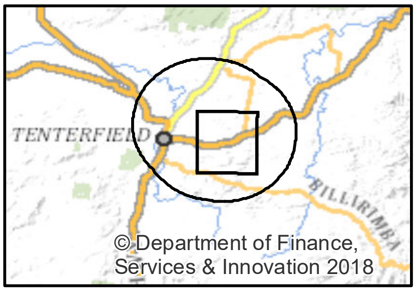
Tenterfield Observer Point Analysis

House ID: 1688



Legend

- House
- Solar farm area
- Visible (surface model)
- Visible (Terrain model)



0 0.5 1
Kilometres

Datum/Projection:
GDA 1994 MGA Zone 56

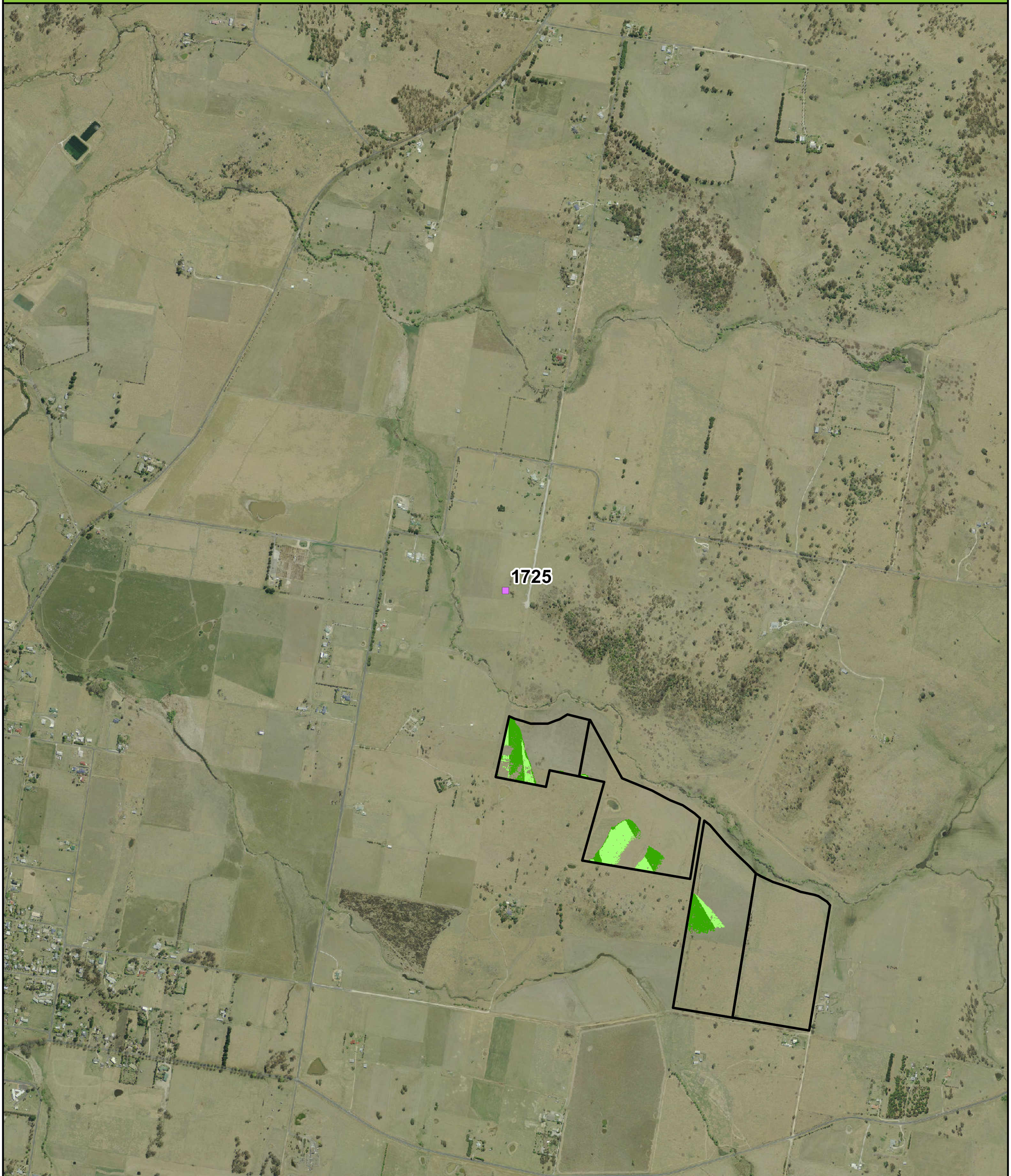
N

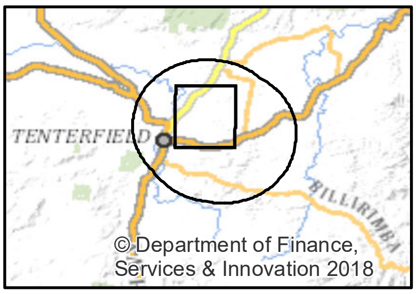
eco logical AUSTRALIA
www.ecoaus.com.au

Prepared by: MS Date: 20/11/2018

Tenterfield Observer Point Analysis

House ID: 1725





Legend

- House
- Solar farm area
- Visible (surface model)
- Visible (Terrain model)

0 0.5 1

Kilometres

Datum/Projection: GDA 1994 MGA Zone 56

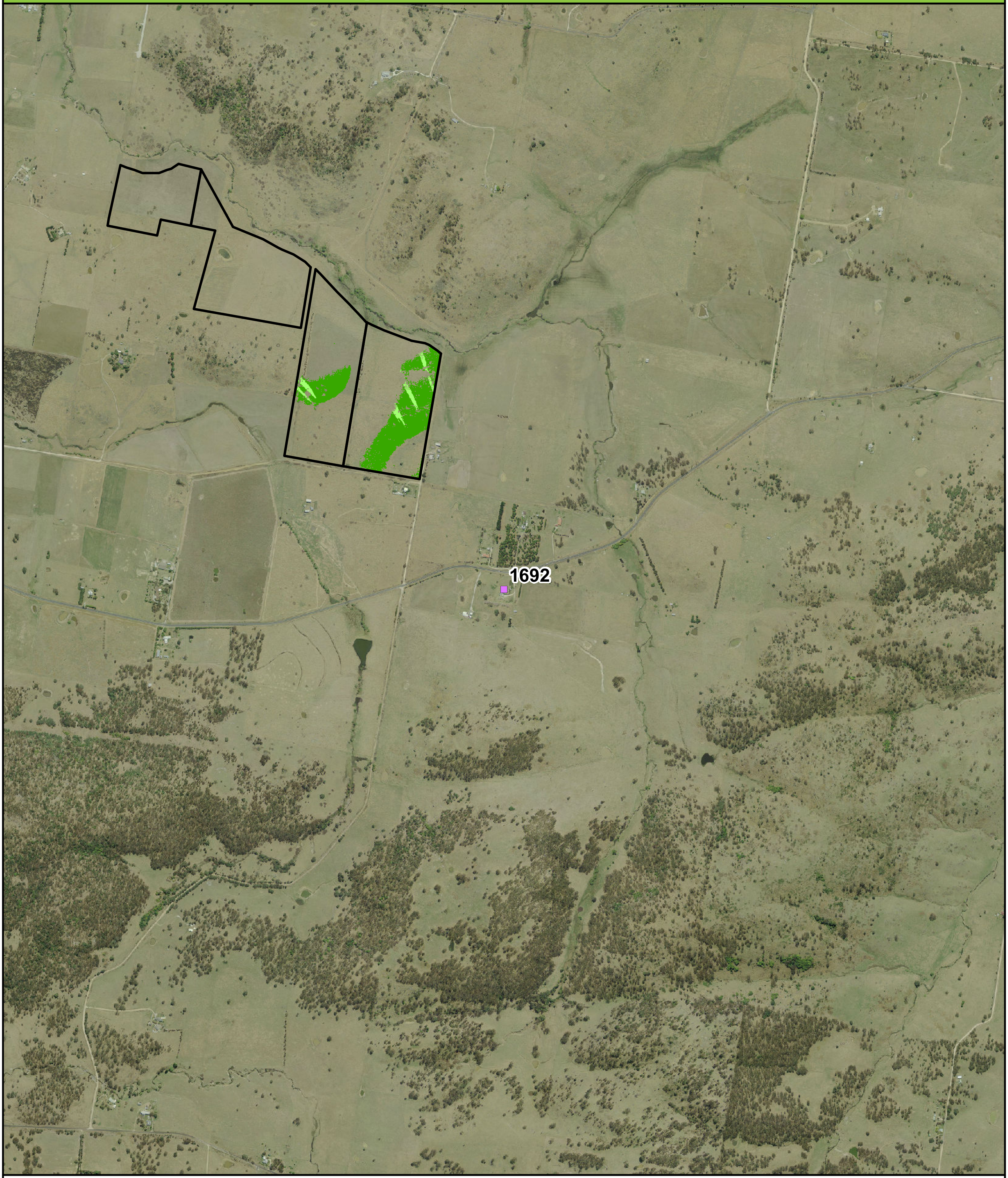
N

www.ecoaus.com.au

Prepared by: MS Date: 20/11/2018

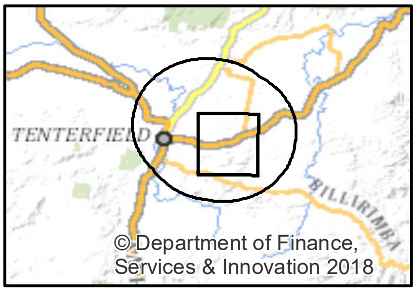
Tenterfield Observer Point Analysis

House ID: 1692



Legend

- House
- Solar farm area
- Visible (surface model)
- Visible (Terrain model)



0 0.5 1
Kilometres

Datum/Projection:
GDA 1994 MGA Zone 56

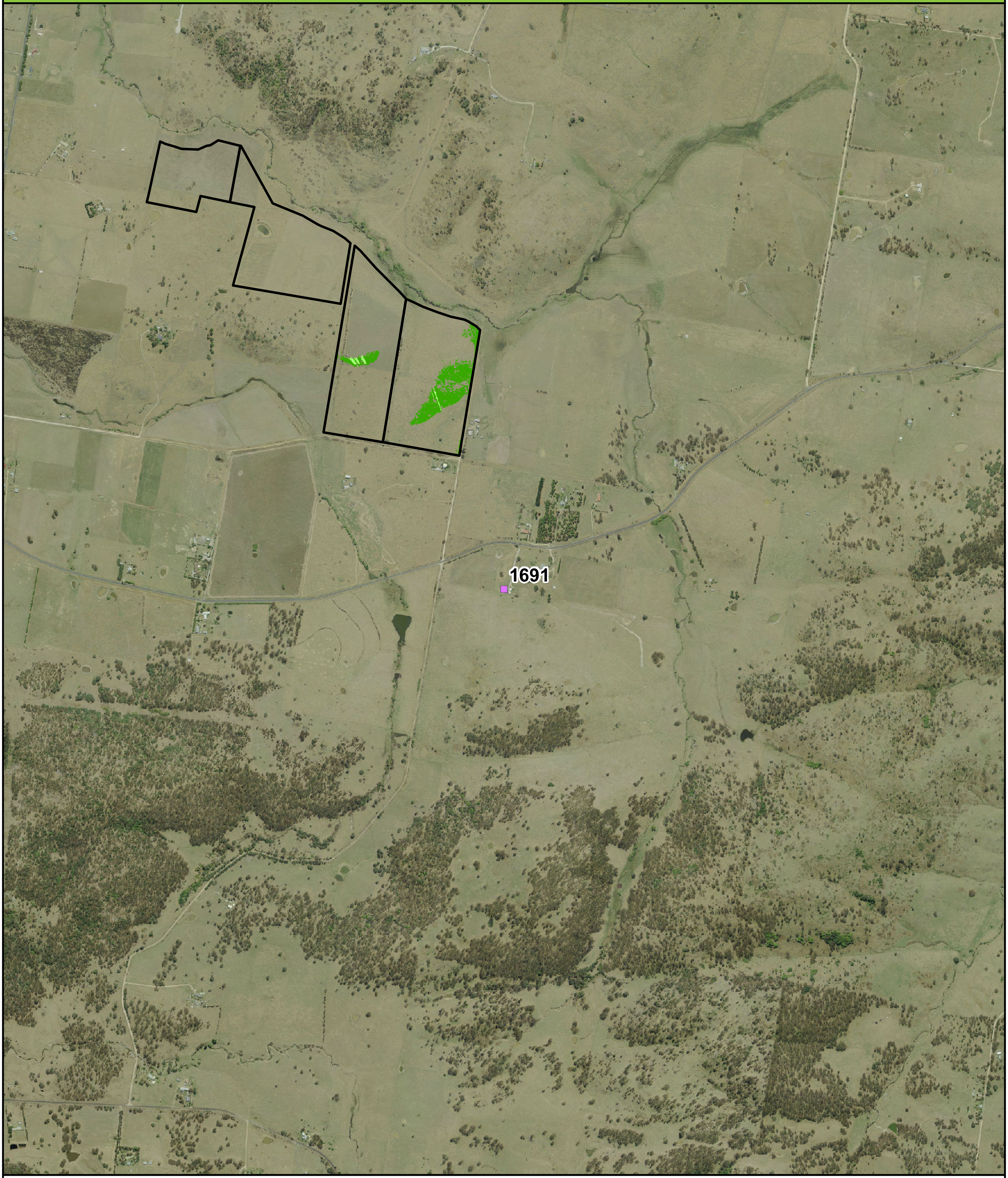
N

eco logical AUSTRALIA
www.ecoaus.com.au

Prepared by: MS Date: 20/11/2018

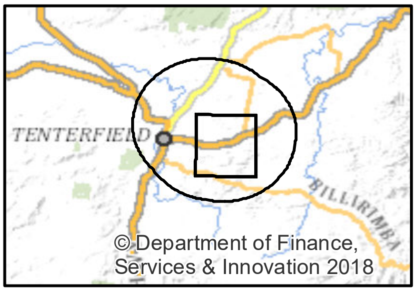
Tenterfield Observer Point Analysis

House ID: 1691



Legend

- House
- Solar farm area
- Visible (surface model)
- Visible (Terrain model)



0 0.5 1
Kilometres

Datum/Projection:
GDA 1994 MGA Zone 56

N

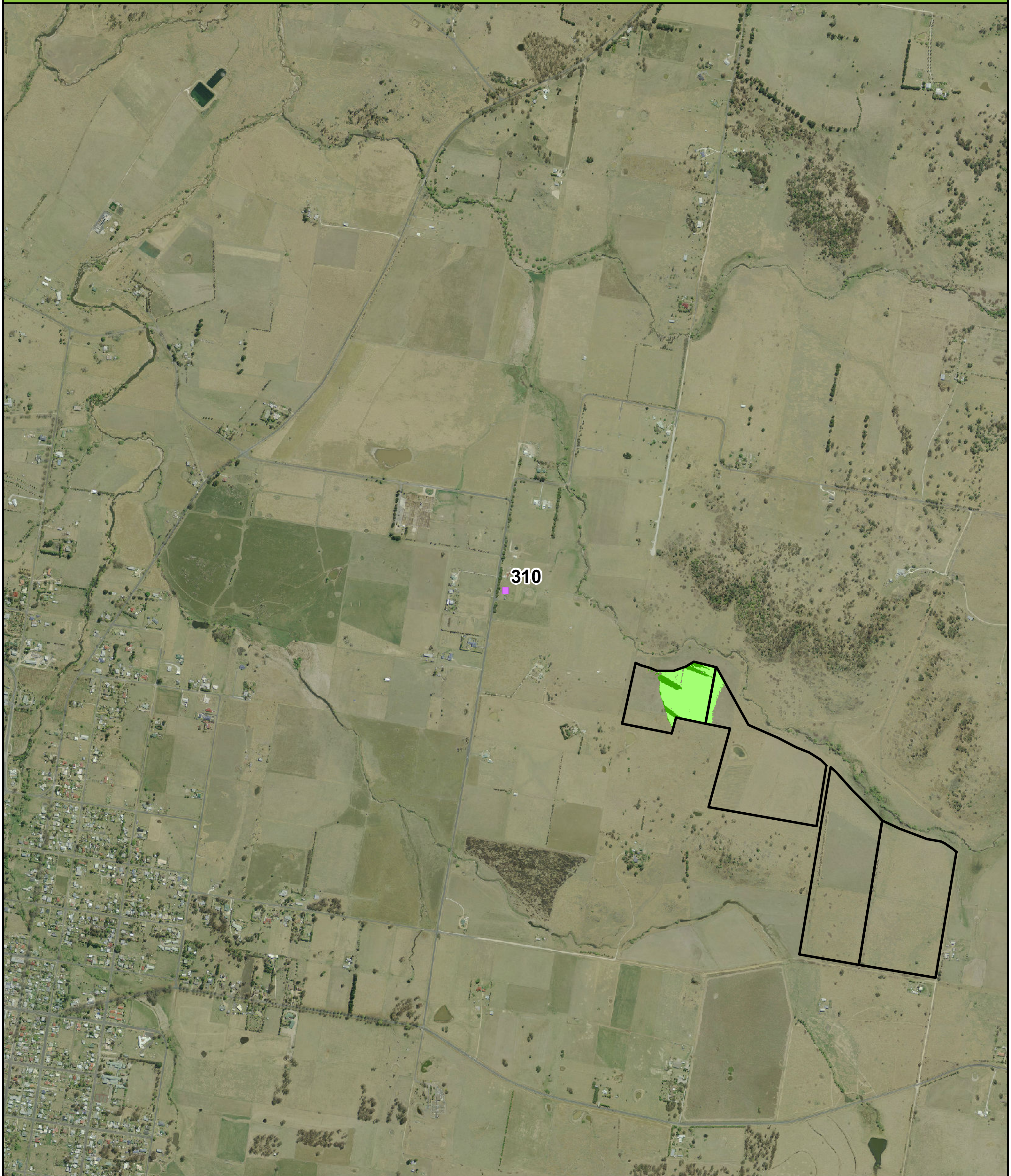
eco logical AUSTRALIA

www.ecoaus.com.au

Prepared by: MS Date: 20/11/2018

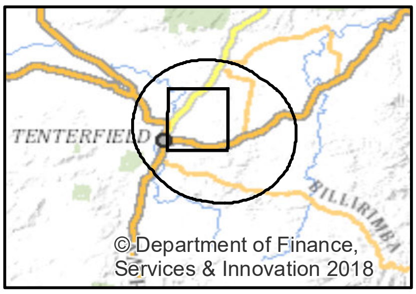
Tenterfield Observer Point Analysis

House ID: 310



Legend

- House
- Solar farm area
- Visible (surface model)
- Visible (Terrain model)



0 0.5 1
Kilometres

Datum/Projection:
GDA 1994 MGA Zone 56

N

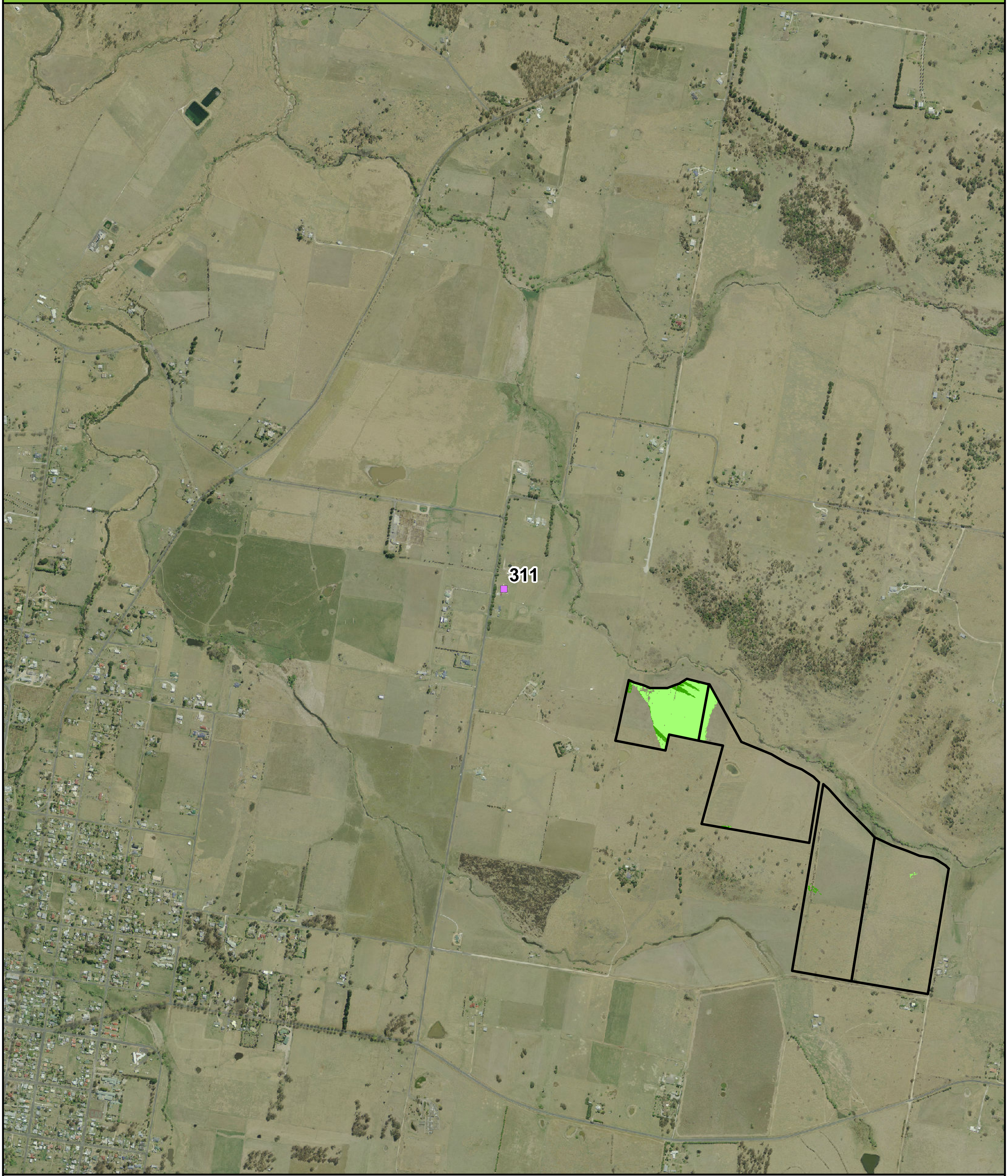
eco logical AUSTRALIA

www.ecoaus.com.au

Prepared by: MS Date: 20/11/2018

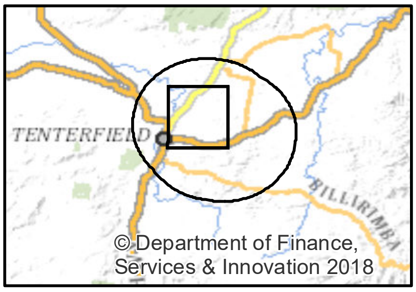
Tenterfield Observer Point Analysis

House ID: 311



Legend

- House
- Solar farm area
- Visible (surface model)
- Visible (Terrain model)



0 0.5 1
Kilometres

Datum/Projection:
GDA 1994 MGA Zone 56

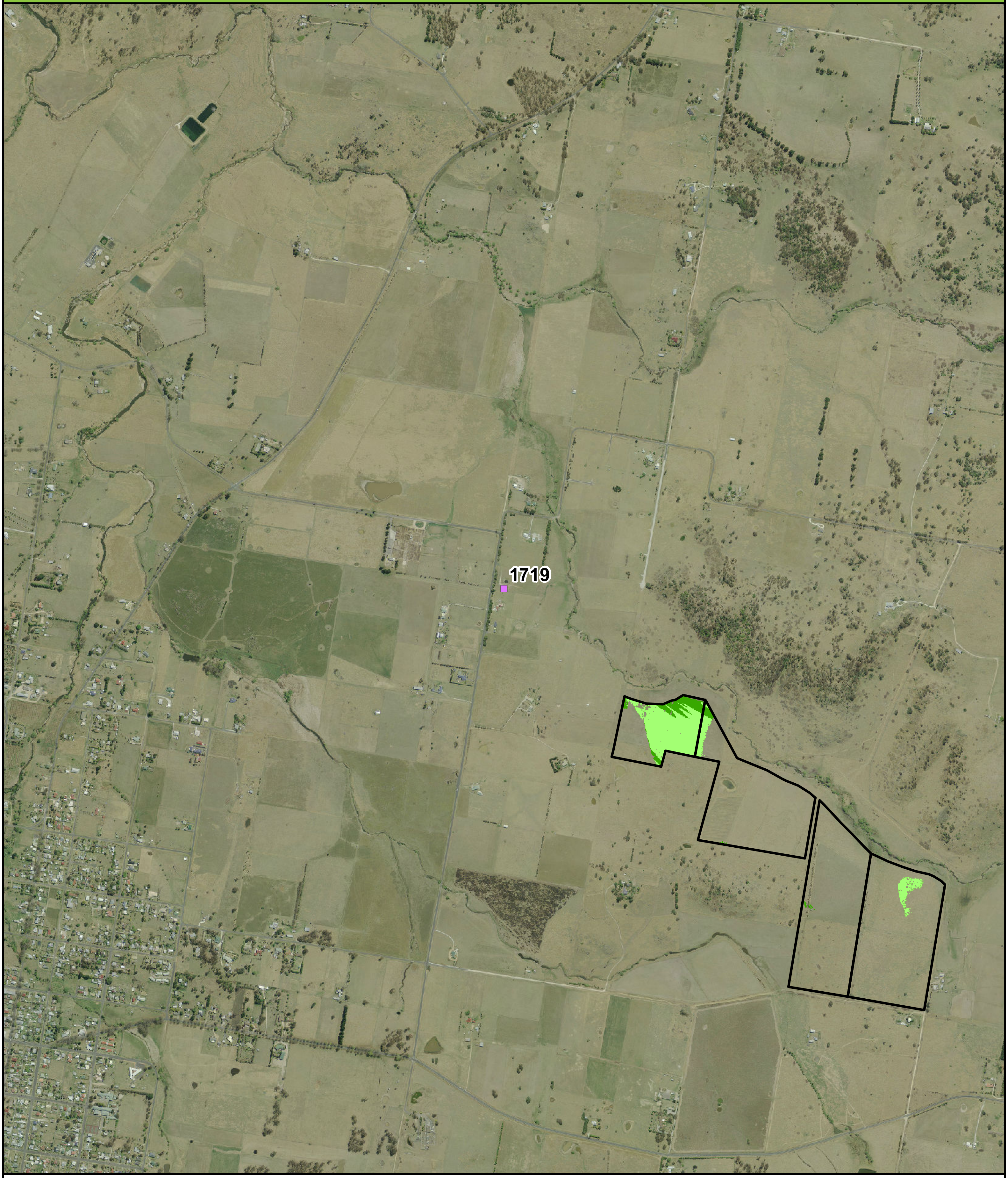
N

eco logical AUSTRALIA
www.ecoaus.com.au

Prepared by: MS Date: 20/11/2018

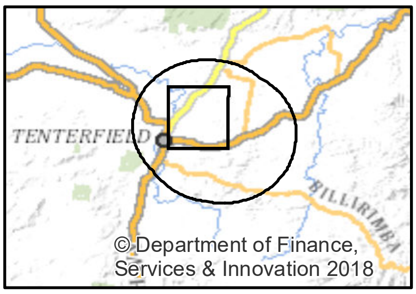
Tenterfield Observer Point Analysis

House ID: 1719



Legend

- House
- Solar farm area
- Visible (surface model)
- Visible (Terrain model)



0 0.5 1
Kilometres

Datum/Projection:
GDA 1994 MGA Zone 56

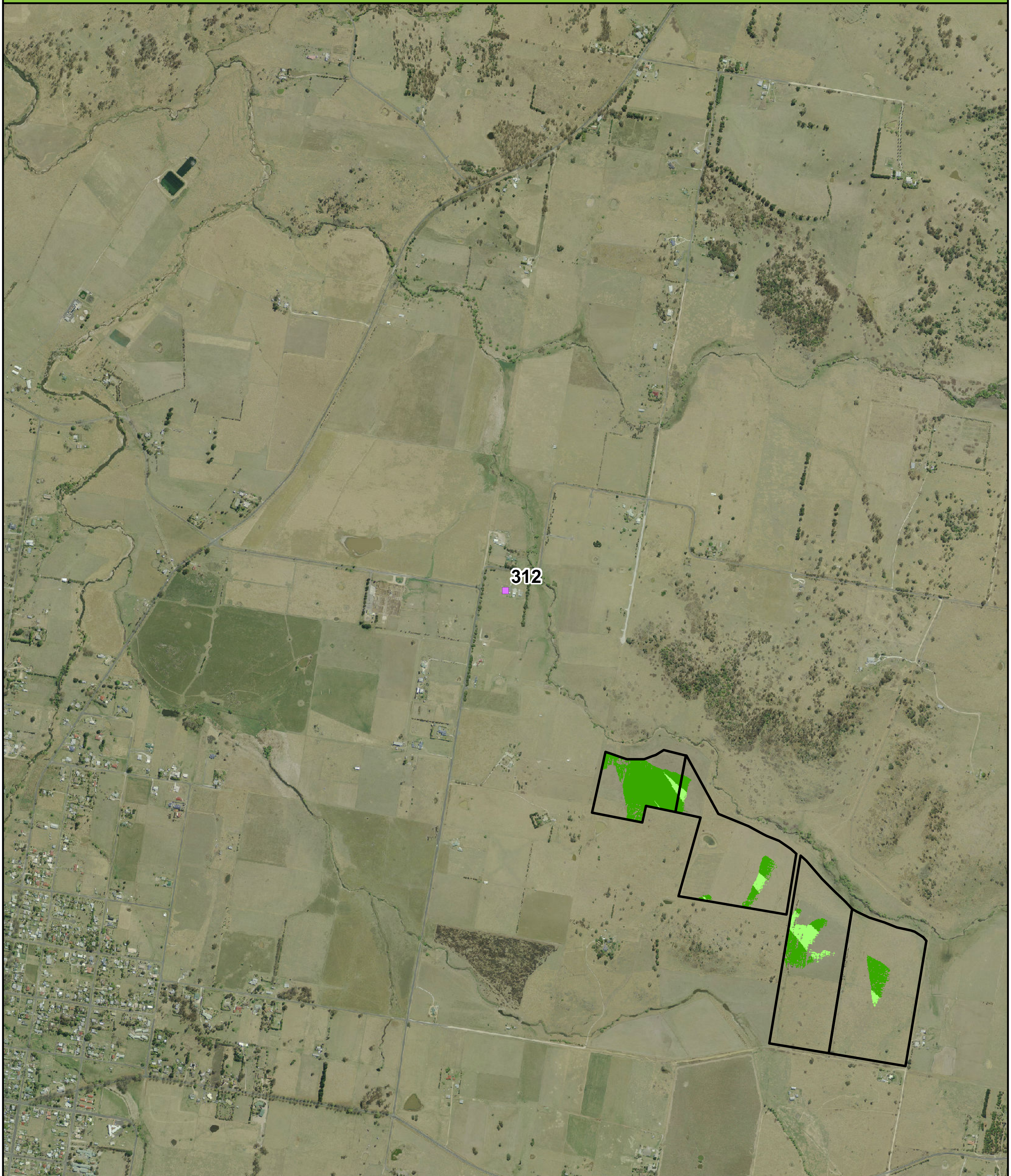
N

eco logical AUSTRALIA
www.ecoaus.com.au

Prepared by: MS Date: 20/11/2018

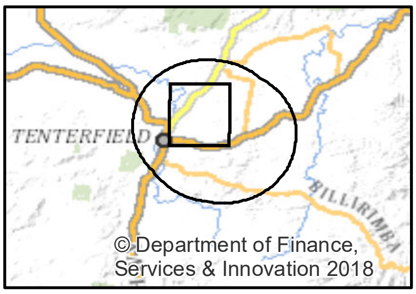
Tenterfield Observer Point Analysis

House ID: 312



Legend

- House
- Solar farm area
- Visible (surface model)
- Visible (Terrain model)



© Department of Finance, Services & Innovation 2018

0 0.5 1
Kilometres

Datum/Projection:
GDA 1994 MGA Zone 56

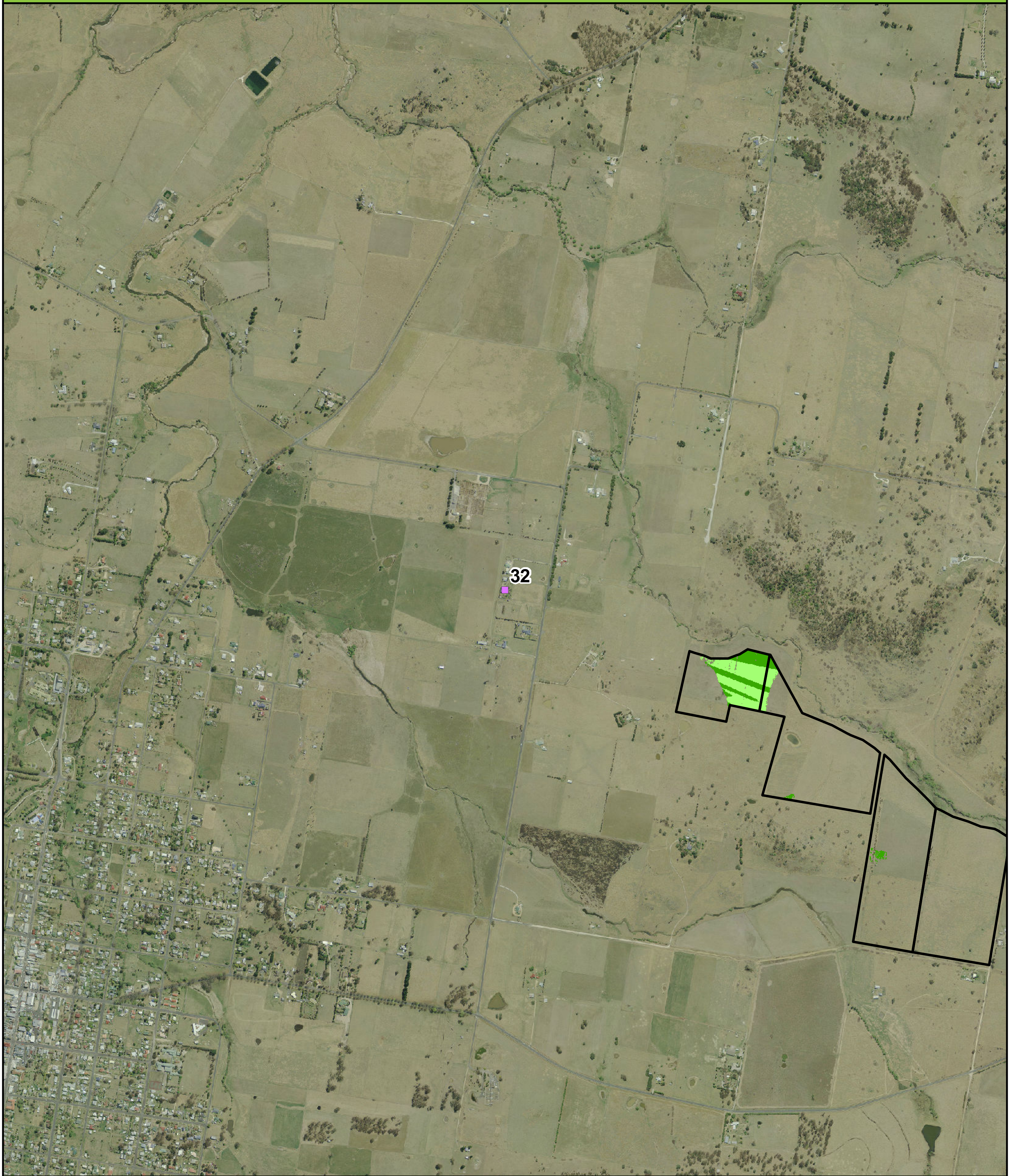
N

eco logical AUSTRALIA
www.ecoaus.com.au

Prepared by: MS Date: 20/11/2018

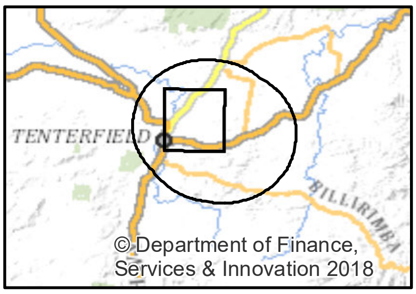
Tenterfield Observer Point Analysis

House ID: 32



Legend

- House
- Solar farm area
- Visible (surface model)
- Visible (Terrain model)



0 0.5 1
Kilometres

Datum/Projection:
GDA 1994 MGA Zone 56

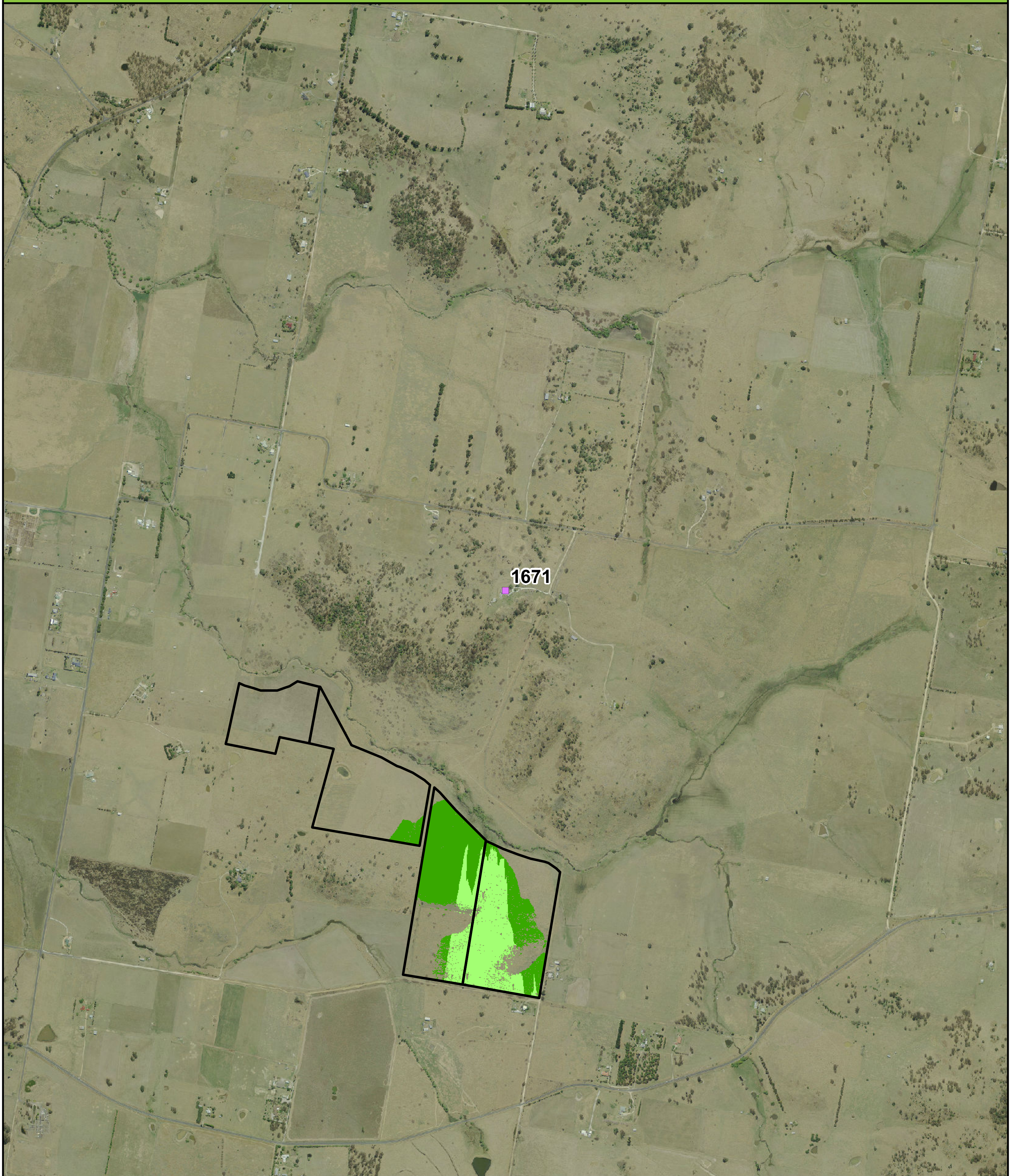
N

eco logical AUSTRALIA
www.ecoaus.com.au

Prepared by: MS Date: 20/11/2018

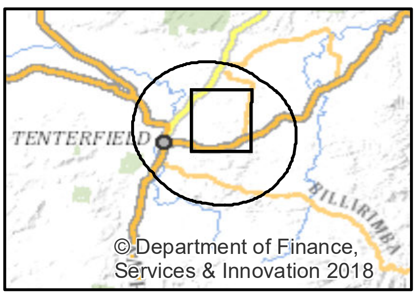
Tenterfield Observer Point Analysis

House ID: 1671



Legend

- House
- Solar farm area
- Visible (surface model)
- Visible (Terrain model)



© Department of Finance, Services & Innovation 2018

0 0.5 1
Kilometres

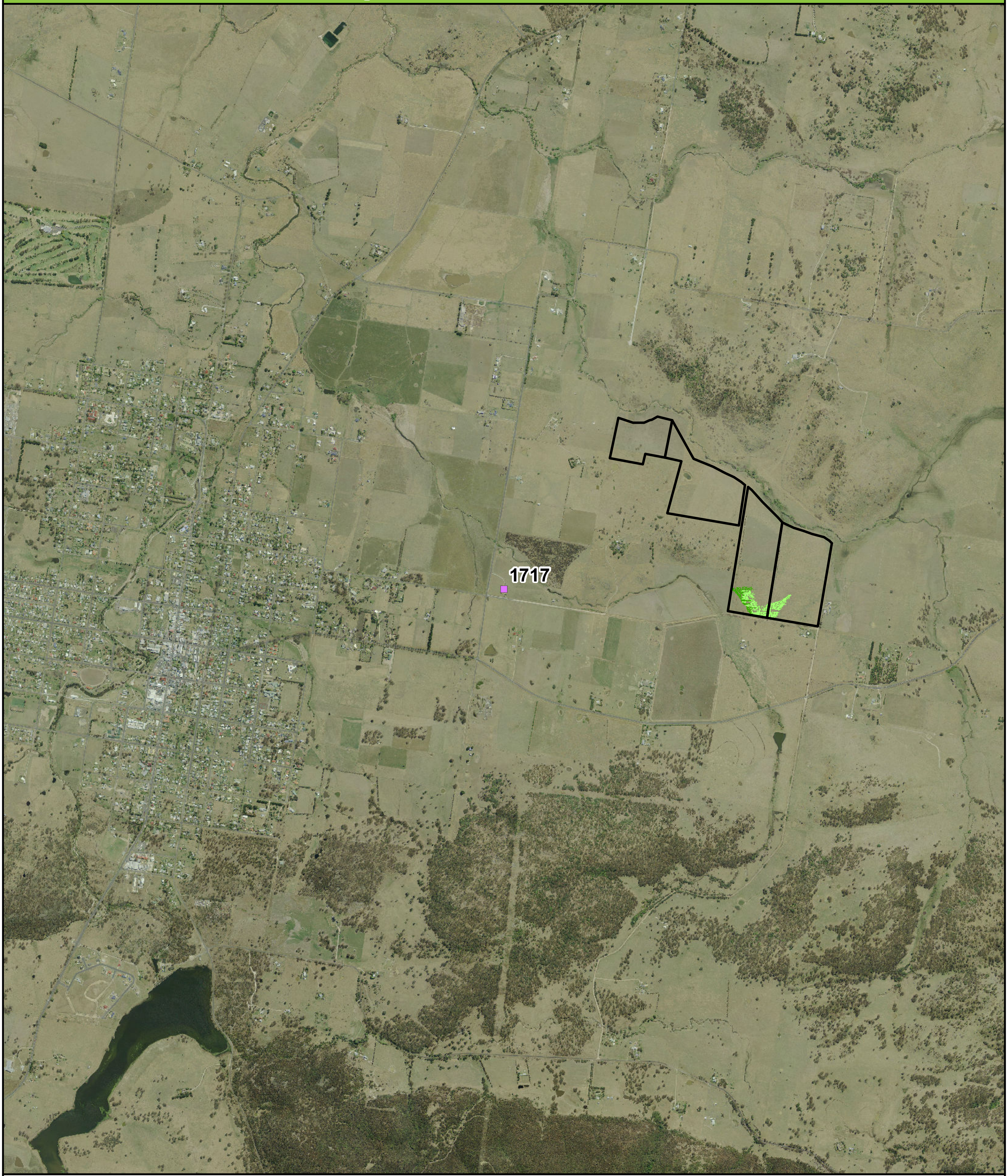
Datum/Projection:
GDA 1994 MGA Zone 56

N

eco logical AUSTRALIA
www.ecoaus.com.au

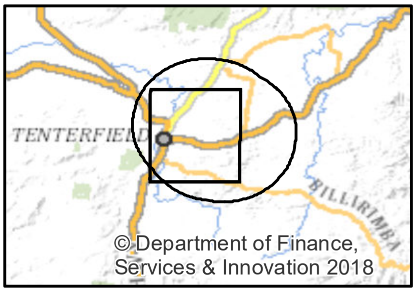
Prepared by: MS Date: 20/11/2018

Tenterfield Observer Point Analysis **House ID: 1717**



Legend

- House
- Solar farm area
- Visible (surface model)
- Visible (Terrain model)



0 0.5 1
Kilometres

Datum/Projection:
GDA 1994 MGA Zone 56

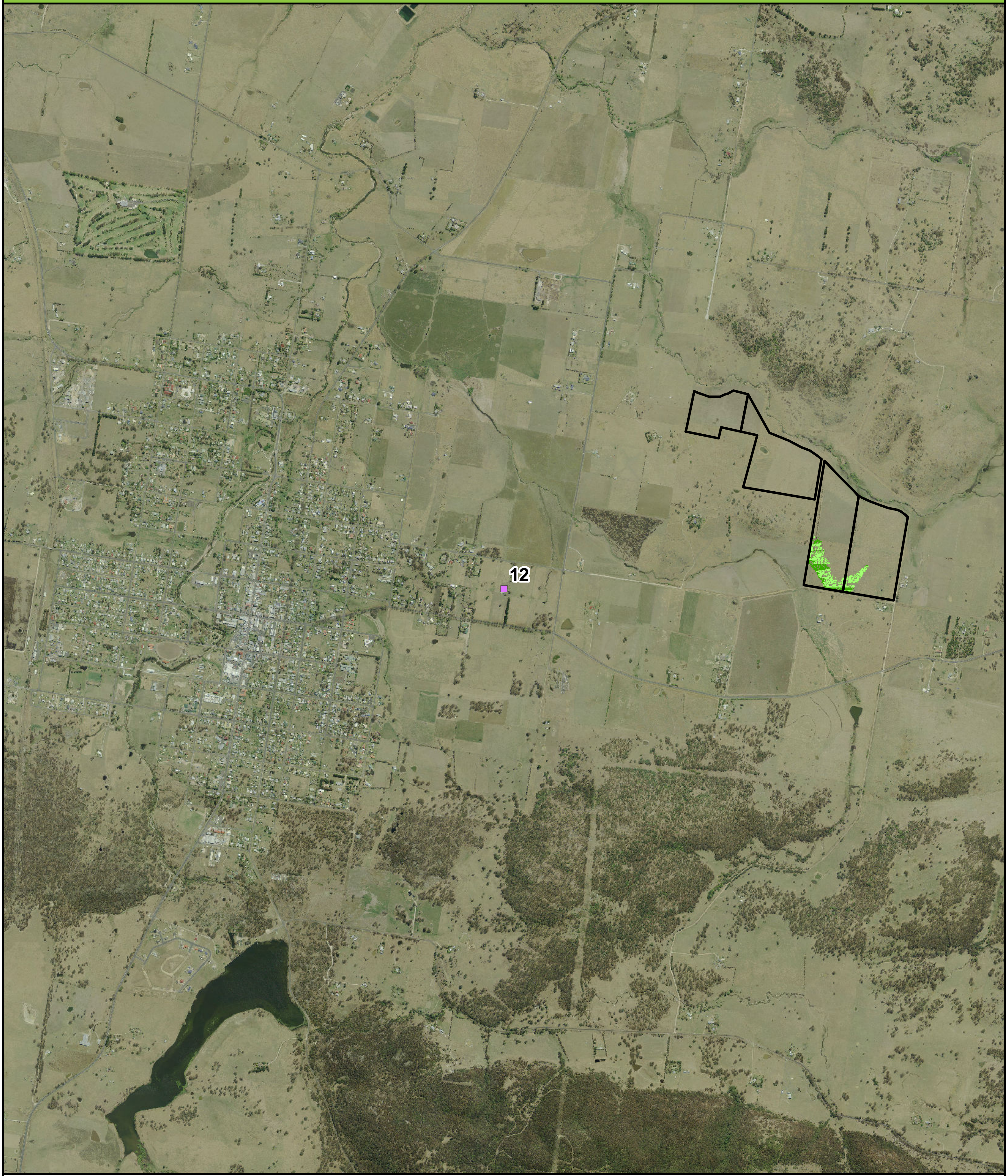
N

eco logical AUSTRALIA
www.ecoaus.com.au

Prepared by: MS Date: 20/11/2018

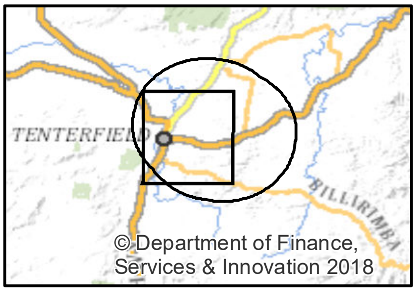
Tenterfield Observer Point Analysis

House ID: 12



Legend

- House
- Solar farm area
- Visible (surface model)
- Visible (Terrain model)



0 0.5 1

Kilometres

Datum/Projection:
GDA 1994 MGA Zone 56

N

eco logical AUSTRALIA

www.ecoaus.com.au

Prepared by: MS Date: 20/11/2018

Appendix F : Glint and Glare Assessment

PAGERPOWER
Urban & Renewables

Solar Photovoltaic Glint and Glare Study

Tenterfield Solar Farm

Eco Logical Australia

April, 2019

ADMINISTRATION PAGE

Job reference:	9542A
Date:	April, 2019
Author:	Danny Scrivener
Telephone:	+44 (0)1787 319001
Email:	danny@pagerpower.com

Reviewer:	Kai Frolic
Date:	April, 2019
Telephone:	+44 (0)1787 319001
Email:	kai@pagerpower.com

Issue	Date	Detail of Changes
1	April, 2019	Initial issue

South Suffolk Business Centre, Alexandra Road, Sudbury, CO10 2ZX

T: *+44 (0)1787 319001* E: *info@pagerpower.com* W: *www.pagerpower.com*

EXECUTIVE SUMMARY

Report Purpose

Pager Power has been retained to assess the possible effects of glint and glare from a proposed solar photovoltaic (PV) installation to be located to the east of Tenterfield in New South Wales, Australia.

This assessment pertains to the possible effects upon an identified dwelling to the north of the proposed solar development.

Pager Power

Pager Power has undertaken over 350 glint and glare assessments in Australia, Europe and worldwide. The company's own glint and glare guidance is based on industry experience and extensive consultation with industry stakeholders including airports and aviation regulators.

Guidance and Studies

Guidelines exist in the UK (produced by the CAA[1]) and in the USA (produced by the FAA[2]) with respect to solar developments and aviation activity, however a specific methodology produced by official bodies for the assessment of residential amenity both internationally and in Australia has not been produced to date[3]. Therefore, Pager Power has reviewed the limited existing guidelines and the available studies (discussed below) in the process of defining its own glint and glare assessment guidance. This Pager Power guidance document[4] defines the process for determining the impact upon local residents. Pager Power's approach is to undertake geometric reflection calculations and review the results against the scenario in which a solar reflection can occur. A comparison is made against the available solar panel reflection studies to determine the overall impact.

The available studies have measured the intensity of reflections from solar panels with respect to other naturally occurring and manmade surfaces. The results show that the reflections produced are of intensity similar to or less than those produced from still water and significantly less than reflections from glass and steel[5].

Glint and Glare

The definition of glint and glare used by Pager Power is as follows:

- Glint – a momentary flash of bright light;
- Glare – a continuous source of bright light.

---

[1] Civil Aviation Authority.
[2] Federal Aviation Administration.
[3] To the author's knowledge.
[4] Pager Power's Glint and Glare Assessment Guidance, Second Edition.
[5] SunPower, 2009, SunPower Solar Module Glare and Reflectance (appendix to Solargen Energy, 2010).

Dwelling Results

Overall, no impact upon the residential amenity of the assessed dwelling to the north of the proposed solar development is expected. This is because a solar reflection from the proposed solar development is not geometrically possible. This is true for a panel elevation angle of 25-degrees and 30-degrees orientated north.

Overall Conclusions and Recommendations

No impact upon the residential amenity of the assessed dwelling is anticipated. No mitigation is required.

LIST OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 46 countries within South Africa, Europe, America, Asia and Australasia.

The company comprises a team of experts to provide technical expertise and guidance on a range of planning issues for large and small developments.

Pager Power was established in 1997. Initially the company focus was on modelling the impact of wind turbines on radar systems. Over the years, the company has expanded into numerous fields including:

- Renewable energy projects.
- Building developments.
- Aviation and telecommunication systems.

Pager Power prides itself on providing comprehensive, understandable and accurate assessments of complex issues in line with national and international standards. This is underpinned by its custom software, longstanding relationships with stakeholders and active role in conferences and research efforts around the world.

Pager Power's assessments withstand legal scrutiny and the company can provide support for a project at any stage.

1 INTRODUCTION

1.1 Overview

Pager Power has been retained to assess the possible effects of glint and glare from a proposed solar photovoltaic (PV) installation to be located to the east of Tenterfield in New South Wales, Australia. The proposed solar development is called the Tenterfield Solar Farm.

This assessment pertains to the possible effects upon ground level receptors. Specifically, an identified dwelling to the north of the proposed solar development has been assessed. A report has therefore been produced that contains the following:

- Details of the proposed solar development;
- Explanation of glint and glare;
- Overview of relevant guidance;
- Overview of relevant studies;
- Identification of aviation concerns and receptors;
- Assessment methodology;
- Glint and glare assessment for the identified dwelling;
- Results discussion.

The relevant technical analysis is presented in each section. Following the assessment, conclusions and recommendations are made. This report is solely desk based and no site visit has taken place.

1.2 Pager Power's Experience

Pager Power has undertaken over 350 Glint and Glare assessments internationally. The studies have included assessment civil and military aerodromes, railway infrastructure and other ground-based receptors including roads and dwellings.

1.3 Glint and Glare Definition

The definition of glint and glare can vary however, the definition used by Pager Power is as follows:

- Glint – a momentary flash of bright light typically received by moving receptors or from moving reflectors.
- Glare – a continuous source of bright light typically received by static receptors or from large reflective surfaces.

These definitions are aligned with those of the Federal Aviation Administration (FAA) in the United States of America. The term 'solar reflection' is used in this report to refer to both reflection types i.e. glint and glare.

2 PROPOSED DEVELOPMENT LOCATION AND DETAILS

2.1 Proposed Solar Panel Design

The solar panels will be orientated facing north and have an elevation angle of 25-30 degrees above the horizontal. The maximum height of the solar panels will be 2.437m above ground level (agl). Figure 1[6] below shows the proposed solar panel design.

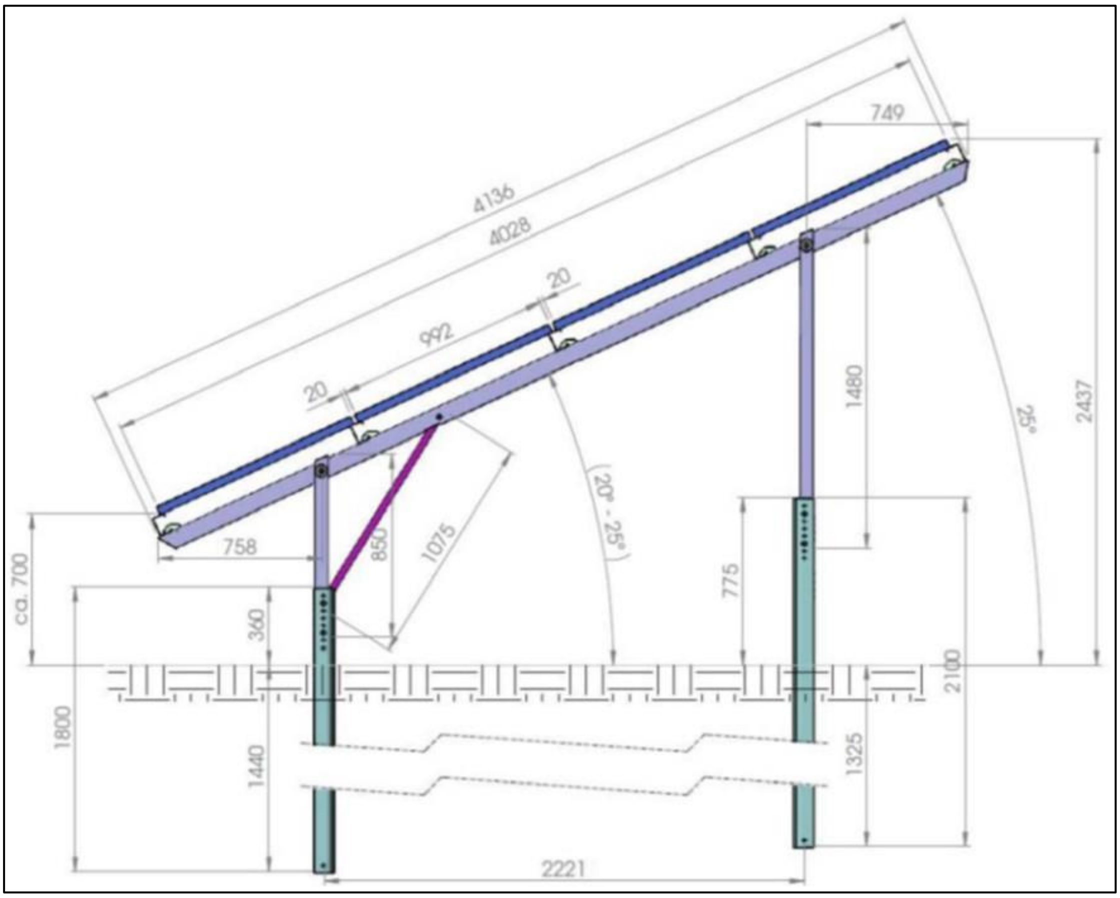


Figure 1 *Proposed solar panel design*

[6] Provided by Eco Logical Australia.

2.2 Proposed Development Location and Solar Panel Area

The approximate site boundary location of the proposed solar development is shown in Figure 2[7] below (red line). The blue area represents the solar panel area.

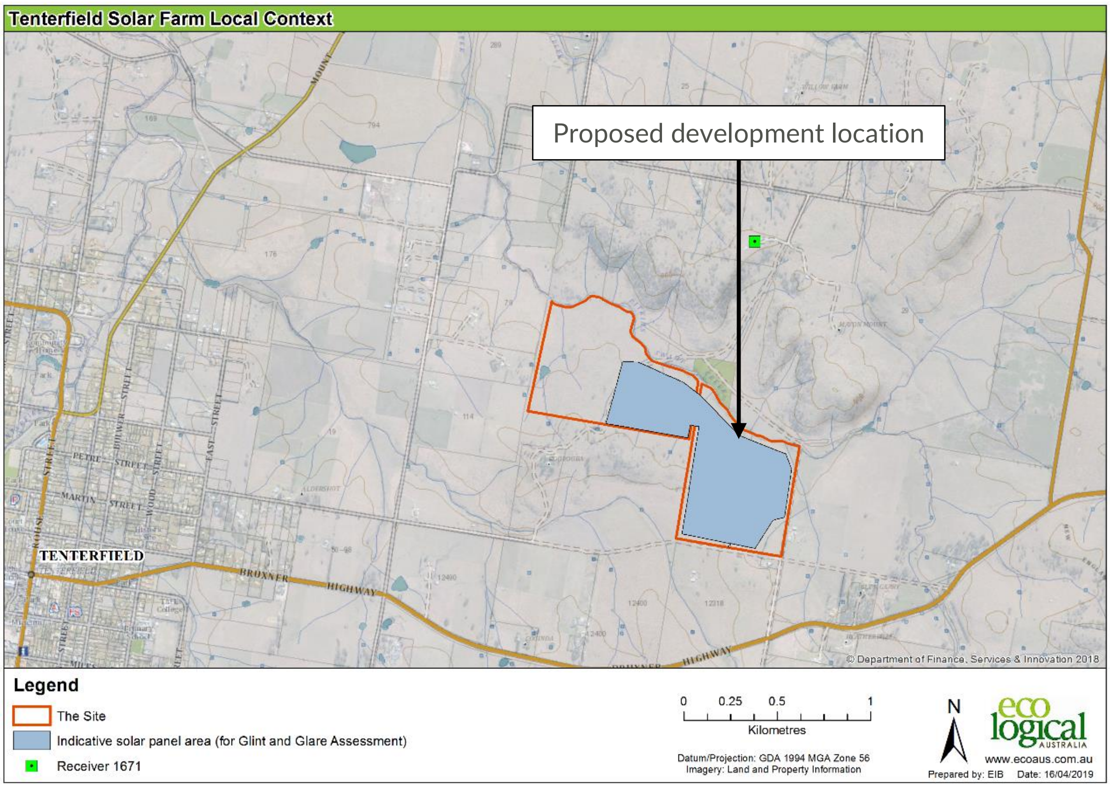


Figure 2 *Proposed development red line boundary and solar panel area*

[7] Source Eco Logical Australia (edited).

3 GLINT AND GLARE ASSESSMENT METHODOLOGY

3.1 Overview

The following sub-sections provide a general overview with respect to the guidance studies and methodology which informs this report.

3.2 Guidance and Studies

Appendix A and B present a review of relevant guidance and independent studies with regard to glint and glare issues from solar panels and glass. The overall conclusions from the available studies are as follows:

- Specular reflections of the Sun from solar panels and glass are possible;
- The measured intensity of a reflection from solar panels can vary from 2% to 30% depending on the angle of incidence;
- Published guidance shows that the intensity of solar reflections from solar panels are equal to or less than those from water and similar to those from glass. It also shows that reflections from solar panels are significantly less intense than many other reflective surfaces, which are common in an outdoor environment.

3.3 Background

Details of the Sun's movements and solar reflections are presented in Appendix C.

3.4 Methodology

The assessment methodology is based on guidance, studies, previous discussions with stakeholders and Pager Power's practical experience. Information regarding the methodology of Pager Power's methodology is presented below.

3.4.1 Pager Power's Methodology

The glint and glare assessment methodology has been derived from the information provided to Pager Power through consultation with stakeholders and by reviewing the available guidance. The methodology for the glint and glare assessment is as follows:

- Identify receptors in the area surrounding the proposed development;
- Consider direct solar reflections from the proposed development towards the identified receptors by undertaking geometric calculations;
- Consider the visibility of the reflectors from the receptor's location. If the reflectors are not visible from the receptor then no reflection can occur;
- Based on the results of the geometric calculations, determine whether a reflection can occur, and if so, at what time it will occur;
- Consider both the solar reflection from the proposed development and the location of the direct sunlight with respect to the receptor's position;
- Consider the solar reflection with respect to the published studies and guidance;

- Determine whether a significant detrimental impact is expected in line with Appendix D.

Within the Pager Power model, the reflector area is defined, as well as the relevant receptor locations. The result is a chart that states whether a reflection can occur, the duration and the panels that can produce the solar reflection towards the receptor.

3.5 Assessment Methodology and Limitations

Further technical details regarding the methodology of the geometric calculations and limitations are presented in Appendix E and Appendix F.

4 IDENTIFICATION OF RECEPTORS

4.1 Overview

The following section presents the relevant receptor assessed within this report.

4.2 Dwelling Receptor

Dwellings are typically identified within approximately 1km of the proposed solar development that are most likely to have visual line of sight to the solar panels (based on an initial high-level review of aerial photography[8] plus local topography). In this instance only one dwelling has been assessed.

If visual line of sight exists between the solar development and the dwelling, then a solar reflection could be experienced if it is geometrically possible. If there is no line of sight, then a reflection cannot be experienced.

For the dwelling receptor, a height of 1.8m has been added to the overall ground height to simulate the typical viewing height a ground floor window. The details regarding the identified dwelling are presented in Appendix G. Figure 3[9] on the following page show the location of the identified dwelling receptor relative to the approximate red line boundary of the proposed solar development.

---

[8] It is worth noting, however, that aerial and street view imagery may not provide the most up to date information of the surrounding area.

[9] Source: Aerial image Copyright © 2019 Google.

Figure 3 *Identified dwelling receptor*

5 ASSESSED REFLECTOR AREA

5.1 Overview

The following section presents the modelled reflector area.

5.2 Reflector Area

A number of representative panel locations are selected within the proposed reflector (solar panel) area. The number of modelled reflector points being determined by the size of the reflector area and the assessment resolution. The bounding co-ordinates for the proposed solar development have been extrapolated from the site maps. The ground heights are based on SRTM data and the panel elevation data has been provided by the developer. All data can be found in Appendix G.

A resolution of 20m has been chosen for this assessment. This means that a geometric calculation is undertaken for each identified receptor every 20m from within the defined area. This resolution is sufficiently high to maximise the accuracy of the results – increasing the resolution further would not significantly change the modelling output.

A panel elevation angle of 25 degrees and 30 degrees has been assessed,

If a reflection is experienced from an assessed panel location, then it is likely that a reflection will be viewable from similarly located panels within the proposed solar development.

The reflector area assessed is shown in Figure 4[10] on the following page (blue).

[10] Source: Aerial image copyright © 2019 Google.

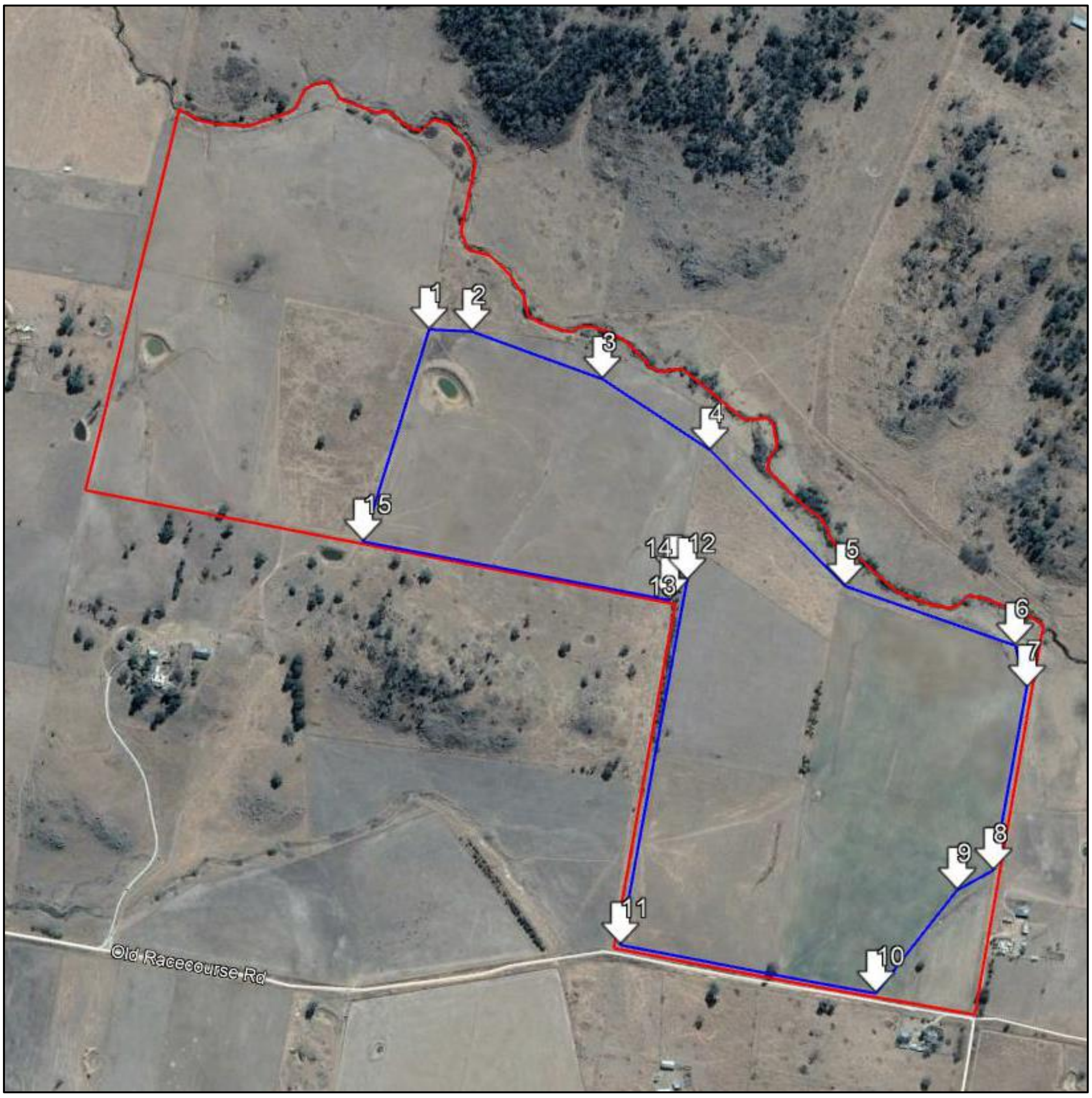


Figure 4 *Assessed reflector area*

6 GLINT AND GLARE ASSESSMENT RESULTS

6.1 Overview

The table in the following subsection summarises the months and times during which a solar reflection could be experienced by the dwelling, if at all.

This does not mean that reflections would occur continuously between the times shown.

The range of times at which reflections are geometrically possible is generally greater than the length of time for any particular day. This is because the times of day at which reflections could start and stop vary throughout the days/months.

The range of times for which reflections are geometrically possible are presented on the solar reflection charts in Appendix H for each receptor if a solar reflection is possible.

6.2 Geometric Reflection Calculation Results Overview – Dwellings

The result of the geometric calculations for the dwelling receptor is presented in Table 1 below.

<table>
<tr><th rowspan="3">Receptor</th><th colspan="2">Pager Power Results</th><th rowspan="3">Comment</th></tr>
<tr><th colspan="2">Reflection theoretically possible towards the dwelling? (GMT +10)</th></tr>
<tr><th>am</th><th>pm</th></tr>
<tr><td>1</td><td>No</td><td>No</td><td>25-degree panel
No solar reflection is geometrically possible.
No impact expected.</td></tr>
<tr><td>1</td><td>No</td><td>No</td><td>30-degree panel
No solar reflection is geometrically possible.
No impact expected.</td></tr>
</table>

Table 1 *Analysis results for the dwelling*

7 GEOMETRIC ASSESSMENT RESULTS AND DISCUSSION

7.1 Overview

The result of the glint and glare calculations and a discussion for the identified dwelling receptor is presented in the following sub-section.

7.2 Dwelling Results

Based on a review of the geometric analysis, no solar reflection is possible towards the identified dwelling. This is because the Sun is never in a position to reflect from the solar panels towards the dwellings. This is true for both the panel elevation angle of 25-degrees and 30-degrees orientated north.

7.3 Dwelling Assessment Conclusions

In accordance with the methodology set out in Section 3 and Appendix D, no impact upon residential amenity for the identified dwelling to the north of the proposed solar development is expected. No mitigation is required.

8 OVERALL CONCLUSIONS

8.1 Dwelling Results

Overall, no impact upon the residential amenity of the assessed dwelling to the north of the proposed solar development is expected. This is because a solar reflection from the proposed solar development is not geometrically possible. This is true for both the panel elevation angle of 25-degrees and 30-degrees orientated north.

8.2 Overall Conclusions and Recommendations

No impact upon the residential amenity of the assessed dwelling is anticipated. No mitigation is required.

APPENDIX A – OVERVIEW OF GLINT AND GLARE GUIDANCE

Overview

This section presents details regarding the relevant UK guidance and studies with respect to the considerations and effects of solar reflections from solar panels, known as 'Glint and Glare'. It is presented for reference only.

This is not a comprehensive review of the data sources, rather it is intended to give an overview of the important parameters and considerations that have informed this assessment.

UK Planning Policy

UK National Planning Practice Guidance dictates that in some instances a glint and glare assessment is required however, there is no specific guidance with respect to the methodology for assessing the impact of glint and glare.

The planning policy from the Department for Communities and Local Government (paragraph 27[11]) states:

'Particular factors a local planning authority will need to consider include… the effect on landscape of glint and glare and on ***neighbouring uses and aircraft safety***.*'*

The National Planning Policy Framework for Renewable and Low Carbon Energy[12] (specifically regarding the consideration of solar farms, paragraph 26 and 27) states:

'What are the particular planning considerations that relate to large scale ground-mounted solar photovoltaic Farms?

The deployment of large-scale solar farms can have a negative impact on the rural environment, particularly in undulating landscapes. However, the visual impact of a well-planned and well-screened solar farm can be properly addressed within the landscape if planned sensitively.

Particular factors a local planning authority will need to consider include:

- *the proposal's visual impact, the effect on landscape of glint and glare (see guidance on landscape assessment) and on* ***neighbouring uses and aircraft safety****;*
- *the extent to which there may be additional impacts if solar arrays follow the daily movement of the sun;*

The approach to assessing cumulative landscape and visual impact of large scale solar farms is likely to be the same as assessing the impact of wind turbines. However, in the case of ground-mounted solar panels it should be noted that with effective screening and appropriate land topography the area of a zone of visual influence could be zero.'

---

[11] Planning practice guidance for renewable and low carbon energy, Department for Communities and Local Government, date: 06/2013, accessed on: 20/03/2019
[12] Planning practice guidance for renewable and low carbon energy, Department for Communities and Local Government, date: 06/2013, accessed on: 20/03/2019

Assessment Process – Ground-Based Receptors

No process for determining and contextualising the effects of glint and glare are, however, provided for assessing the impact of solar reflections upon surrounding dwellings. Therefore, the Pager Power approach is to determine whether a reflection from the proposed solar development is geometrically possible and then to compare the results against the relevant guidance/studies to determine whether the reflection is significant. The Pager Power approach has been informed by the policy presented above, current studies (presented in Appendix B) and stakeholder consultation. Further information can be found in Pager Power's Glint and Glare Guidance document[13] which was produced due to the absence of existing guidance and a specific standardised assessment methodology.

[13] Solar Photovoltaic Development – Glint and Glare Guidance, Second Edition 2, October 2018. Pager Power.

APPENDIX B – OVERVIEW OF GLINT AND GLARE STUDIES

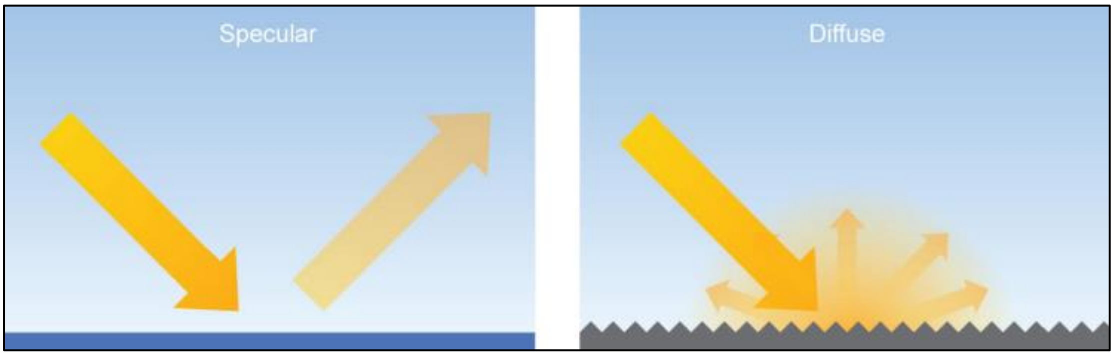
Overview

Studies have been undertaken assessing the type and intensity of solar reflections from various surfaces including solar panels and glass. An overview of these studies is presented below.

The guidelines presented are related to aviation safety. The results are applicable for the purpose of this analysis.

Reflection Type from Solar Panels

Based on the surface conditions reflections from light can be specular and diffuse. A specular reflection has a reflection characteristic similar to that of a mirror; a diffuse will reflect the incoming light and scatter it in many directions. The figure below, taken from the FAA guidance[14], illustrates the difference between the two types of reflections. Because solar panels are flat and have a smooth surface most of the light reflected is specular, which means that incident light from a specific direction is reradiated in a specific direction.



Specular and diffuse reflections

---

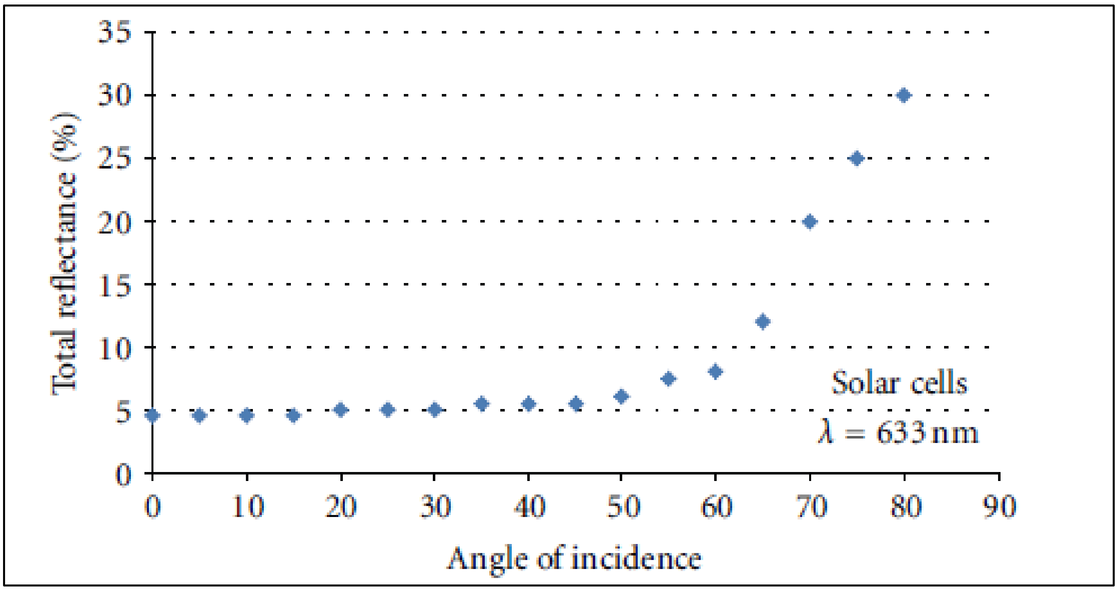
[14]Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration (FAA), date: 04/2018, accessed on: 20/03/2019.

Solar Reflection Studies

An overview of content from identified solar panel reflectivity studies is presented in the subsections below.

Evan Riley and Scott Olson, "A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic Systems"

Evan Riley and Scott Olson published in 2011 their study titled: *A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic Systems*[15]". They researched the potential glare that a pilot could experience from a 25 degree fixed tilt PV system located outside of Las Vegas, Nevada. The theoretical glare was estimated using published ocular safety metrics which quantify the potential for a postflash glare after-image. This was then compared to the postflash glare after-image caused by smooth water. The study demonstrated that the reflectance of the solar cell varied with angle of incidence, with maximum values occurring at angles close to 90 degrees. The reflectance values varied from approximately 5% to 30%. This is shown on the figure below.



Total reflectance % when compared to angle of incidence

The conclusions of the research study were:

- The potential for hazardous glare from flat-plate PV systems is similar to that of smooth water;
- Portland white cement concrete (which is a common concrete for runways), snow, and structural glass all have a reflectivity greater than water and flat plate PV modules.

---

[15] Evan Riley and Scott Olson, "A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic Systems," ISRN Renewable Energy, vol. 2011, Article ID 651857, 6 pages, 2011. doi:10.5402/2011/651857

FAA Guidance – "Technical Guidance for Evaluating Selected Solar Technologies on Airports"[16]

The 2010 FAA Guidance included a diagram which illustrates the relative reflectance of solar panels compared to other surfaces. The figure shows the relative reflectance of solar panels compared to other surfaces. Surfaces in this figure produce reflections which are specular and diffuse. A specular reflection (those made by most solar panels) has a reflection characteristic similar to that of a mirror. A diffuse reflection will reflect the incoming light and scatter it in many directions. A table of reflectivity values, sourced from the figure within the FAA guidance, is presented below.

Surface	Approximate Percentage of Light Reflected[17]
Snow	80
White Concrete	77
Bare Aluminium	74
Vegetation	50
Bare Soil	30
Wood Shingle	17
Water	5
Solar Panels	5
Black Asphalt	2

Relative reflectivity of various surfaces

Note that the data above does not appear to consider the reflection type (specular or diffuse).

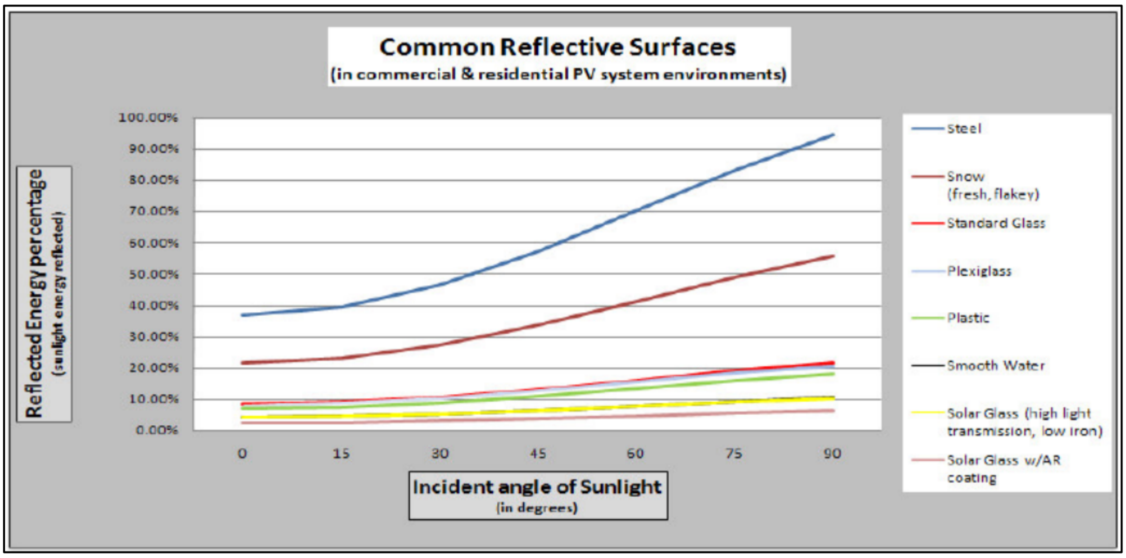
An important comparison in this table is the reflectivity compared to water which will produce a reflection of very similar intensity when compared to that from a solar panel. The study by Riley and Olsen study (2011) also concludes that still water has a very similar reflectivity to solar panels.

[16] Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration (FAA), date: 04/2018, accessed on: 20/03/2019.
[17] Extrapolated data, baseline of 1,000 W/m^2 for incoming sunlight.

SunPower Technical Notification (2009)

SunPower published a technical notification[18] to '*increase awareness concerning the possible glare and reflectance impact of PV Systems on their surrounding environment'*.

The figure presented below shows the relative reflectivity of solar panels compared to other natural and manmade materials including smooth water, standard glass and steel.



Common reflective surfaces

The results, similarly to those from Riley and Olsen study (2011) and the FAA (2010), show that solar panels produce a reflection that is less intense than those of '*standard glass and other common reflective surfaces*'.

[18] Source: Technical Support, 2009. SunPower Technical Notification – Solar Module Glare and Reflectance.

APPENDIX C – OVERVIEW OF SUN MOVEMENTS AND RELATIVE REFLECTIONS

The Sun's position in the sky can be accurately described by its azimuth and elevation. Azimuth is a direction relative to true north (horizontal angle i.e. from left to right) and elevation describes the Sun's angle relative to the horizon (vertical angle i.e. up and down).

The Sun's position can be accurately calculated for a specific location. The following data being used for the calculation:

- Time;
- Date;
- Latitude;
- Longitude.

The combination of the Sun's azimuth angle and vertical elevation will affect the direction and angle of the reflection from a reflector.

APPENDIX D – GLINT AND GLARE IMPACT SIGNIFICANCE

Overview

The significance of glint and glare will vary for different receptors. The following section presents a general overview of the significance criteria with respect to experiencing a solar reflection.

Impact significance definition

The table below presents the recommended definition of 'impact significance' in glint and glare terms and the requirement for mitigation under each.

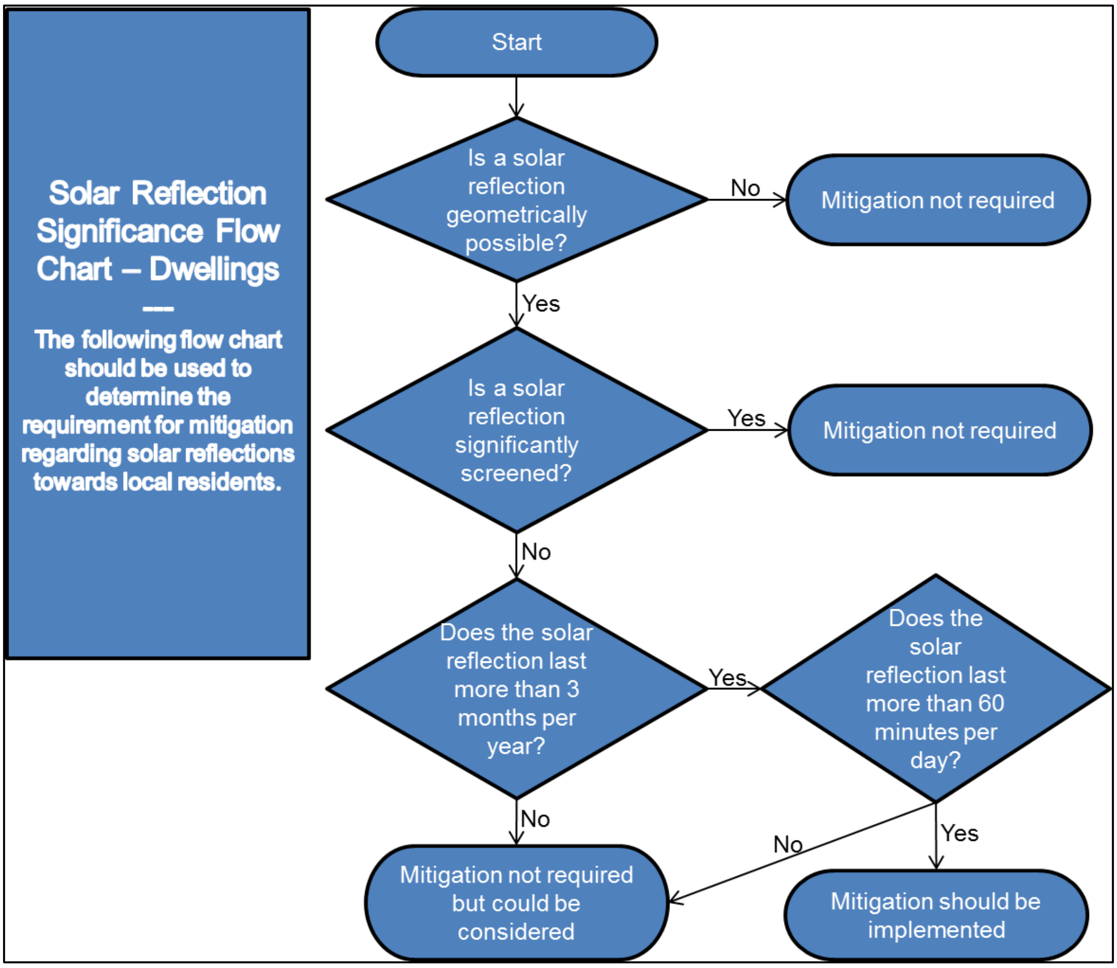
Impact Significance	Definition	Mitigation Requirement
No Impact	A solar reflection is not geometrically possible or will not be visible from the assessed receptor.	No mitigation required.
Low	A solar reflection is geometrically possible however any impact is considered to be small such that mitigation is not required e.g. intervening screening will limit the view of the reflecting solar panels.	No mitigation required.
Moderate	A solar reflection is geometrically possible and visible however it occurs under conditions that do not represent a worst-case.	Whilst the impact may be acceptable, consultation and/or further analysis should be undertaken to determine the requirement for mitigation.
Major	A solar reflection is geometrically possible and visible under conditions that will produce a significant impact. Mitigation and consultation is recommended.	Mitigation will be required if the proposed development is to proceed.

Impact significance definition

The flow charts presented in the following sub-sections have been followed when determining the mitigation requirement for dwelling receptors.

Assessment Process for Dwelling Receptors

The flow chart presented below has been followed when determining the mitigation requirement for dwelling receptors.



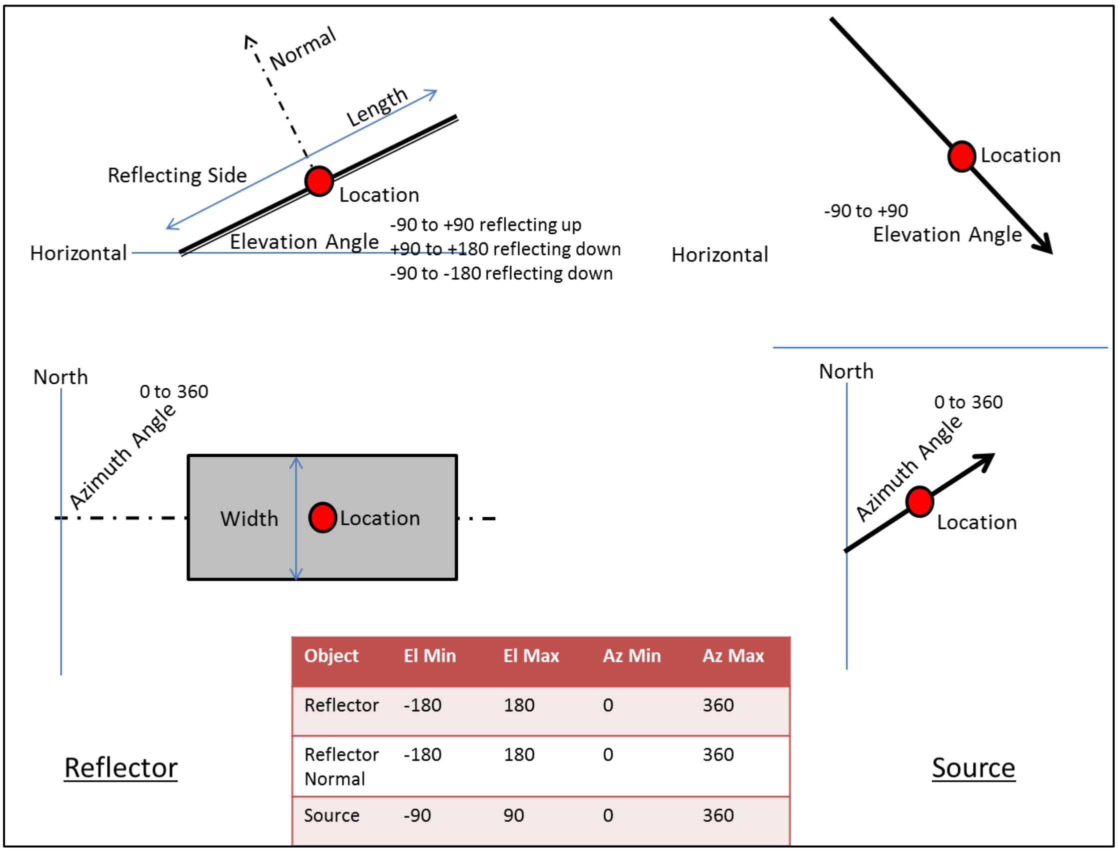
Dwelling receptor mitigation requirement flow chart

APPENDIX E – PAGER POWER'S REFLECTION CALCULATIONS METHODOLOGY

The calculations are three dimensional and complex, accounting for:

- The Earth's orbit around the Sun;
- The Earth's rotation;
- The Earth's orientation;
- The reflector's location;
- The reflector's 3D Orientation.

Reflections from a flat reflector are calculated by considering the normal which is an imaginary line that is perpendicular to the reflective surface and originates from it. The diagram below may be used to aid understanding of the reflection calculation process.



Object	El Min	El Max	Az Min	Az Max
Reflector	-180	180	0	360
Reflector Normal	-180	180	0	360
Source	-90	90	0	360

The following process is used to determine the 3D azimuth and elevation of a reflection:

- Use the Latitude and Longitude of reflector as the reference for calculation purposes;
- Calculate the Azimuth and Elevation of the normal to the reflector;
- Calculate the 3D angle between the source and the normal;

- If this angle is less than 90 degrees a reflection will occur. If it is greater than 90 degrees no reflection will occur because the source is behind the reflector;
- Calculate the Azimuth and Elevation of the reflection in accordance with the following:
    - The angle between source and normal is equal to angle between normal and reflection;
    - Source, Normal and Reflection are in the same plane.

APPENDIX F – ASSESSMENT LIMITATIONS AND ASSUMPTIONS

Pager Power's Model

It is assumed that the panel elevation angle provided by the developer represents the elevation angle for all of the panels within the solar development.

It is assumed that the panel azimuth angle provided by the developer represents the azimuth angle for all of the panels within the solar development.

Only a reflection from the face of the panel has been considered. The frame or the reverse of the solar panel has not been considered.

The model assumes that a receptor can view the face of every panel within the proposed development area whilst in reality this, in the majority of cases, will not occur. Therefore any predicted reflection from the face of a solar panel that is not visible to a receptor will not occur.

A finite number of points within the proposed development are chosen based on an assessment resolution so we can build a comprehensive understanding of the entire development. This will determine whether a reflection could ever occur at a chosen receptor. The calculations do not incorporate all of the possible panel locations within the development outline.

A single reflection point on the panel has been chosen for the geometric calculations. This will suitably determine whether a reflection can be experienced at a location and the general time of year and duration of this reflection. Increased accuracy could be achieved by increasing the number of heights assessed however this would only marginally change the results and is not considered significant.

Whilst line of sight to the development from receptors has been considered, only available street view imagery and satellite mapping has been used. In some cases this imagery may not be up to date and may not give the full perspective of the installation from the location of the assessed receptor.

Any screening in the form of trees, buildings etc. that may obstruct the Sun from view of the solar panels is not considered unless stated.

APPENDIX G – RECEPTOR AND REFLECTOR AREA DETAILS

Receptor Data – Dwellings

Location	Longitude (°)	Latitude (°)	Ground Height (m)	Assessed Height (m)
1	152.0591	-29.0377	898.51	900.31

Dwelling receptor details

Modelled Reflector Area

ID	Longitude (°)	Latitude (°)	Ground Height amsl	Assessment Data
1	152.0518	-29.0436	Based on SRTM terrain data	Reflector point has been modelled at 1.6m agl. The azimuth angle of the solar panels has been assessed at 0 degrees. The panel elevation angle has been assessed at 25 and 30 degrees.
2	152.0525	-29.0436		
3	152.0545	-29.0442		
4	152.0562	-29.0452		
5	152.0583	-29.0471		
6	152.061	-29.0479		
7	152.0612	-29.0485		
8	152.0607	-29.051		
9	152.0601	-29.0513		
10	152.0588	-29.0527		
11	152.0548	-29.052		
12	152.0559	-29.047		
13	152.0556	-29.047		
14	152.0556	-29.0473		
15	152.0508	-29.0465		

Modelled reflector area data

Modelled reflector area image

APPENDIX H – GEOMETRIC CALCULATION RESULTS – PAGER POWER RESULTS

The charts for the receptors are shown on the following pages. Each chart shows:

- The receptor (observer) location – top right image. This also shows the azimuth range of the Sun itself at times when reflections are possible. If sunlight is experienced from the same direction as the reflecting panels, the overall impact of the reflection is reduced as discussed within the body of the report;
- The reflecting areas – bottom right image. The reflecting area is shown in yellow. If the yellow panels are not visible from the observer location, no issues will occur in practice. Additional obstructions which may obscure the reflector area from view are considered separately within the analysis;
- The reflection date/time graph – below the main chart. The line indicates the dates and times at which geometric reflections are possible. This relates to reflections from the yellow areas only.
- The red and yellow lines show the sunrise and sunset time respectively.

Dwelling Receptors

The solar reflection charts are presented below.

25-degree panel

Observer D1

No valid reflections found.

30-degree panel

Observer D1

No valid reflections found.

PAGERPOWER
Urban & Renewables

Pager Power Limited
South Suffolk Business Centre
Alexandra Road
Sudbury
Suffolk
CO10 2ZX

Tel: +44 1787 319001 **Email:** info@pagerpower.com **Web:** www.pagerpower.com

Appendix G : Noise assessment

Noise Impact Assessment

Tenterfield Solar Farm

Prepared for Eco Logical Australia
Report Reference: 18SYA0068 R01_1

About TTM

For 30 years, we've been at the centre of the Australian development and infrastructure industry. Our unique combination of acoustics, data, traffic and waste services is fundamental to the success of any architectural or development project.

We have over 50 staff, with an unrivalled depth of experience. Our industry knowledge, technical expertise and commercial insight allow us to deliver an exceptional and reliable service.

T: (02) 9418 3033
F: (02) 9418 3112
E: ttmnsw@ttmgroup.com.au

Acoustics Data Traffic Waste

Revision Record

No.	Author	Reviewed/Approved	Description	Date
A.	K. Dhayam	-	Draft – Issued to client	09/11/2018
0.	K. Dhayam	J. Fox	Final	19/11/2018
1.	K. Dhayam	J. Fox	Revision 1 – Minor Changes	26/11/2018

Level 5, Suite 501, 174 Pacific Highway. PO Box 5238 Greenwich NSW 2065

Contents

Table Index

Figure Index

1 Introduction

TTM Consulting has been engaged by Eco Logical Australia to conduct a noise impact assessment for the proposed Tenterfield solar farm.

The proposed solar farm is located approximately 3km to the north east of the township of Tenterfield, which is an agricultural town, approximately 200km inland due west from Byron Bay. The assessment includes the following:

- Construction noise assessment:
  - Identification of construction stages and associated activities including, specialised machinery and equipment used during the works
  - Assessment in accordance with the NSW Interim Construction Noise Guideline[1] (ICNG), and
  - Advice on practical and appropriate in-principle noise mitigation and management, where required.
- Operational noise impact assessment:
  - Confirm locations of sub-stations on site
  - Obtain noise data for typical sub-station to be used
  - Obtain noise data for inverters to be used
  - Assessment in accordance with the NSW Noise for Industry Policy (2017)[2], and
  - Advice on practical and appropriate in-principle noise mitigation and management, where required.

[1] NSW Department of Environment and Climate Change (DECC) (2009), Interim Construction Noise Guideline

[2] NSW Environment Protection Authority (2017), Noise Policy for Industry

2 Site Description

The subject site comprises approximately 60ha of land that forms part of the Tenterfield Solar Farm area. The site comprises of Lots 85, 87, 89 and 90 on DP751540.

An aerial image of the site locality is shown in Figure 1.

Figure 1: Site Locality

The site is generally flat with cleared farm land. The subject land is farmed mainly for crop raising and some low intensive grazing. Access to the site would be via an existing access point from Old Racecourse Road.

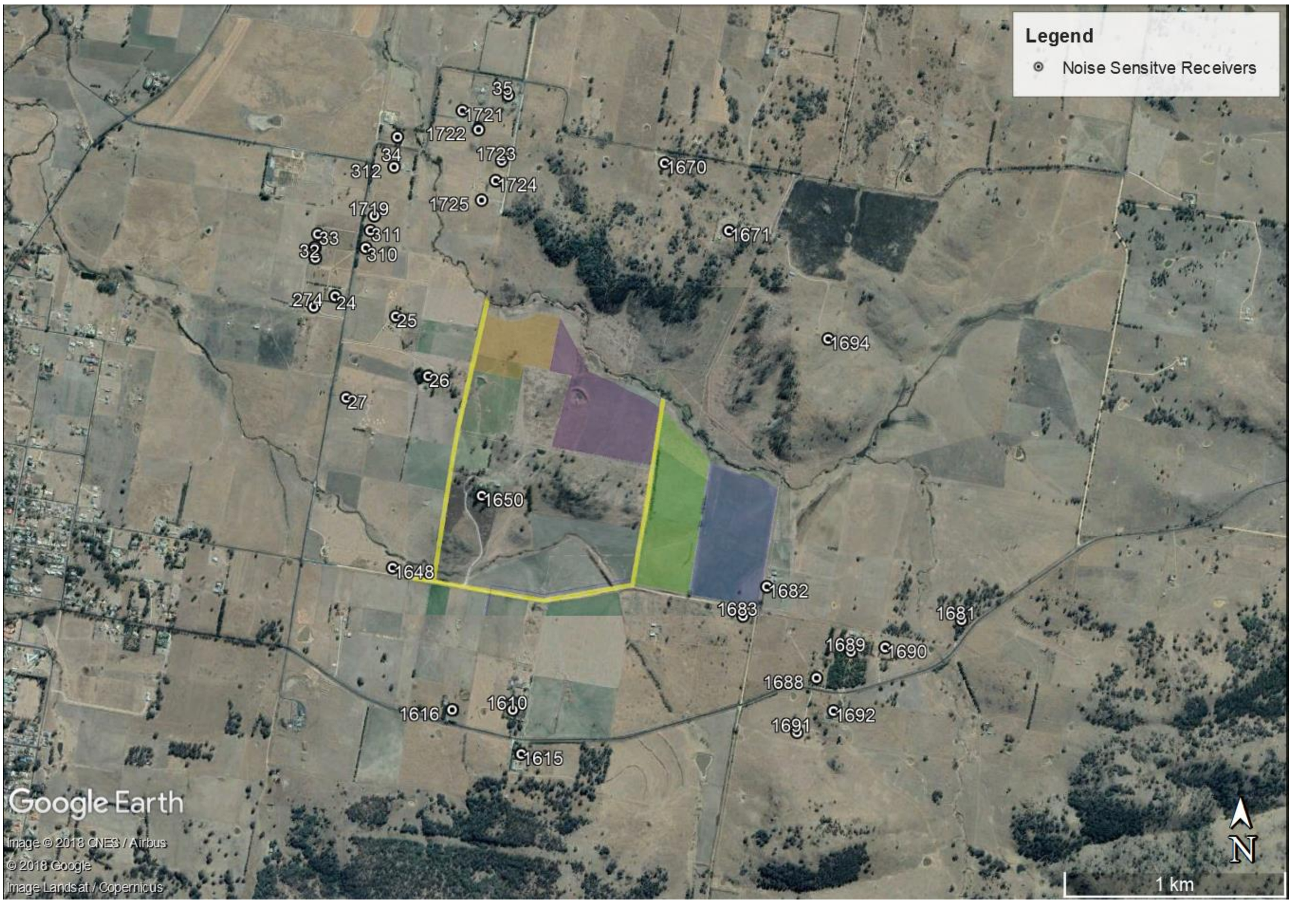
Bruxner Highway, located south of the site, is the main access to Tenterfield from the east.

2.1 Surrounding Areas and Noise Sensitive Receivers

The surrounding area is generally characterised by productive farm land and seldom residential properties.

There are 35 dwellings which have been identified within 1km of the site. The dwellings have been marked based on the identification number adopted by Eco Logical Australia (ELA) and are shown in Figure 2.

Figure 2: Surrounding Areas and Noise Sensitive Receivers



2.2 Noise Sensitive Receivers (NSRs)

The closest residential properties which may be adversely impacted by noise from the construction and operation of the solar farm have been identified in Figure 2 and are summarised in Table 1.

Table 1: List of Noise Sensitive Receivers

ELA ID	Distance to 'Solar farm area' (metres)	Lot and DP Number	Longitude	Latitude
1682	31	Lot 91 on DP751540	152.0608	-29.0521
1683	47	Lot 1 on DP809079	152.0597	-29.0532
26	195	Lot 140 on DP751540	152.0451	-29.0435
1650	370	Lot 861 on DP1218118	152.0476	-29.0484
25	388	Lot 34 on DP1175097	152.0436	-29.0411
1688	414	Lot 1 on DP800400	152.0631	-29.0557
1689	468	Lot 2 on DP800400	152.0647	-29.0547
1725	519	Lot 10 on DP1173703	152.0476	-29.0364
1692	575	Lot 2 on DP805186	152.0639	-29.0571
27	577	Lot 39 on DP751540	152.0413	-29.0444
1691	585	Lot 1 on DP805186	152.0622	-29.0579
1690	607	Lot 3 on DP800400	152.0663	-29.0545
1724	611	Lot 9 on DP1173703	152.0483	-29.0356
310	616	Lot 2 on DP1135378	152.0422	-29.0383
311	642	Lot 51 on DP1208742	152.0424	-29.0376
24	675	Lot 5 on DP875148	152.0408	-29.0403
1719	675	Lot 52 on DP1208742	152.0426	-29.0370
1723	704	Lot 8 on DP1173703	152.0485	-29.0348
1694	706	Lot 417 on DP751540	152.0637	-29.0420
274	757	Lot 6 on DP875148	152.0398	-29.0407
1610	773	Lot 528 on DP751540	152.0491	-29.0570
312	785	Lot 8 on DP1135378	152.0435	-29.0350
32	805	Lot 3 on DP875148	152.0399	-29.0387
31	823	Lot 3 on DP875148	152.0399	-29.0383
33	835	Lot 2 on DP875148	152.0400	-29.0378
1722	841	Lot 6 on DP1173703	152.0474	-29.0335
1671	845	Lot 429 on DP751540	152.0591	-29.0377
1670	852	Lot 424 on DP751540	152.0561	-29.0349
1648	890	Lot 38 on DP137557	152.0435	-29.0513
34	897	Lot 1 on DP630104	152.0437	-29.0338
1615	902	Lot 1 on DP804234	152.0495	-29.0588
1681	921	Lot 1 on DP1087402	152.0699	-29.0534
1721	934	Lot 4 on DP1173703	152.0467	-29.0327
1616	984	Lot 2 on DP777724	152.0463	-29.0570

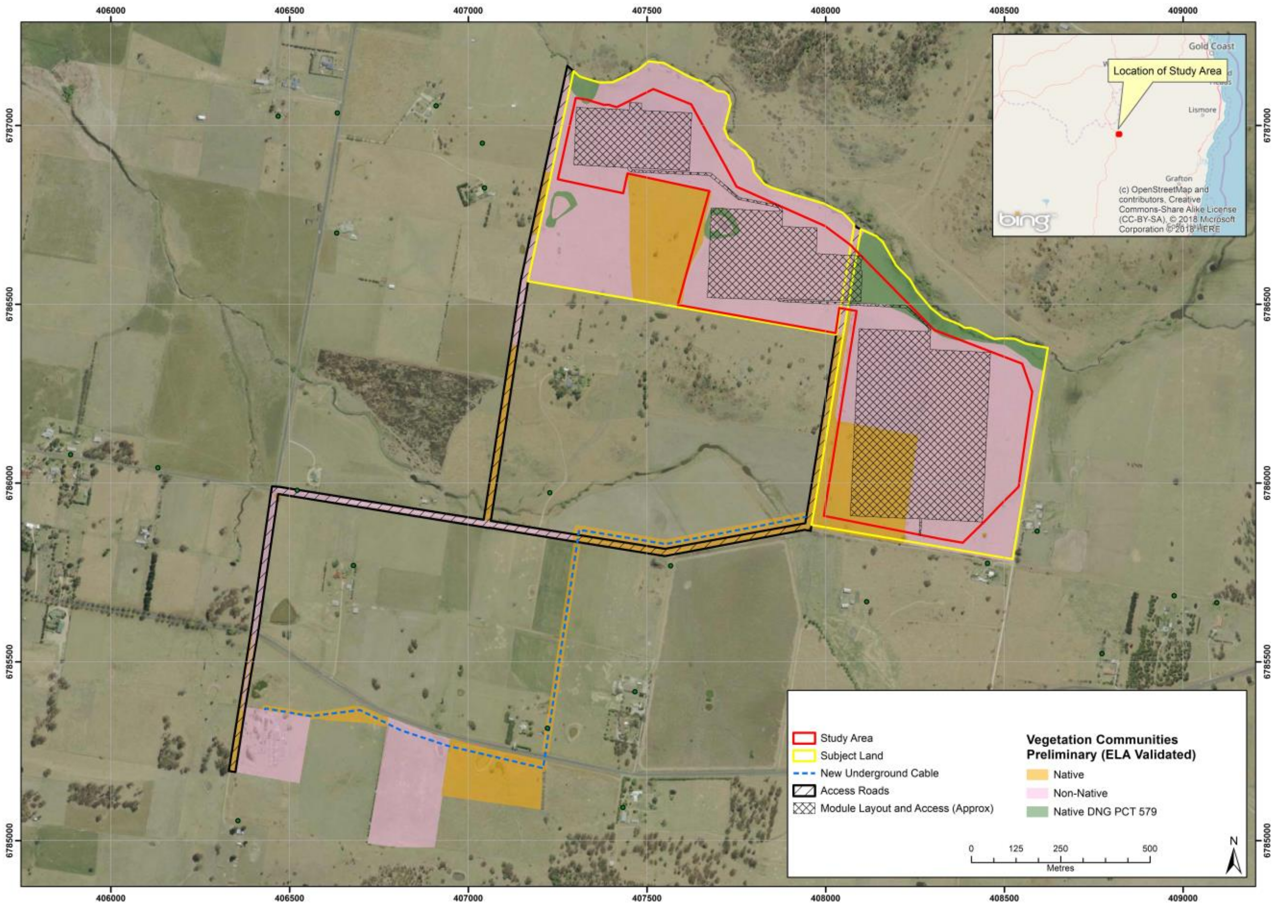
ELA ID	Distance to 'Solar farm area' (metres)	Lot and DP Number	Longitude	Latitude
35	994	Lot 7 on DP1173703	152.0488	-29.0321

Noise from the solar farm construction and operational activities may be audible at properties located further away, more than 1km from the site. However, noise mitigation and management measures implemented at the identified NSRs ensure that impact at properties located further away will be significantly less due to increased distance attenuation.

3 Development Proposal

The development proposal involves the construction of a 25MW Photovoltaic (PV) Facility located on approximately 60ha of farmland. A layout Plan is shown in Figure 3.

Figure 3: Layout Plan



The PV project intends to generate electrical power by converting solar radiation into electricity via the use of photovoltaic power generation. The facility is intended to operate year-round to generate electricity during daylight hours, when electricity demand in New South Wales is at its peak.

The site is proposed to be connected to the new underground 22kV line power line.

The system is to be operated remotely with physical presence on the site limited to maintenance activities and inspections.

4 Acoustic Environment

The site is located in a rural area with an acoustic environment that is dominated by natural sounds, having relatively little road traffic noise from Old Racecourse Road and Bruxner Highway (AADT less than 2000[3]). The area is generally characterised by low background noise levels. The settlement pattern is typically sparse.

The identified noise sensitive receivers are expected to experience a similar acoustic environment with low background noise levels.

The background noise levels of the area have therefore been estimated by referring to Appendix A of Australian Standard AS 1055.2[4]. The standard provides estimated average background noise levels for different residential areas in Australia, which may be used as a guideline.

In accordance with Appendix A of AS 1055.2 (extract attached in Appendix A of the report), the noise area category R1 is applicable to the site and the corresponding average background noise levels are summarised in Table 2.

Table 2: Average background noise levels for a noise area category R1

Time period*	Average background noise level, L_{90}, in dB(A)
Day	40
Evening	35
Night	30
Note: * Day-time period is from 0700 to 1800 (Monday to Saturday) and 0900 to 1800 (Sundays and Public Holidays) Evening period is from 1800 to 2200 Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0900 (Sundays and Public Holidays)	

The above estimated background noise levels have been used to determine the applicable criteria for the noise impact assessment.

[3] Roads and Maritime Services - Tenterfield Heavy Vehicle Bypass Preliminary Route Options Report, May 2014

[4] AS 1055.2:1997. Acoustics - Description and measurement of environmental noise - Application to specific situations

5 Noise Criteria

The main guidelines, standards and other policy documents relevant to the construction and operational noise impact assessment include:

- NSW Department of Environment and Climate Change (DECC) (2009), Interim Construction Noise Guideline, and
- NSW Environment Protection Authority (2017), NSW Noise Policy for Industry.

5.1 DECC Interim Construction Noise Guideline (ICNG)

The DECC Interim Construction Noise Guideline (ICNG) provides guidelines for the assessment and management of noise from construction works. Construction activities and associated duration for the proposed development mean that it is considered a major construction project. Therefore, the quantitative approach has been adopted for the construction noise assessment.

5.1.1 ICNG Noise Management Levels

The ICNG suggests the following standard hours for construction activities where noise is audible at residential premises:

- Monday to Friday, 7am to 6pm
- Saturday, 8am to 1pm, and
- No construction work is to take place on Sundays or public holidays.

Time restrictions on construction works are the primary management tool of the ICNG. The construction working hours of the proposed development are expected to be in line with the above standard hours.

The guideline also provides noise management levels for residential premises for both the recommended, and outside standard hours of construction. The noise management levels recommended for residential premises have been extracted from the ICNG and are summarised in Table 3.

Table 3: Residential – ICNG noise management levels

Time of day	Management level, $L_{Aeq\ (15\ min)}$ *	How to apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected RBL + 10 dB **= 50 dB(A)**	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: a. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences b. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB **= 40 dB(A) Evening period** **= 35 dB(A) Night-time period**	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2 of the ICNG.
Note: * Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.		

5.2 NSW Noise Policy for Industry

The policy sets out the procedure to determine the project noise trigger levels relevant to assess noise from industrial developments. The project noise trigger level applies to existing noise-sensitive receivers.

The project noise trigger level provides a benchmark or objective for assessing a proposal or site. It is not intended for use as a mandatory requirement. The project noise trigger level is a level that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response; for example, further investigation of mitigation measures.

The project noise trigger level is the lower (that is, the more stringent) value of the project intrusiveness noise level and project amenity noise level determined in Sections 2.3 and 2.4 of the policy.

5.2.1 Project Intrusiveness Noise Level

The Noise Policy for Industry states:

> *The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does*

not exceed the background noise level by more than 5 dB when beyond a minimum threshold. This intrusiveness noise level seeks to limit the degree of change a new noise source introduces to an existing environment.

The intrusiveness noise level is determined as follows:

$$L_{Aeq,\ 15min} \leq \text{Rating Background Noise Level} + 5\ \text{dB}$$

5.2.1.1 Minimum Rating Background Noise Level and Intrusive Noise Levels

The rating background noise level (RBL) is the overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24-hour period used for the assessment background level). The rating background noise level is the level used for assessment purposes.

However, for this assessment, noise monitoring was not conducted and instead RBLs have been assumed from AS1055, as shown in Table 2.

Regardless of the measured or assumed RBLs, minimum RBLs apply in this policy, which result in minimum intrusiveness noise levels as follows:

Table 4: Minimum assumed RBLs and project intrusiveness noise levels.

Time of day	Minimum assumed rating background noise level, in dB(A)	Minimum project intrusiveness noise levels, in $L_{Aeq,15min}$ dB(A)
Day	35	40
Evening	30	35
Night	30	35

For the purpose of the assessment, the minimum project intrusive noise levels have been adopted.

5.2.2 Amenity noise levels and Project Amenity Noise Levels

To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 of the Noise Policy for Industry where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance. The noise amenity area is defined as residential rural and the relevant noise amenity levels are given in Table 5.

Table 5: Amenity Noise Levels

Receiver/ Noise amenity area	Assessment period	Recommended amenity noise level, L_{eq} dB(A)
Residential Rural	Day	50
	Evening	45
	Night	40

Note:
- Day-time period is from 0700 to 1800 (Monday to Saturday) and 0800 to 1800 (Sundays and Public Holidays)
- Evening period is from 1800 to 2200
- Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0800h (Sundays and Public Holidays)

The recommended amenity noise levels represent the objective for total industrial noise at a receiver location, whereas the project amenity noise level represents the objective for noise from a single industrial development at a receiver location.

To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows:

Project amenity noise level for industrial developments = Recommended amenity noise level minus 5 dB(A)

5.2.3 Project Noise Trigger Level

The project noise trigger level (PNTL) has been determined in Table 6 and are the most stringent of the intrusiveness and amenity noise criteria.

Table 6: NSW Noise Policy for Industry Evaluated criteria

Assessment period	Project Intrusiveness Noise Level $L_{eq,15min}$ dB(A)*	Project Amenity Noise Level L_{eq} dB(A)	Project Noise Trigger Level L_{eq} dB(A)
Day	40	45	**40**
Evening	35	40	**35**
Night	35	35	**35**

Note:
- Day-time period is from 0700 to 1800 (Monday to Saturday) and 0800 to 1800 (Sundays and Public Holidays)
- Evening period is from 1800 to 2200
- Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0800h (Sundays and Public Holidays)

* Based on minimum intrusive noise levels in Table 4.

Table 6 shows that the PSNLs are set by the project intrusiveness noise level for all assessment periods.

By meeting the PNTLs at the identified NSRs, all other properties located further away from the development site are expected to comply with the noise requirements of this policy.

5.3 Noise-enhancing Weather Conditions

Certain meteorological/weather conditions may increase noise levels by focusing sound-wave propagation paths at a single point. Such refraction of sound waves will occur during temperature inversions (atmospheric conditions where temperatures increase with height above ground level), and where there is a wind gradient (that is, wind velocities increasing with height) with wind direction from the source to the receiver.

As meteorological data was not captured for the assessment, a range of meteorological conditions have been considered in the construction and operational noise impact assessment of the solar farm, to account for all conditions.

The standard meteorological conditions and noise-enhancing meteorological conditions as defined in the NSW Noise for Industry Policy, which have been considered in this assessment are summarised in Table 7.

Table 7: Standard and noise-enhancing meteorological conditions

Meteorological conditions	Meteorological parameters
Standard meteorological conditions	Day/evening/night: stability categories A–D with wind speed up to 0.5 m/s at 10 m AGL.
Noise-enhancing meteorological conditions	Daytime/evening: stability categories A–D with light winds (up to 3 m/s at 10 m AGL). Night-time: stability categories A–D with light winds (up to 3 m/s at 10 m AGL) and/or stability category F with winds up to 2 m/s at 10 m AGL.

6 Construction Noise Assessment

For the assessment, the noise impact has been assessed for each construction phase. Each construction phase is expected to occur sequentially. Although some construction phases will overlap, they are not expected to occur at the same location, thus eliminating the risk of cumulative impact.

6.1 Construction Process

Construction of the project is to proceed in the manner outlined in Table 8.

Table 8: Construction Phases

Construction Phase	Duration	Description
Site Preparation	2 months	A construction laydown area is to be established near the main site entrance and a second area to the east of the site, and equipment mobilised to the site. The site is then cleared, grubbed, graded, and compacted, with the on-site informal roadway system staked and established. Roads would be treated to create a durable, dust-minimising surface to ensure minimisation of dust emissions, and security fencing would be installed around the site perimeter.
Photovoltaic (PV) Panel System Installation	4 months	Following the Site Preparation Phase, the PV Panel system will be installed. The structure supporting the PV module arrays consists of steel piles (e.g., cylindrical pipes, H-beams, or similar), which would be driven into the existing soil through pneumatic techniques. Single Axis tracking technology has been selected for the installation. This includes motorised equipment that allows the panel faces to move from east to west to follow the movement of the sun across the sky. Following the steel pile installation, the associated motors, torque tubes, and drivelines would be placed and secured. For some single-axis tracking systems a galvanized metal racking system, which secures the PV panels to the installed foundations, would be field-assembled and attached according to the manufacturer's guidelines.
Inverters, Transformers, and Electrical Collector System Installation	2 months	Once the PV Panel System has been installed, it is anticipated that the underground cables connecting the panel strings will be connected using ordinary trenching techniques. After trenching, cable rated for direct burial or cables installed inside a polyvinyl chloride (PVC) conduit are to be installed in the trench, and the excavated soil would likely be used to fill the trench and be lightly compressed. The electrical inverters, transformers and electrical storage enclosures are then to be placed on concrete foundation structures or steel skids. Once all inverters, transformers and electrical collector systems have been installed, commissioning can occur. Commissioning of equipment will include testing, calibration of equipment, and troubleshooting. The inverters, transformers, collector system, storage system, and PV array system would be tested prior to commencement of commercial operations to ensure any potential glitches or system issues are rectified. Upon completion of successful testing, the equipment would be energised.
Grid Connection	2 months	Once construction of the main solar field is completed, the process will move to construct the grid connection infrastructure, which will involve connecting the new underground 22kV. Noise from this phase will be negligible and has not been assessed further.

6.2 Plant and Machinery Sound Levels

For each construction phase, the expected plant and machinery information to be used are summarised in Table 9. The table also includes an estimated percentage of use for each equipment during each phase, which reflects the transient and changing nature of the construction noise activities, dependent upon site-conditions, timelines, delays and other unexpected occurrences.

Table 9: Plant and Machinery for each phase

Construction Phase	Task	Equipment	% Use	Sound Power Level, dB(A)	Reference*
Site Preparation	Site Clearing	Dozer 20t, Power rating 142kW	75	109	Ref. No. 1, Table 2 in DEFRA[5]
		Tracked Excavator 16t, 72kW	50	104	Ref. No. 5, Table 2 in DEFRA
		Tracked Excavator (Idling) 16t, Power rating 72kW	25	91	Ref. No. 6, Table 2 in DEFRA
		Wheeled Backhoe Loader 8t, Power rating 62kW	50	96	Ref. No. 8, Table 2 in DEFRA
		Wheeled Backhoe Loader (Idling) 8t, Power rating 62kW	25	83	Ref. No. 9, Table 2 in DEFRA
	Earthworks	Dozer 20t, Power rating 142kW	75	109	Ref. No. 1, Table 2 in DEFRA
		Tracked Excavator 16t, 72kW	50	104	Ref. No. 5, Table 2 in DEFRA
		Tracked Excavator (Idling) 16t, Power rating 72kW	25	91	Ref. No. 6, Table 2 in DEFRA
	Loading Trucks	Wheeled Loader, Power rating 170kW	50	104	Ref. No. 28, Table 2 in DEFRA
		Tracked Excavator 16t, Power rating 72kW	25	104	Ref. No. 5, Table 2 in DEFRA
	Distribution of Material	Dump Truck (Tipping Fill)	25	107	Ref. No. 30, Table 2 in DEFRA
		Dump Truck (Empty)	25	115	Ref. No. 31, Table 2 in DEFRA
		Articulated Dump Truck (Tipping Fill)	50	102	Ref. No. 32, Table 2 in DEFRA
		Articulated Dump Truck	50	109	Ref. No. 33, Table 2 in DEFRA
		Truck	75	108	Ref. No. 34, Table 2 in DEFRA
		Telescopic Handler	25	99	Ref. No. 35, Table 2 in DEFRA
	Rolling and Compaction	Dozer (Towing Roller)	75	109	Ref. No. 36, Table 2 in DEFRA
		Roller (Rolling fill)	75	107	Ref. No. 37, Table 2 in DEFRA
Photovoltaic Panel System Installation	-	Pickup truck (>20t)	50	107	AS 2436[6]
		Water Bowser	75	107	Ref. No. 37, Table 6 in DEFRA
		Flatbed truck (>20t)	50	107	AS 2436

[5] Department for Environment Food and Rural Affairs, DEFRA – Update of Noise Database for Prediction of Noise on Construction and Open Sites - 2005

[6] AS 2436:2010. Guide to noise and vibration control on construction, demolition and maintenance sites

Construction Phase	Task	Equipment	% Use	Sound Power Level, dB(A)	Reference*
		Wheeled Loader, 170kW	75	104	Ref. No. 28, Table 2 in DEFRA
		Hydraulic Hammer Rig 4t hammer, Power rating 186kW	25	115	Ref. No. 2, Table 3 in DEFRA
		Forklifts	75	106	AS 2436
		Welders	75	105	AS 2436
Inverters, Transformers, and Electrical Collector System Installation	Trenching	Tracked Excavator 16t, 72kW	50	104	Ref. No. 5, Table 2 in DEFRA
		Tracked Excavator (Idling) 16t, Power rating 72kW	25	91	Ref. No. 6, Table 2 in DEFRA
		Wheeled Backhoe Loader 8t, Power rating 62kW	50	96	Ref. No. 8, Table 2 in DEFRA
		Wheeled Backhoe Loader (Idling) 8t, Power rating 62kW	25	83	Ref. No. 9, Table 2 in DEFRA
		Pickup truck (>20t)	75	107	AS 2436
		Water truck	75	107	AS 2436
		Flatbed truck (>20t)	75	107	AS 2436
		Water Pump	75	93	Ref. No. 45, Table 2 in DEFRA
		Concrete Pump + Cement Mixer Truck (Discharging)	50	95	Ref. No. 24, Table 4 in DEFRA
		Hydraulic Hammer Rig 4t hammer, Power rating 186kW	25	115	Ref. No. 2, Table 3 in DEFRA
		Lifting Platform	75	95	Ref. No. 57, Table 4 in DEFRA
		Tipper Truck	75	108	Ref. No. 34, Table 2 in DEFRA
		Diesel generator	80	99	AS 2436

Note: * DEFRA – Department for Environment Food and Rural Affairs (DEFRA), 2005. Update of noise database for prediction of noise on construction and open sites. Noise levels are given as a sound pressure level at 10 metres from the source. The sound pressure levels have been converted to sound power levels in the table.

6.3 Assessment Methodology

The impact of each construction phase has been predicted based on the following assumptions:

- Noise source modelled as follows:
  - One point source for each construction phase.
  - All plant and equipment for each construction phase are operating simultaneously at the same location.
  - Total sound power level for each construction phase is calculated based on sound power level information and percentage use of each plant and equipment given in Table 9.
- Distance attenuation, as follows:
  a. Average impact scenario:
  - Due to the transient and changing nature of construction works, the location of the noise source can be assumed to be in the middle of the site for each construction phase on average. This scenario provides an indication to the average impact on the receivers. Impact is typically maximum when the construction works are closest to the receivers on one side of the site, and minimal when works are on the other side of the site away from receivers.

  b. Worst-case impact scenario:
  - Maximum impact is experienced when construction works occur at the closest boundary of the construction works (As indicated in hash on Figure 3) to each respective receiver. Maximum impact will however be for a short duration until the activities move to a different location. Assessing the maximum impact ensures the right mitigation methods are implemented.
- Atmospheric, meteorological and ground attenuation using the CONCAWE[7] method (over 100 metres separation distance between source and receiver), as follows:
  a. Category 6:
  - A conservative prediction of the propagation of noise from source to receiver, which includes the effects of temperature inversions and favourable winds onto the noise.

  b. Category 4:
  - A neutral prediction based on neutral meteorological conditions.

For the construction noise assessment, noise levels have been predicted to the receivers based on the above methodology. The predicted noise levels have then been compared to the following noise targets:

[7] CONCAWE is a noise prediction method developed for assessing environmental noise propagation, drawn from both acoustic theory and extensive field noise measurements. The CONCAWE predictions consider atmospheric, meteorological and ground attenuation. *The propagation of noise from petroleum and petrochemical complexes to neighbouring communities. Report no.4/81, 1981*

1. ICNG noise management level of 50 dB(A) Day-time, and
2. ICNG highly noise affected limit of 75 dB(A) as shown in Table 3.

6.4 Predicted Construction Impact

The predicted noise levels for each construction phase are provided in Table 10, Table 11, and Table 12 below. Exceedances of the ICNG noise management level of **50 dB(A) Day-time** are shown in bold. Exceedances of the ICNG highly noise affected limit of 75 dB(A) are shown in bold and red.

Table 10: Site Preparation – Predicted Impact

Receivers ELA ID	Site Preparation			
	Predicted Average Impact, in dB(A)		Predicted Worst-case Impact, in dB(A)	
	Category 4	Category 6	Category 4	Category 6
1682	50	50	**64**	**66**
1683	50	50	**61**	**64**
26	40	45	**54**	**58**
1650	39	44	47	**51**
25	35	40	48	**53**
1688	39	44	44	49
1689	< 35	37	43	48
1725	< 35	36	45	50
1692	< 35	39	41	46
27	< 35	39	42	47
1691	< 35	38	40	45
1690	< 35	38	41	46
1724	< 35	38	43	48
310	< 35	38	43	48
311	< 35	38	42	47
24	< 35	< 35	41	47
1719	< 35	< 35	41	47
1723	< 35	< 35	41	47
1694	< 35	< 35	41	46
274	< 35	< 35	40	45
1610	< 35	< 35	40	45
312	< 35	< 35	39	45
32	< 35	< 35	39	44
31	< 35	< 35	39	44
33	< 35	< 35	39	44
1722	< 35	< 35	39	44
1671	< 35	< 35	38	44
1670	< 35	< 35	38	43

1648	< 35	< 35	38	43
34	< 35	< 35	37	43
1615	< 35	< 35	37	43
1681	< 35	< 35	37	43
1721	< 35	< 35	37	43
1616	< 35	< 35	37	43
35	< 35	< 35	37	43

Table 11: Photovoltaic Panel System Installation – Predicted Impact

Receivers ELA ID	Photovoltaic Panel System Installation			
	Predicted Average Impact, in dB(A)		Predicted Worst-case Impact, in dB(A)	
	Category 4	Category 6	Category 4	Category 6
1682	**52**	**52**	**66**	**69**
1683	**52**	**52**	**63**	**66**
26	42	48	**56**	**60**
1650	42	47	49	**54**
25	37	43	**51**	**56**
1688	41	46	46	**51**
1689	34	40	46	**51**
1725	35	40	47	**52**
1692	36	41	43	48
27	36	42	44	49
1691	35	40	43	48
1690	35	40	43	48
1724	35	40	45	50
310	35	40	45	50
311	35	40	45	50
24	< 35	< 35	44	49
1719	< 35	< 35	44	49
1723	< 35	< 35	44	49
1694	< 35	< 35	43	48
274	< 35	< 35	42	47
1610	< 35	< 35	42	47
312	< 35	< 35	42	47
32	< 35	< 35	41	47
31	< 35	< 35	41	46
33	< 35	< 35	41	46
1722	< 35	< 35	41	46
1671	< 35	< 35	41	46
1670	< 35	< 35	41	46

1648	< 35	< 35	40	45
34	< 35	< 35	40	45
1615	< 35	< 35	40	45
1681	< 35	< 35	40	45
1721	< 35	< 35	40	45
1616	< 35	< 35	40	45
35	< 35	< 35	40	45

Table 12: Inverters, Transformers, and Electrical Collector System Installation – Predicted Impact

Receivers ELA ID	Inverters, Transformers, and Electrical Collector System Installation			
	Predicted Average Impact, in dB(A)		Predicted Worst-case Impact, in dB(A)	
	Category 4	Category 6	Category 4	Category 6
1682	48	48	**62**	**64**
1683	48	48	**59**	**62**
26	39	44	**52**	**56**
1650	38	43	45	50
25	< 35	39	47	**51**
1688	37	43	42	47
1689	< 35	36	42	47
1725	< 35	37	43	48
1692	< 35	38	39	44
27	< 35	38	40	45
1691	< 35	37	39	44
1690	< 35	37	39	44
1724	< 35	37	41	46
310	< 35	37	41	46
311	< 35	37	41	46
24	< 35	< 35	40	45
1719	< 35	< 35	40	45
1723	< 35	< 35	40	45
1694	< 35	< 35	39	45
274	< 35	< 35	38	44
1610	< 35	< 35	38	43
312	< 35	< 35	38	43
32	< 35	< 35	38	43
31	< 35	< 35	37	43
33	< 35	< 35	37	42
1722	< 35	< 35	37	42
1671	< 35	< 35	37	42
1670	< 35	< 35	37	42
1648	< 35	< 35	36	41

34	< 35	< 35	36	41
1615	< 35	< 35	36	41
1681	< 35	< 35	36	41
1721	< 35	< 35	36	41
1616	< 35	< 35	36	41
35	< 35	< 35	36	41

6.5 Discussion of Impact

6.5.1 Highly Noise Affected

The predicted construction impact shows that there are no exceedances of the ICNG highly noise affected limit of 75 dB(A) at any receivers.

6.5.2 Exceedance of ICNG Noise Management Level

The predicted construction impact shows that ICNG Noise Management Level of 50 dB(A) are exceeded at the receivers summarised in Table 13.

Table 13: Receivers – Exceedance of ICNG Noise Management Level

Construction Phase	Duration	Receivers and Exceedance over 50 dB(A)			
		Average Impact		Worst-case Impact	
		Category 4	Category 6	Category 4	Category 6
Site Preparation	2 months	-	-	1682 (+14dB) 1683 (+11dB) 26 (+4dB)	1682 (+16dB) 1683 (+14dB) 26 (+8dB) 1650 (+1dB) 25 (+3dB)
Photovoltaic Panel System Installation	4 months	1682 (+2dB) 1683 (+2dB)	1682 (+2dB) 1683 (+2dB)	1682 (+16dB) 1683 (+13dB) 26 (+6dB) 25 (+1dB)	1682 (+19dB) 1683 (+16dB) 26 (+10dB) 1650 (+4dB) 25 (+6dB) 1688 (+1dB) 1689 (+1dB) 1725 (+2dB)
Inverters, Transformers, and Electrical Collector System Installation	2 months	-	-	1682 (+12dB) 1683 (+9dB) 26 (+2dB)	1682 (+14dB) 1683 (+12dB) 26 (+6dB) 25 (+1dB)

6.5.2.1 Site Preparation Phase

For the site preparation phase, the affected receivers are predicted to exceed the ICNG Noise Management Level of 50 dB(A) when the works are closest to the receivers, as shown by the worst-case impact. However, as the works move towards the middle of the site away from the receivers, the impact is predicted to comply with the ICNG Noise Management Level.

The exceedances at Receivers 25 and 1650 are not significant (1-4dB) and expected to be of short duration until the work move away to a different location.

However, exceedances at Receivers 26, 1682 and 1683 are 8-16dB for a worst-case prediction when the works are at the closest boundary. Noise management techniques are recommended to minimise the exceedances. The duration of the exceedances is predicted to last for less than one month, until the works move away from the receivers to the opposite side of the site.

6.5.2.2 Photovoltaic Panel System Installation Phase

For this phase, the affected receivers are predicted to exceed the ICNG Noise Management Level of 50 dB(A) when the works are closest to the receivers, as shown by the worst-case impact. However, as the works move towards the middle of the site away from the receivers, Receivers 1682 and 1683 are predicted to marginally exceed the ICNG Noise Management Level by 2dB, as shown by the average case impact.

The exceedances at Receivers 1688, 1689 and 1725 are not significant (1-2dB) and expected to be of short duration until the work move away to a different location.

However, exceedances at Receivers 25, 26, 1682 and 1683 are up to 19dB when the works are at the closest boundary. Noise management techniques are recommended to minimise the exceedances. The duration of the exceedances are predicted to last for just over two months, until the works move away from the receivers to the opposite side of the site.

6.5.2.3 Inverters, Transformers, and Electrical Collector System Installation Phase

For this phase, the affected receivers are predicted to exceed the ICNG Noise Management Level of 50 dB(A) when the works are closest to the receivers, as shown by the worst-case impact. However, as the works move towards the middle of the site away from the receivers, the impact is predicted to comply with the ICNG Noise Management Level.

The exceedances at Receiver 25 is not significant and expected to be of short duration until the work move away to a different location.

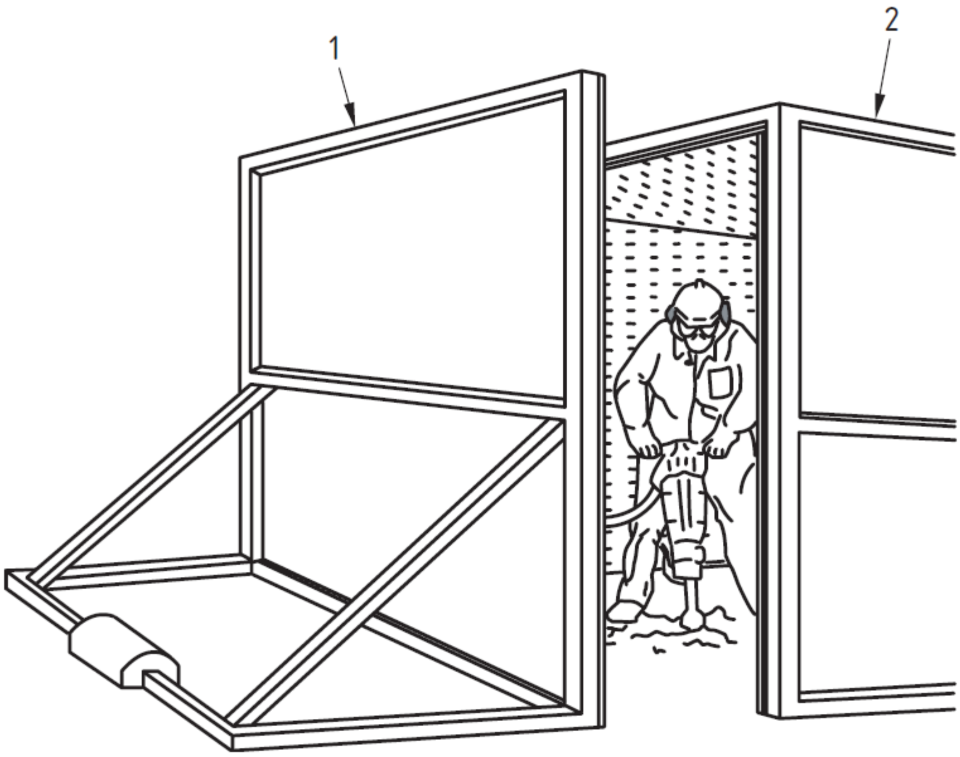
However, exceedances at Receivers 26, 1682 and 1683 are up to 14dB when the works are at the closest boundary for a worst-case prediction. Noise management techniques are recommended to minimise the exceedances. The duration of the exceedances is predicted to last for less than one month, until the works move away from the receivers to the opposite side of the site.

6.6 Good Practice Construction Noise Mitigation and Management

As with all construction projects, noise levels can be minimised with adherence to good practice, which means following some basic procedures. Based on the results of the construction noise assessment showing that there are some minor exceedances of the ICNG noise management level at NSR's, suggestions and ideas to minimise construction noise have been provided below. Not all will be necessary and practical, but should there be an adverse response from the community these suggestions will be helpful.

The opportunities for practical physical noise control are few given the transient and constantly moving nature of the construction work. However, mobile noise barriers/enclosures during certain construction work, such as around stationary work activities and plant, can be used to mitigate construction noise. Examples of mobile enclosure and demountable noise barriers are shown in Figure 4 and Figure 5 respectively.

Figure 4: Illustration of a mobile enclosure and barrier



Key

1 Acoustic screen 2 m wide and 2.7 m high

2 Acoustic shed 2 m square and 2.7 m high

Figure 5: Photos demountable noise barriers

In other circumstances, management measures should be employed to minimise the construction noise impact onto residential premises. These can include:

- Informing and consulting residents and interested parties, as far as practicable, regarding impending or current events that may cause high levels of noise and how long they are expected to take. This may take the form of letter drops, or community notices.
- Provide a complaints telephone number prominently displayed where the works are taking place and on any letter drops or community notices.
- Respite hours agreed with residents when noisy works will not take place if necessary.
- Investigate complaints when received to establish the cause, and where possible implement a corrective action such as, provide a respite period or other practical measure.
- Minimising the operating noise of machinery brought on to the site.
- Where appropriate, obtaining acoustic test certificates for machinery brought on to the site.
- Undertake noise monitoring at the start of a new noisy activity so noise levels can be investigated should a complaint be received.
- If there is excessive noise from any process, that process will be stopped and if possible that noise attenuated to acceptable levels. Where there is no alternative the process will be rescheduled to non-sensitive hours.
- Ensuring that plant is not left idling when not in use.
- Ensuring that plant is well maintained and in good working order and not causing unnecessary noise, such as damaged mufflers on plant, and
- All access hatches for plant to be kept closed.

7 Construction Traffic Noise Assessment

The traffic accessing the site will be during the construction phase and consist of a mix of broad traffic categories as follows:

- General traffic generated by staff travelling to / from the site (i.e. utes, vans and private cars)
- Over Dimensional (OD) used for the delivery of the large substation components, and
- Other heavy vehicles (HV) which are used for the delivery of the solar panel components and construction materials such as aggregate.

The likely traffic mix for the various works that are anticipated during construction are summarised in Table 14.

Table 14: Total Heavy Vehicle Movements

Plant/Equipment	Description	Heavy Vehicles
Modules	107, 268 modules (392 modules per 40' container) delivered on semi-trailers	275
Mounting frames	30 x 40' container per MW, inclusive of piles, and structural frames and materials	30
Inverter Stations	10 x inverter station – delivered 1 per semitrailer	10
Battery storage	6 x 20' shipping containers and 6 x 40; shipping containers on semitrailers	9
Concrete	Estimated 200 m^3 required inverter assembly foundations and security fence in 10m^3 concrete trucks	20
Gravel	Estimated 2000 m^3 (~4000 tonne) of gravel for internal access roads and temporary hardstand lay down and construction compound area: delivered in 42.5 tonne truck & dog trailers. Assumes access road and hardstand all at 100 mm	100
Sand	Estimated 2200m^3 of sand (~3200 tonne) would be delivered in 42.5 tonne truck & dog trailers	80
Miscellaneous	Provision for 5 miscellaneous deliveries (fencing, building materials, cable drums, water for dust suppression, etc) a week during construction period, dropping to an average of 2 trucks a week for the one month shoulder periods	116
	TOTAL	640

7.1 Predicted Traffic Impact and Discussion

During the delivery of the materials, a total of 640 vehicles are expected, including 180 42.5 tonne truck & dog trailers. The 42.5 tonne truck & dog trailers represent the biggest risk of an adverse noise impact to residents living close to public roads used by the delivery vehicles.

Spread over a 7-month period for construction works, an average of 5 vehicles would access the site per day, including 1 truck & dog trailer.

The closest receiver to the proposed access route is Receiver 1648 (Refer to Figure 2), approximately 25 metres from the boundary of the road.

Using this scenario, a Truck & Dog articulated trailer has an approximate maximum pass-by noise level of **81 dB L_{Amax}** at 10m (Source: DEFRA database, Table 2, Ref 33 Articulated Dump Truck). This translates to a noise level incident at the façade of the receiver of **73 dB L_{Amax}**.

As all traffic movements associated with the site will occur during daytime hours (6am – 6pm), sleep disturbance is not expected.

With an average of one pass-by event from a truck & dog trailer occurring during a 12-hour construction period from 6am – 6pm, it follows that the impact will be insignificant at the closest receiver to the access road. In addition, it should be noted that **73 dB L_{Amax}** is a maximum noise level, and as such, the noise will be at this level only for a very short duration, and the whole pass-by will be over in a matter of seconds.

Therefore, the risk of an adverse noise impact being caused to residents is considered low.

Other construction related traffic is not expected to result in an adverse noise impact to residents.

8 Operational Noise Assessment

This section of the report addresses the operational impact of the proposed development onto sensitive receivers. The assessment includes:

- Prediction of noise emissions from the operation and maintenance of the solar farm
- Comparison of predicted noise emissions to noise criteria derived from the NSW Noise Policy for Industry (Refer to Table 6), and
- Provide noise mitigation measures, if any, to ensure compliance with the criteria.

8.1 Operation and Maintenance

The solar modules at the site are to operate during daylight hours, seven days per week, 365 days per year. No permanent employees are expected to be stationed on-site throughout the duration of project operations. The operation and maintenance tasks are summarised in Table 15.

Table 15: Operation and Maintenance Tasks

Task	Description
Noise from the operation of Inverter stations (Including transformers)	When the solar farm is fully operational, noise from the inverter stations may impact upon nearby receivers. The inverter stations emit constant noise and are expected to be located within the module layout area. The stations are expected to operate 24/7.
Solar module washing	The solar modules are to be periodically washed to remove any excess dirt, dust or other matter (i.e. bird droppings), which may prevent sunlight from effectively reaching the solar cells and subsequently reducing the electricity production output. The solar panels are anticipated to be cleaned via means of water spray from a water truck driven through the informal roadways constructed on-site. No chemicals will be added to the water to ensure minimal impact to the surrounding environment through runoff.
Vegetation, weed, and pest management	Weed and vegetation control will be conducted throughout the project site for the duration of project operations. Weed control is likely to consist of any or, all of the following methods: biological (sheep grazing), mechanical or manual, or chemical methods. Site conditions are to be evaluated prior to the selection of the management method to ensure the method employed is the most appropriate to the environmental conditions of the subject site.
Equipment maintenance and inspection	Responding to automated electronic alerts based on monitored data, including actual versus expected tolerances for system output and other key performance metrics.
Security detail	PV Facility security will be managed through a range of different measures employed on-site. Site access arrangements will be regulated for staff through identification requirements. Access to the PV Facility is to be restricted to the one ingress/egress point, with the perimeter of the facility appropriately fenced with chain mesh fence and potentially 3-strand barbed wire. In addition, the lighting employed on site will act as a deterrent to possible nefarious activity. It is noted this lighting is not permanently on but reacts to sophisticated sensors when there is unauthorised entry into the site. The lighting is designed not to react to birds and animals etc. entering the site.

8.2 Operational Sound Levels

For each operational task, the expected equipment and associated sound levels are summarised in Table 16.

Table 16: Operational Sound Levels

Task	Item	Equipment	% use per day	Sound Level, dB(A)	Reference*
Noise from Inverter Stations	Inverters, Transformers	-	100	64 SPL @10m	Data provided by Eco Logical
Solar module washing	Water spraying	Water Truck	75	107 SWL	AS 2436
		Water Pump	75	93 SWL	Ref. No. 45, Table 2 in DEFRA
Vegetation, weed, and pest management	Mechanical method	Truck	75	107 SWL	AS 2436
		Pump	75	93 SWL	Ref. No. 45, Table 2 in DEFRA
Equipment maintenance and inspection	Insignificant noise impact				
Security detail	Insignificant noise impact				

Note: * DEFRA – Department for Environment Food and Rural Affairs (DEFRA), 2005. Update of noise database for prediction of noise on construction and open sites. Noise levels are given as a sound pressure level at 10 metres from the source. The sound pressure levels have been converted to sound power levels in the table.

8.3 Assessment Methodology

A similar methodology to assessing construction noise has been adopted to predict operational noise. The impact of each task has been predicted based on the following assumptions:

- Noise source modelled as follows:
  - One point source for each task.
  - All plant and equipment for each task are operating simultaneously at the same location.
  - Total sound power level for each task is calculated based on sound level information and percentage use of each plant and equipment given in Table 16.
- Distance attenuation, as follows:
  a. Average impact scenario (Solar module washing and Vegetation, weed, and pest management tasks only):
  - Due to the transient and changing nature of maintenance works, the location of the noise source can be assumed to be in the middle of the site for each task on average. This scenario provides an indication to the average impact on the receivers. Impact is typically maximum when the maintenance works are closest to the receivers on one side of the site, and minimal when works are on the other side of the site away from receivers.

  b. Worst-case impact scenario:

- Maximum impact is experienced when tasks occur at the closest boundary of the site (As indicated in hash on Figure 3) to each respective receiver. Assessing the maximum impact ensures the right mitigation methods are implemented.

- Atmospheric, meteorological and ground attenuation using the CONCAWE[8] method (over 100 metres separation distance between source and receiver), as follows:

    c. Category 6:

    - A conservative prediction of the propagation of noise from source to receiver, which includes the effects of temperature inversions and favourable winds onto the noise.

    d. Category 4:

    - A neutral prediction based on neutral meteorological conditions.

8.4 Predicted Noise Impact from Inverter Stations

Noise from the inverter stations are required to meet the Project Noise Trigger Levels of 35 dB(A) derived in Table 6.

Based on the sound levels given in Table 16, the radius of impact of one inverter station is 260 metres.

The final locations of the inverter stations are yet to be determined, therefore it is recommended to ensure all inverter stations are located at least 260 metres from the closest noise sensitive receiver.

8.5 Predicted Operational Impact

The predicted noise levels for each operational task are provided in Table 17. The impact of the solar module washing and vegetation, weed, and pest management are expected to be similar due to similar equipment and machinery being used in the process.

Table 17: Predicted noise levels – Solar module washing

Receivers ELA ID	Solar module washing & Vegetation, weed, and pest management			
	Predicted Average Impact, in dB(A)		Predicted Worst-case Impact, in dB(A)	
	Category 4	Category 6	Category 4	Category 6
1682	< 25	< 25	32	34
1683	< 25	< 25	29	32
26	< 25	< 25	< 25	26
1650	< 25	< 25	< 25	< 25
25	< 25	< 25	< 25	< 25

[8] CONCAWE is a noise prediction method developed for assessing environmental noise propagation, drawn from both acoustic theory and extensive field noise measurements. The CONCAWE predictions consider atmospheric, meteorological and ground attenuation. *The propagation of noise from petroleum and petrochemical complexes to neighbouring communities. Report no.4/81, 1981*

Table 17 shows that when assuming the worst-case meteorological category 6 and a neutral/average case meteorological category 4, the PNTL of 40 dB $L_{eq,Day}$ is met at the closest five NSRs from the operational noise sources. No receivers are predicted to be impacted.

Also, as the operational tasks will occur periodically and the impact to the closest receivers will be for a short duration, no additional noise mitigation measures are required.

9 Conclusion

TTM has carried out a construction and operational noise assessment for the proposed Tenterfield Solar Farm project.

TTM predicted construction impact levels from the phases of construction at the nearest sensitive receivers. The predictions showed that the impact is considered to be minor to negligible. Impact to the closest receivers will be maximum when the works are at the boundary of the site for a short duration until the works move away from the receivers. Good practice construction noise management procedures have been provided to minimise noise impact to the community.

Construction traffic on public roads has been assessed and the risk of an adverse noise impact to residents living beside the road is considered low.

Noise from the inverter stations has been assessed. It is recommended to locate the stations at least 260 metres away from the closest noise sensitive receiver.

Noise generated from the operation of the solar farm has also been assessed and found to be minimal. No additional noise mitigation measures are recommended.

Overall this noise impact assessment report has shown that noise associated with the construction and operation of the Tenterfield Solar Farm is manageable to preserve the acoustic amenity of the local community.

Appendix A Extract from AS1055.2

APPENDIX A

ESTIMATED AVERAGE BACKGROUND A-WEIGHTED SOUND PRESSURE LEVELS ($L_{A90,T}$) FOR DIFFERENT AREAS CONTAINING RESIDENCES IN AUSTRALIA

(Informative)

This Appendix may only be used as a guideline. Whenever possible values of $L_{A90,T}$ shall be measured in accordance with Clause 4.2.1. Where the measured values are obtainable, this Appendix shall not be used.

Noise area category (Notes 1 and 2)	Description of neighbourhood	Average background A-weighted sound pressure level, $L_{A90,T}$					
		Monday to Saturday			Sundays and public holidays		
		0700–1800	1800–2200	2200–0700	0900–1800	1800–2200	2200–0900
R1	Areas with negligible transportation	40	35	30	40	35	30
R2	Areas with low density transportation	45	40	35	45	40	35
R3	Areas with medium density transportation or some commerce or industry	50	45	40	50	45	40
R4	Areas with dense transportation or some commerce or industry	55	50	45	55	50	45
R5 (See Note 3)	Areas with very dense transportation or in commercial districts or bordering industrial districts	60	55	50	60	55	50
R6 (See Note 3)	Areas with extremely dense transportation or within predominantly industrial districts	65	60	55	65	60	55

NOTES:

1 The division into noise area categories is necessary in order to accommodate existing sound levels encountered at residential sites in predominantly commercial or industrial districts, or in areas located close to main land transport routes, i.e. road and rail.

2 The noise area category most appropriate should be selected irrespective of metropolitan or rural zoning and will vary from location to location.

3 Some industrial and commercial sites are not predominant sources of high background sound levels.

Appendix B Glossary

In this acoustic report unless the context of the subject matter otherwise indicates or requires, a term has the following meaning:

TERM	DEFINITION
ABL	The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night-time (for each day). It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.
Adverse Weather	Weather effects that increases noise (i.e. wind and temperature inversion) that occurs at a site for a significant period of time (i.e. wind occurring more than 30% of the time in any assessment period in any season and / or temperature inversion occurring more than 30% of the nights in winter).
Ambient Noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources both near and far.
Assessment Period	The period in a day over which assessments are made: day (0700 to 1800h), evening (1800 to 2200h) or night (2200 to 0700h) or actual operating period if only a part of a period(s).
A – Weighting Filter	A-weighting is the most commonly used of a family of curves defined in the International standard IEC 61672:2003 and various national standards relating to the measurement of sound pressure level. A-weighting is applied to instrument-measured sound levels in effort to account for the relative loudness perceived by the human ear, as the ear is less sensitive to low audio frequencies.
Background Noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is excluded. Usually described using the L90 measurement parameter.
C – Weighting Filter	The C-weighting approximates the sensitivity of human hearing at industrial noise levels (above about 85 dB(A)). The C-weighted sound level (i.e., measured with the C-weighting) is more sensitive to sounds at low frequencies than the A-weighted sound level and is sometimes used to assess the low-frequency content of complex sound environments and entertainment noise.
Decibel	The ratio of sound pressures which we can hear is a ratio of 106 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the ‘sound pressure level’ (Lp) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.
dB(A)	The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dB(A). An A-weighting network can be built into a sound level measuring instrument such that sound levels in dB(A) can be read directly from a sound level meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. It is worth noting that an increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise, and a change of 2 to 3 dB is subjectively barely perceptible.
Equivalent Continuous Sound Level (L_{eq})	Another index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period, similar to the

TERM	DEFINITION
	average. Hence fluctuating levels can be described in terms of a single figure level.
Extraneous Noise	Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated during holiday periods and during special events such as concert or sporting events.
Fast Time Weighting	125 ms integration time while the signal level is increasing and decreasing.
Frequency	The rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. A thousand hertz is often denoted kHz, e.g. 2 kHz = 2000 Hz. Human hearing ranges approximately from 20 Hz to 20 kHz. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.
Impulse Time Weighting	35 ms integration time while the signal level is increasing and 1.5s integration time while the signal level is decreasing.
L_{Aeq}	See equivalent continuous sound level definition above. This is the A-weighted energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environmental. This measure is also a common measure of environmental noise and road traffic noise.
$L_{Aieq,T}$	Equivalent continuous A-weighted sound pressure level over the measurement period T with impulse time weighting.
$L_{Ceq,T}$	The equivalent continuous C-weighted sound pressure level (integrated level) that, over the measurement period T, has the same mean square sound pressure (referenced to 20 μPa) as the fluctuating sound(s) under consideration.
$L_{C, Peak}$	The C-weighted Peak sound pressure level during a designated time interval or a noise event.
Low Frequency	Noise containing major components in the low-frequency range (20Hz to 250Hz) of the frequency spectrum.
Maximum Noise Levels L_{max}	The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.
Minimum Noise Levels L_{min}	The minimum noise level over a sample period is the minimum level, measured on fast response, during the sample period.
Noise Sensitive Receiver (NSR)	A noise sensitive receiver is any person or building or outside space in which they reside or occupy that has the potential to be adversely impacted by noise from an outside source, or noise not generated by the noise sensitive receiver.
Octave Bands	Octave bands are frequency ranges in which the upper limit of each band is twice the lower limit. Octave bands are identified by their geometric mean frequency, or centre frequency.

TERM	DEFINITION
Project-Specific Noise Levels	They are target noise levels for a particular noise generating facility. They are based on the most stringent of the intrusive or amenity criteria derived from the NSW Industrial Noise Policy.
RBL	The Rating Background Level for each period is the median value of the ABL values for the period over all the days measured. There is a therefore an RBL value for each period – daytime, evening and night-time.
Shoulder Periods	Where early morning (5 am to 7 am) operations are proposed, it may be unduly stringent to expect such operations to be assessed against the night-time criteria (especially if existing background noise levels are steadily rising in these early morning hours). In these situations, appropriate noise level targets may be negotiated with the regulatory/consent authority on a case-by-case basis.
Slow Time Weighting	1 second integration time while the signal level is increasing and decreasing.
Sound Level Difference (D)	The sound insulation required between two spaces may be determined by the sound level difference needed between them. A single figure descriptor, the weighted sound level difference, D_w, is sometimes used (see BS EN ISO 717-1).
Sound Power	The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source. The sound pressure level varies as a function of distance from a source. However, the sound power level is an intrinsic characteristic of a source (analogous to its volume or mass), which is not affected by the environment within which the source is located.
Sound Reduction Index (R)	The sound reduction index (or transmission loss) of a building element is a measure of the loss of sound through the material, i.e. its attenuation properties. It is a property of the component, unlike the sound level difference which is affected by the common area between the rooms and the acoustic of the receiving room. The weighted sound reduction index, R_w, is a single figure description of sound reduction index which is defined in BS EN ISO 717-1: 1997. The R_w is calculated from measurements in an acoustic laboratory. Sound insulation ratings derived from site (which are invariably lower than the laboratory figures) are referred to as the R'_w ratings.
Statistical Noise Levels	For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10}, the level exceeded for ten per cent of the time period under consideration, has been adopted in this country for the assessment of road traffic noise. The L_{90}, the level exceeded for ninety per cent of the time, has been adopted to represent the background noise level. The L_1, the level exceeded for one per cent of the time, is representative of the maximum levels recorded during the sample period. A-weighted statistical noise levels are denoted L_{A10}, dBL_{A90} etc. The reference time period (T) is normally included, e.g. $dBL_{A10, 5min}$ or $dBL_{A90, 8hr}$.
L_{A1}	The L_{A1} level is the A-weighted noise level which is exceeded for 15 of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.
L_{A10}	The L_{A10} level is the A-weighted noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.
L_{A50}	The L_{A50} level is the A-weighted noise level which is exceeded for 50% of the sample period.

TERM	DEFINITION
L_{A90}	The LA90 level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the LA90 level for 10% of the time. This measure is a commonly referred to as the background noise level.
Structureborne Noise	The L_{A90} level is the A-weighted noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is a commonly referred to as the background noise level.
Temperature Inversion	An atmospheric condition in which temperature increases with height above the ground.
Tonality	Noise containing a prominent frequency and characterised by a definite pitch.

Appendix H : Traffic Assessment

Traffic Impact Assessment

Tenterfield Solar Farm

Eco Logical Australia

About TTM

For 30 years, we've been at the centre of the Australian development and infrastructure industry. Our unique combination of acoustics, data, traffic and waste services is fundamental to the success of any architectural or development project.

We have over 50 staff, with an unrivalled depth of experience. Our industry knowledge, technical expertise and commercial insight allow us to deliver an exceptional and reliable service.

T: (02) 9418 3033
E: ttmnsw@ttmgroup.com.au

Acoustics Data Traffic Waste

Revision Record

No.	Author	Reviewed/Approved	Description	Date
1.	Paul Cai	Calum Hutcheson	Rev00	16.11.2018
2.	Calum Hutcheson	Calum Hutcheson	Rev01	23.11.2018
3.				
4.				
5.				

Level 5, Suite 501, 174 Pacific Highway, Greenwich NSW 2065

Contents

Table Index

Figure Index

1 Introduction

1.1 Background

TTM Consulting was engaged by Eco Logical Australia to undertake a traffic impact assessment for the proposed Tenterfield Solar Farm.

The proposed solar farm is located approximately 3km to the north east of the township of Tenterfield, NSW, which is approximately 200km inland due west from Byron Bay.

1.2 Scope

This report investigates the transport aspects associated with the construction and operation of the site, particularly the access point and haulage route to the site from the New England Highway. The scope of the transport aspects investigated include:

- Likely traffic generation and impacts.
- Access arrangements for staff and deliveries.
- Assessment of the implications and recommendation arising from a Road Safety Audit prepared independently of this report.
- Identification of any roads or intersections which need to be upgraded, in addition to mitigations for pavement impacts.
- Assessment of the outcomes of a Road Safety Audit.
- Traffic Impact Assessment.

A separate independent Road Safety Audit has been undertaken. The audit identifies issues which are assessed as part of this report. Some of the issues relate to existing conditions for which Tenterfield Council and the NSW Roads and Maritime Services are responsible for.

To assess the proposed transport arrangements, the proposal has been assessed against the following guidelines and planning documents:

- RMS (RTA) Guide to Traffic Generating Developments Version 2.2 (2002).
- Austroads Guide to Road Safety: Part 6; Road Safety Audit Third Edition (2009).
- RMS (RTA) Traffic Control at Work Sites Version 5 (July 2018).

1.3 Site Location

The site is located approximately 3km to the north east of the township of Tenterfield NSW. The site location is shown in Figure 1.1. the subject site comprises approximately 60ha of land that forms part of the Tenterfield Solar Farm Area. The site comprises of Lots 85, 87, 89 and 90 on DP751540 (see Figure 1-2).

Access to the site would be via a new access point off Old Racecourse road.

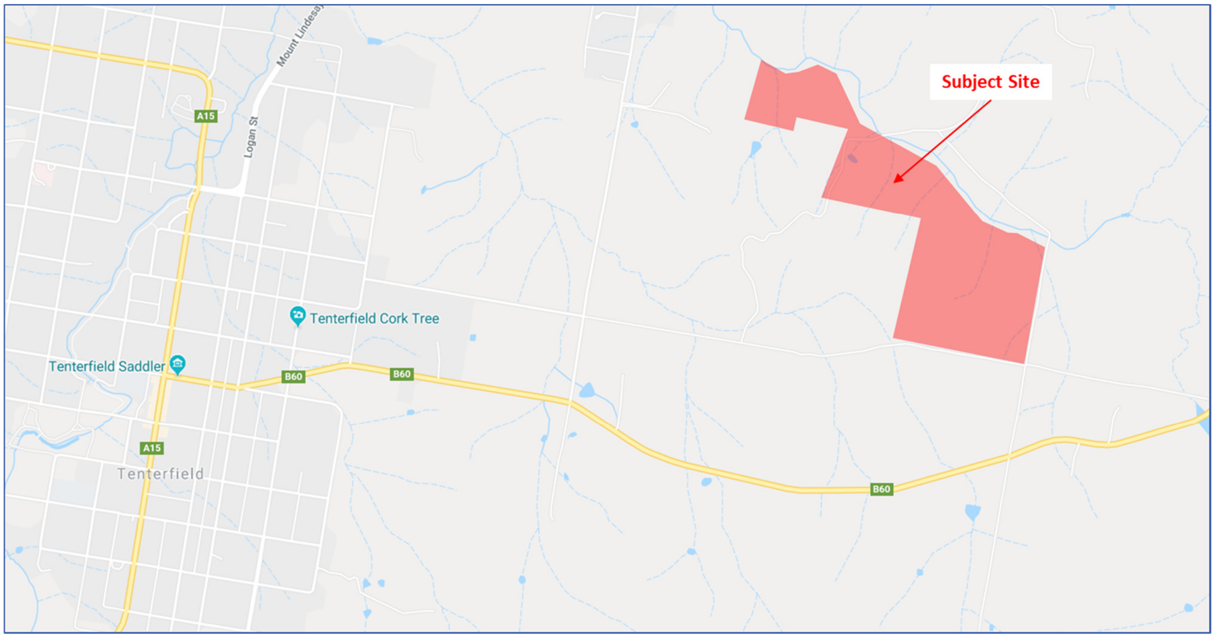


Figure 1-1: Site location

Figure 1-2: Site locality

2 The Proposal

2.1 Development Profile

The proposal is the development of a solar farm with an estimated capacity of approximately 22 MW located on approximately 60ha of farmland. The proposal is located on land within the Tenterfield Shire Council area.

The proposed development will include the following:

- Installation of photovoltaic (PV) panels, steel racking and piled supports.
- Installation of battery based storage to dispatch the power generated by the panels.
- Installation of electrical transformers and inverters, electrical cabling, telecommunications equipment and security fencing.
- Construction of formed gravel roads for permanent access distributed throughout the project.
- A project office consisting of a building fitted out with necessary office, communication and messing facilities.

The facility is intended to operate year-round.

2.2 Traffic Generation

2.2.1 Site Access

The Tenterfield solar farm site will be accessed via a new access point off Old Racecourse Road from the western part of Bruxner Highway.

Most construction trucks and staff vehicles will come via New England Highway, Bruxner Highway, Bellevue Road, and Old Racecourse Road (see Figure 2-2).

2.2.2 Construction Traffic

The construction of the Tenterfield Solar Farm will require access for around 640 heavy and light vehicles over a construction period of approximately 7 months. The anticipated construction program plus the breakdown of heavy vehicles is shown below.

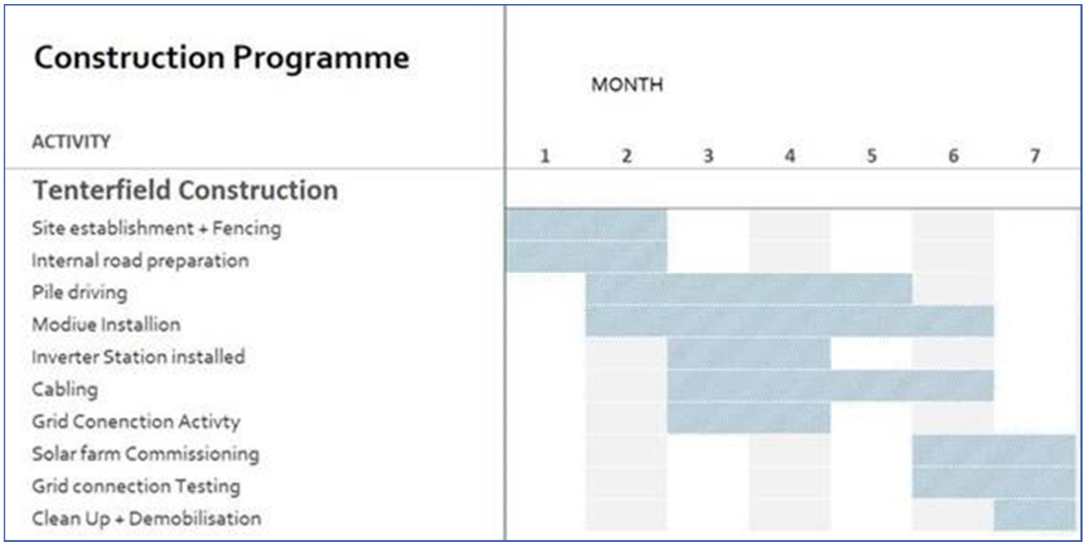


Figure 2-1: Anticipated construction programme

Table 2-1: Estimated heavy vehicles over the seven-month construction period

Plant/Equipment	Description	Heavy Vehicles
Modules	107, 268 modules (392 modules per 40' container) delivered on semi-trailers.	275
Mounting frames	30 x 40' container per MW, inclusive of piles, and structural frames and materials	30
Inverter Stations	10 x inverter stations; delivered 1 per semitrailer.	10
Battery storage	6 x 20' shipping containers and 6 x 40; shipping containers on semitrailers.	9
Concrete	Estimated 200 m^3 required inverter assembly foundations and security fence in 10m^3 concrete trucks.	20
Gravel	Estimated 2000 m^3 (~4000 tonne) of gravel for internal access roads and temporary hardstand lay down and construction compound area: delivered in 42.5 tonne truck & dog trailers. Assumes access road and hardstand all at 100 mm	100
Sand	Estimated 2200m^3 of sand (~3200 tonne) would be delivered in 42.5 tonne truck & dog trailers	80
Miscellaneous	Provision for 5 miscellaneous deliveries (fencing, building materials, cable drums, water for dust suppression, etc) a week during construction period, dropping to an average of 2 trucks a week for the one month shoulder periods.	116
Total		640

The average number of daily construction vehicles visiting the site will be five. Deliveries will depend on day to day operational requirements. The quantity of vehicles will decrease significantly at the completion of construction. Post construction will require service by a limited number of staff.

Some of the construction activities may overlap. It is expected that of the scheduled days of operation there is a 5 percent leakage due to conditions such as bad weather or public holidays resulting in no movements on a particular day. Daily truck movements may increase beyond the five forecast per day to make up for such disruptions. This will not occur for extended periods.

Various types of trucks be will used to access the site. These consist of B-doubles, semi-trailers, truck and dog, concrete trucks, forklift loader, waste collection trucks and utes, etc.

A traffic management plan is proposed to be used for heavy vehicle deliveries to the site. The traffic management plan should include arrival of heavy vehicle deliveries through a proper schedule. Further details can be required as a consent condition.

The construction workers are expected to be local tradespeople plus workers sourced from elsewhere. The workers sourced from elsewhere will be housed nearby in Tenterfield or surrounding towns and bused in and out. Staff accessing the construction site by personal vehicle will be encouraged to adopt car-pooling. It is estimated two staff would ride per car. Overall the average traffic movements during construction will be five heavy vehicles and up to 40 light vehicles daily.

Post construction will require service by a limited number of staff (possibly up to 5 staff if maintenance/repair is required).

2.2.3 Haulage Routes

The construction haulage route for most of the project infrastructure will be required from a container port to the site. It is not known at this stage whether the port will from the south or north. This will be confirmed during the detailed design stage and procurement. Nevertheless, most of the site delivery traffic will be accessing the site via the New England Highway. The proposed construction heavy vehicular movement plan is presented in Figure 2-2.

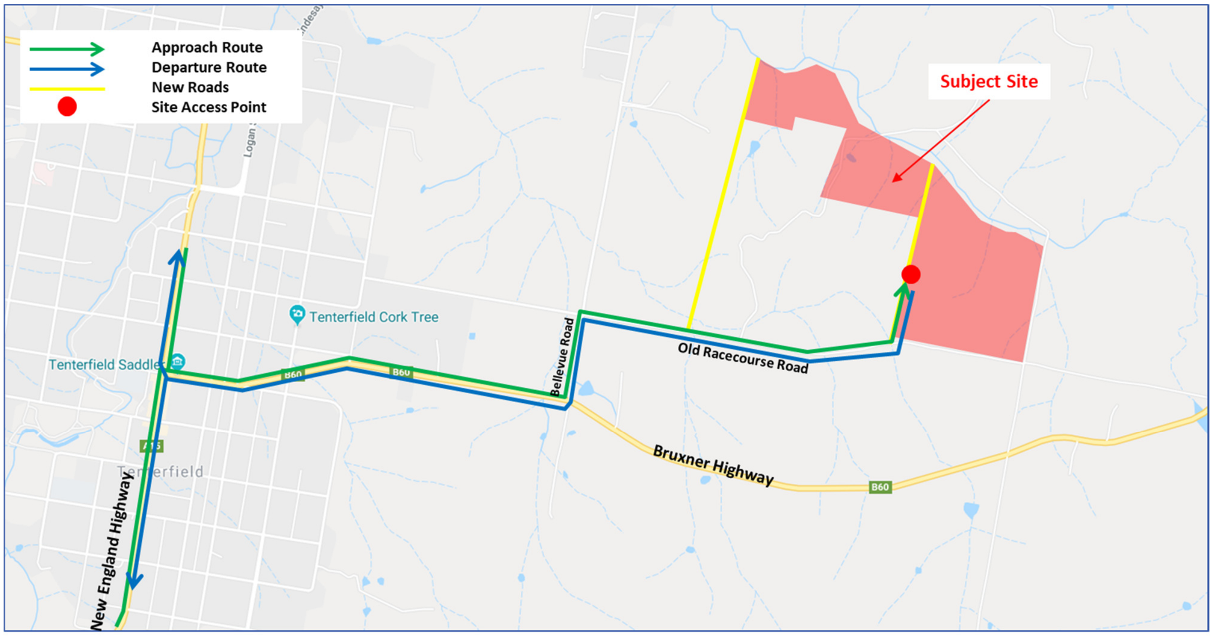


Figure 2-2: Proposed construction traffic haulage route

The proposed haulage route of construction vehicles accessing the solar farm site is:

- Existing New England Highway onto Bruxner Highway
- Turning left from Bruxner Highway onto Bellevue Road
- Turning right from Bellevue Road onto Old Racecourse Road
- Turning left into the site access from Old Racecourse Road

The proposed exit route for construction vehicles from the solar farm is shown below:

- Exiting the site onto Old Racecourse Road
- Turning left from Old Racecourse Road onto Bellevue Road
- Turning right from Bellevue Road onto Bruxner Highway
- Entering onto New England Highway from Bruxner Highway

The Bruxner Highway, Bellevue Road and Old Racecourse Road are not currently approved for B-double vehicle access. Permission from the NSW RMS will be required to allow temporary access during the construction period on the Bruxner Highway, Bellevue Road and Old Racecourse Road for B-double access.

Management and scheduling of construction vehicle access will be required to minimise the occurrence of passing construction vehicles. This is due to the limited carriageway width of Bellevue Road and Old Racecourse Road. Construction and site managers will need to manage the vehicle movements to ensure that there is minimal conflict between inbound and outbound trucks.

The expected construction traffic haulage route is approved for up to 26m B-double trucks as shown in NSW combined higher mass limits and restricted access vehicles map (see Figure 2-3) with an extension along the 2km section of the Bruxner Highway from the New England Highway, also utilising Bellevue Road and Old Racecourse Road.

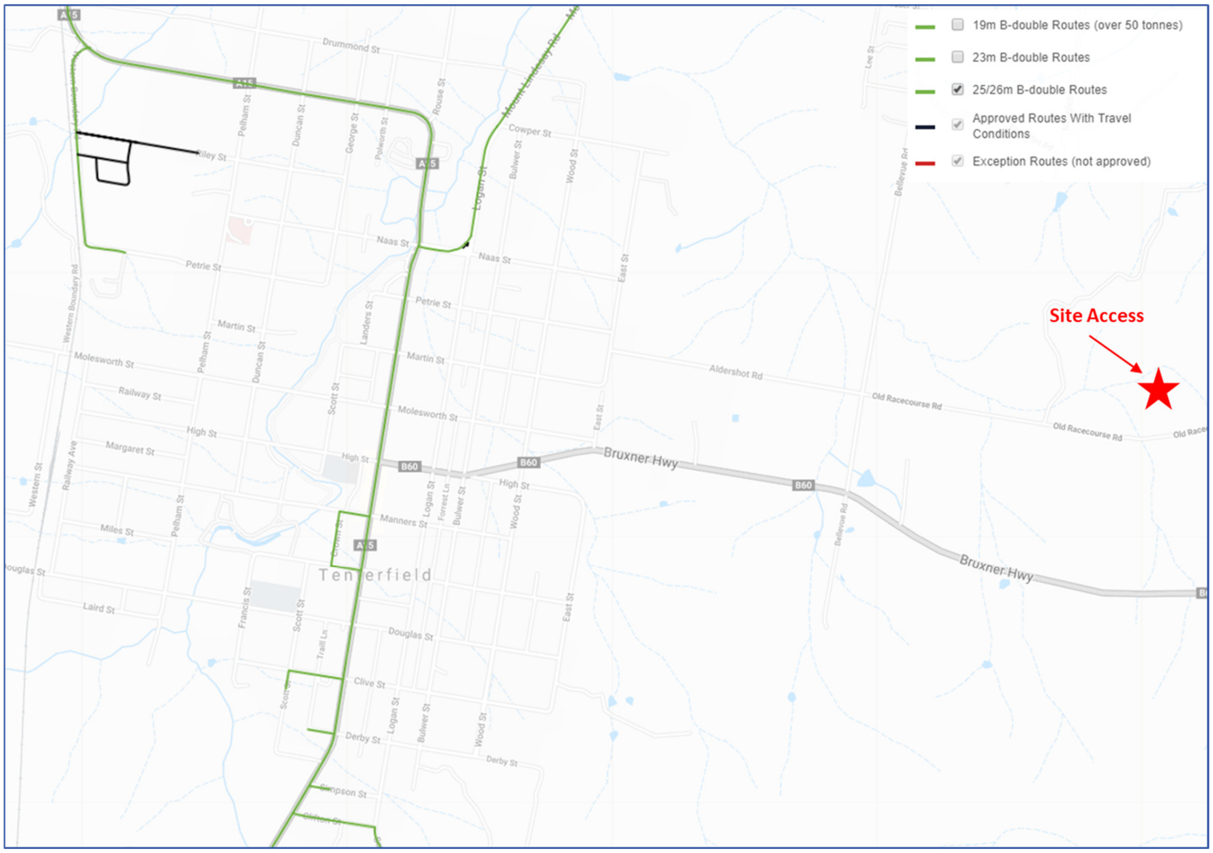


Figure 2-3: NSW combined higher mass limits and restricted access vehicles map[1]

2.2.4 Alternate Access

Coxalls Road could be used as an alternate or supplementary access off the Bruxner Highway. This does not affect the traffic analysis.

[1] Source: Roads and Maritime Services (Link: http://www.rms.nsw.gov.au/business-industry/heavy-vehicles/maps/restricted-access-vehicles-map/map/)

3 Existing Transport Infrastructure

3.1 The Road Network

The characteristics of roads in the immediate vicinity of the site are shown below in Table 3-1.

Table 3-1: Road Characteristics

Road	Speed Limit	Lanes	Road Authority
New England Highway	40km/h*	2 (undivided plus parking, Asphalt Road)	RMS
Bruxner Highway	100 km/h	2 (Undivided, Asphalt Road)	RMS
Bellevue Road	100 km/h	2 (Undivided, Asphalt Road)	Council
Old Racecourse Road	100 km/h	160m of 2 (Undivided, Asphalt Road) 550m of 2 (Undivided, Gravel Road) 740m of 1 (Gravel/Unmade Dirt Road)	Council

**Posted speed limit in Tenterfield town centre*

The posted speed limit on the New England Highway in the built-up area of Tenterfield is 40 km/hr. The posted speed limit on the Bruxner Highway is 50 km/hr within the town extents and 100km/hr further east. Bellevue Road and Old Racecourse Road noted are not sign posted. Speeds on these roads would be compatible with the road conditions.

The intersection of the New England Highway and Bruxner Highway is priority controlled with a right turn slip lane on the New England Highway northbound.

3.2 Traffic Flows

3.2.1 New England Highway

Traffic counts for 2018 were obtained from the RMS Traffic Volume Viewer website, which provided the following information. (Table 3-2)

Table 3-2 : Traffic Volumes on New England Highway

Road	Location	Station ID	Daily Northbound Vol	Daily Southbound Vol
New England Hwy	67km south of Wagga Road	T0259	1,011 (23.34%)	1,092 (26.28%)

The closest station was on New England Highway, 67km south of Tenterfield. The heavy vehicle volume is close to 25%.

3.2.2 Bruxner Highway

The Bruxner Highway to Tenterfield is a state road which provides an important link for the rural communities of the upper northwest of New South Wales to commute and transport their products to wider markets in Casino, Lismore and Ballina. The highest Average Annual Daily Traffic (AADT) volumes on the

Bruxner Highway near Tenterfield is about 2000[2]. The published traffic volumes on the Bruxner Highway between Tenterfield town centre and the subject are presented in RMS's "Tenterfield Heavy Vehicle Bypass Preliminary Route Options Report" (2014). The surveyed traffic volumes are shown in Table 3-3.

Table 3-3: Bruxner Highway traffic volumes

Location	2011[1]	20121
West of Bellevue Street	1,028	1,031
East of Rouse Street	2,444	-

Notes:
1. 2011 and 2012 surveys published by Roads and Maritime Services for the Tenterfield Heavy Vehicle Bypass investigation

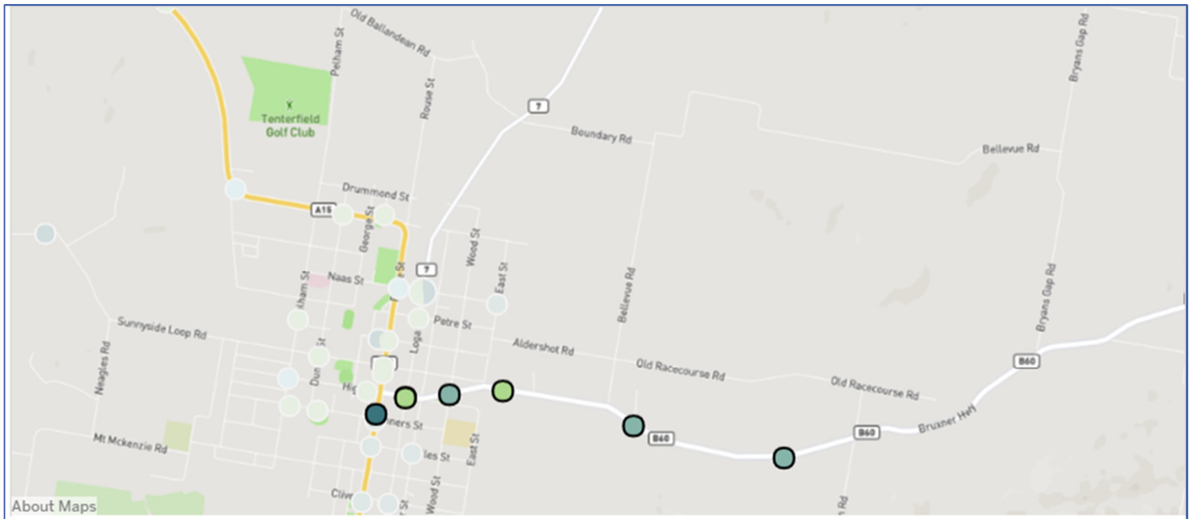
3.2.3 Local Roads

The local roads other than Bruxner Highway are used by the residents to access their farms and houses. Traffic flows on the local roads are low.

[2] Roads and Maritime Services, 2014, "Tenterfield Heavy Vehicle Bypass Preliminary Route Options Report".

3.3 Road Safety

Records of road traffic crashes within the vicinity of the subject site were obtained from the Transport for NSW Centre for Road Safety crash and casualty statistics website. The extent of the crashes in the area are indicated in Figure 3-1.



Degree of crash

Fatal | Serious Injury | Moderate Injury | Minor/Other Injury | Non-casualty (towaway)

Repo..	Crash ID	Degree of crash	RUM - code	RUM - descripti..	Type of location	Natural l..	Longitude	Lattitude	No ..	No Inju..
2013	827145	Serious Injury	2	Ped far side	Divided road	Darkness	152.018857	-29.055	-	1
	831543	Moderate Injury	53	Overtake turning	2-way undivided	Daylight	152.040816	-29.055869	-	1
	845096	Non-casualty (t..	87	Off lft/lft bnd=>obj	X-intersection	Darkness	152.021374	-29.053742	-	-
	848396	Non-casualty (t..	10	Cross traffic	X-intersection	Daylight	152.021365	-29.053786	-	-
	1001541	Non-casualty (t..	73	Off rd rght => obj	2-way undivided	Darkness	152.029673	-29.053274	-	-
2014	1023778	Moderate Injury	10	Cross traffic	X-intersection	Daylight	152.025116	-29.053548	-	2
2016	1125053	Moderate Injury	80	Off left/right bend	2-way undivided	Daylight	152.053645	-29.058252	-	1

Figure 3-1 : RMS 5 Year Crash Data (2013 to 2017) – New England Hwy / Bruxner Hwy

There were three crashes along the section of the Bruxner Highway from Bellevue Road to the New England Highway. Two were non-casualty crashes and one was moderate injury. All of these occurred at locations other than the intersections proposed for the construction traffic of the solar farm.

4 Traffic Impacts

Traffic impacts relate to the effects of the traffic generated by the solar farm and conditions on roads and at intersections. Each is addressed below.

4.1 Traffic Flows

The proposed solar farm is forecast to generate around 5 heavy vehicles and up to 40 light vehicles during the construction period. The existing road network will not be significantly affected by the additional traffic.

4.2 Intersection Operation and Safety

The 'Road Safety Audit' has identified potential sight distance issues. The sight distance issues are addressed in section 5.1. The sight distances of the proposed intersections are sufficient.

There are three crashes along the section of the Bruxner Highway from Bellevue Road to New England Highway from 2013 to 2017. Only one of the crashes involved a moderate injury. This would not be related to potential future or past road crashes.

4.3 Construction and Operational Traffic Management

4.3.1 Construction Phase

Figure 2-2 shows the proposed routes for heavy vehicles.

Construction traffic will enter the site via the New England Highway, Bruxner Highway, Bellevue Road, and Old Racecourse Road.

Construction traffic will exit the site through the same inbound route via Old Racecourse Road, Bellevue Road, Bruxner Highway and the New England Highway.

Staff traffic will use the local road system to access the site. Roads used will depend on where the construction staff live during the working week.

Recommendations and controls have been provided in the Road Safety Audit. The traffic assessment of these issues is contained in Chapter 5.

4.3.2 Operational Phase

For the operational phase, traffic will enter and exit the site via Old Racecourse Road. Large trucks will use the routes specified above.

Two to three vehicle movements are expected during the operational phase which will have negligible impacts. No specific management controls are considered necessary during the operational phase.

5 Road Safety Audit

The separate independent Existing Stage Road Safety Audit was completed in accordance with the requirements of Austroads' Guide to Road Safety: Part 6; Road Safety Audit Third Edition (2009).

The audit identifies issues to be reviewed as part of the assessment of the proposed development. It is based on a site visit conducted during the day. It is not a guarantee of safety and does not necessarily differentiate between issues associated with the proposed development and issues that are part of daily traffic conditions in the area. Nevertheless, it provides an independent and unbiased platform from which issues can be assessed.

Issues identified in the Road Safety Audit are given a priority ranking based on the following criteria:

- Priority A (High Risk) – Highest priority for action from a safety view point.
- Priority B (Medium Risk) – Action needs to be taken from safety view point.
- Priority C (Low Risk) – Action is desirable from a safety view point.
- Priority D (Comment) – An observation which may improve overall performance or safety. It could be of wider significance and possibly outside the scope of the Road Safety Audit but may be where action should be considered.

The priority ranking is based on the subjective assessment of the audit team. The following sections discuss each of the issues and how they should be addressed. The recommendations below take into consideration the contribution of the proposed development to the safety issue. They are not necessarily the recommendations of the Road Safety audit itself.

5.1 Road Safety Audit Report

The following items addressed in the road safety audit report have been addressed in terms of the actions required to mitigate these issues.

5.1.1 Item 1

The New England Highway already caters for B-Double vehicles (see below). There is no crash history in recent years for this access. Speed limits on both The New England Highway and Bruxner Highway have been reduced in the vicinity of Tenterfield to minimise the potential for conflict. There is no need to upgrade intersections to accommodate the short period that construction vehicles will access the solar farm site.

Figure 5-1: B-Double vehicles on the New England Highway

5.1.2 Item 2

Truck crossing signs (W5-22) for trucks crossing or entering are recommended to be on the Bruxner Highway approaches to Bellevue Road during the construction period (see Figure 5-2). Similar signs would be required either side of Coxalls Road should this alternative / supplementary access route be used.

Figure 5-2: Truck crossing signs at the intersection of Bruxner Highway and Bellevue Road

5.1.3 Item 3

There is an existing “Give Way” line marking on Bellevue Road at the intersection of Bellevue Road and Bruxner Highway. Nevertheless, the existing line marking is unclear. It is our recommendation to re-paint the “Give Way” line marking. This is a Council / RMS responsibility relating to existing conditions.

5.1.4 Item 4

Frangible hazard marker posts have been installed along the culvert on the Bruxner Highway. It is our recommendation to have these posts renewed with fresh paint and reflective markers. This is an RMS responsibility relating to existing conditions.

5.1.5 Item 5

Additional frangible posts including reflective markers are recommended for the intersection of Old Racecourse Road and Bellevue Road (see Figure 5-3).

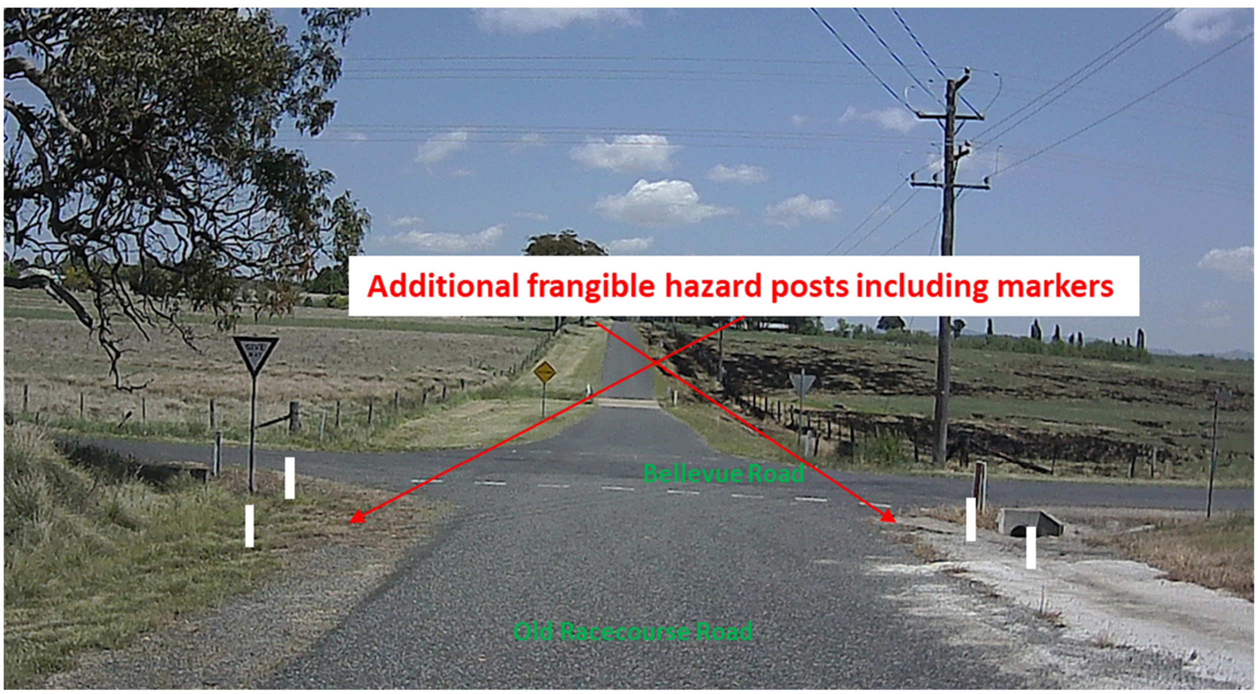


Figure 5-3: Intersection of Old Racecourse Road and Bellevue Road (facing west)

5.1.6 Item 6

No physical changes are recommended for this intersection as the traffic volumes and potential for conflict are low.

We recommend that Council consider reducing the speed limit for vehicles approaching the intersection on Bellevue Road and Old Racecourse Road are recommended to around 60 km/hr during the construction period.

5.1.7 Item 7

It is our advice to provide localised shoulder widening to ensure a total width of 7 metre along the section on Old Racecourse Road where the width is at 6 metre or less. Given the good sight distance on Old Racecourse Road the widening is only needed for 30 metres every 500 metres (3 x widened sections). This will allow for a driver to pull over to allow an opposing driver to pass. The widening would be temporary measure which does not need sealing of the widened section.

Speed limits on Old Racecourse Road (between Bellevue Road and site access) are recommended to be restricted to 60 km/hr during the construction period due to the road carriage width and road conditions. This would will be subject to Council's approval.

A maintenance plan is recommended to maintain the road conditions to a level suitable for the proposed access and for all vehicle types.

6 Summary and Conclusions

This report has examined the traffic and transport implications associated with the construction and operation of the proposed Tenterfield Solar Farm located approximately 2km east of Tenterfield, NSW.

Traffic generation associated with the development during the construction and operational phases will be low. There are no adverse impacts in relation to traffic flows.

A separate Road Safety Audit has identified areas where road improvements could be made. The audit recommendations are considered in this traffic report.

The following roadworks are recommended for consideration for the construction phase:

1. Truck crossing signs (W5-22) for trucks crossing or entering are recommended to be on the Bruxner Highway approaches to Bellevue Road during the construction period (Applicant responsibility).
2. Repainting of the “Give Way” line marking on Bellevue Road at the intersection of Bruxner Highway and Bellevue Road (Council/RMS responsibility).
3. Renewal of hazard markers on the Bruxner Highway (RMS responsibility).
4. Installation of additional frangible posts including reflective markers at the intersection of Old Racecourse Road and Bellevue Road (Applicant responsibility).
5. Provide localised shoulder widening on Old Racecourse Road for laybys to ensure a total width of 7 metres at up to 3 locations (Applicant responsibility).

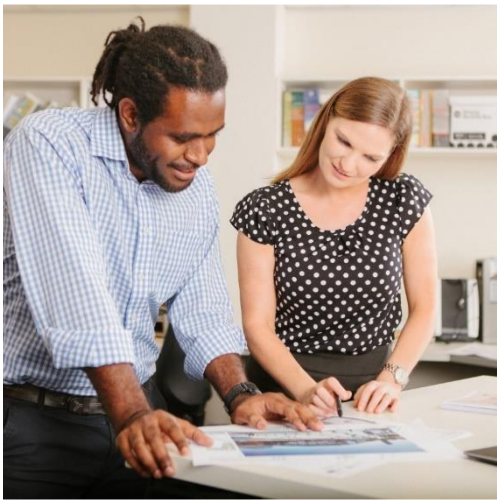
Subject to the recommended roadworks being considered by Council and RMS there are no traffic issues which would prevent the proposal from proceeding.

Appendix A Road Safety Audit

Traffic Engineering

Tenterfield Solar Farm, Tenterfield NSW

Road Safety Audit



About TTM

For 30 years, we've been at the centre of the Australian development and infrastructure industry. Our unique combination of acoustics, data, traffic and waste services is fundamental to the success of any architectural or development project.

We have over 50 staff, with an unrivalled depth of experience. Our industry knowledge, technical expertise and commercial insight allow us to deliver an exceptional and reliable service.

T: (02) 9418 3033
F: (02) 9418 3112
E: ttmnsw@ttmgroup.com.au

Accoustics Data Traffic Waste

Revision Record

No.	Author	Reviewed/Approved	Description	Date
1.	R V Jones / B Husain / Ben Williamson	R V Jones	Road Safety Audit Report	13/11/18
2.				
3.				
4.				
5.				

41A Quay Street, Sanctuary Cove. PO Box 930 Sanctuary Cove QLD 4212

Contents

Table Index

Figure Index

1 Introduction

1.1 Background

TTM Consulting was engaged by Eco Logical Australia to undertake a Road Safety Audit for the proposed Tenterfield Solar Farm. The solar farm is located 2km east of Tenterfield, NSW. The solar farm will have an estimated maximum capacity of up to 25 MW.

This Road Safety Audit has considered the following intersections near the proposed solar farm site.

- New England Highway / Bruxner Highway intersection
- Bruxner highway / Bellevue Road intersection
- Bellevue Road / Old Racecourse Road intersection
- Old Racecourse Road / Site Access locatiopns

This report identifies possible safety issues, and these are noted by the audit team using a combination of onsite investigations and a review of background material. Recommendations for potential remedial treatments are made in response to each safety issue that is raised as part of this audit process.

1.2 Site Location

The location of the proposed solar farm is 2km east of Tenterfield, NSW. Tenterfield is a town, which is located 100km west of Casino in New South Wales. The location of the solar farm in terms of nearby areas is shown in Figure 1-1. The location of the solar farm in terms of surrounding roads is shown in Figure 1-2. Figure 1-3 show the roads in the immediate vicinity of the site.

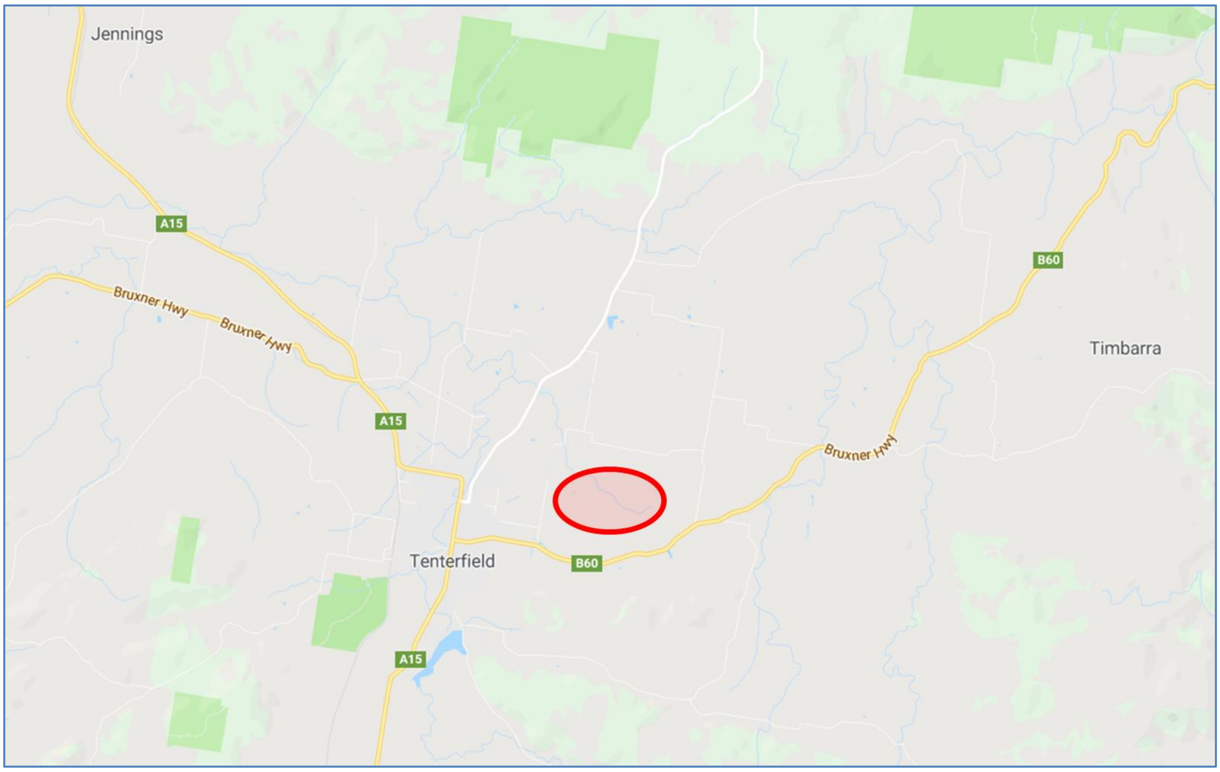


Figure 1-1 Solar farm location with surrounding areas

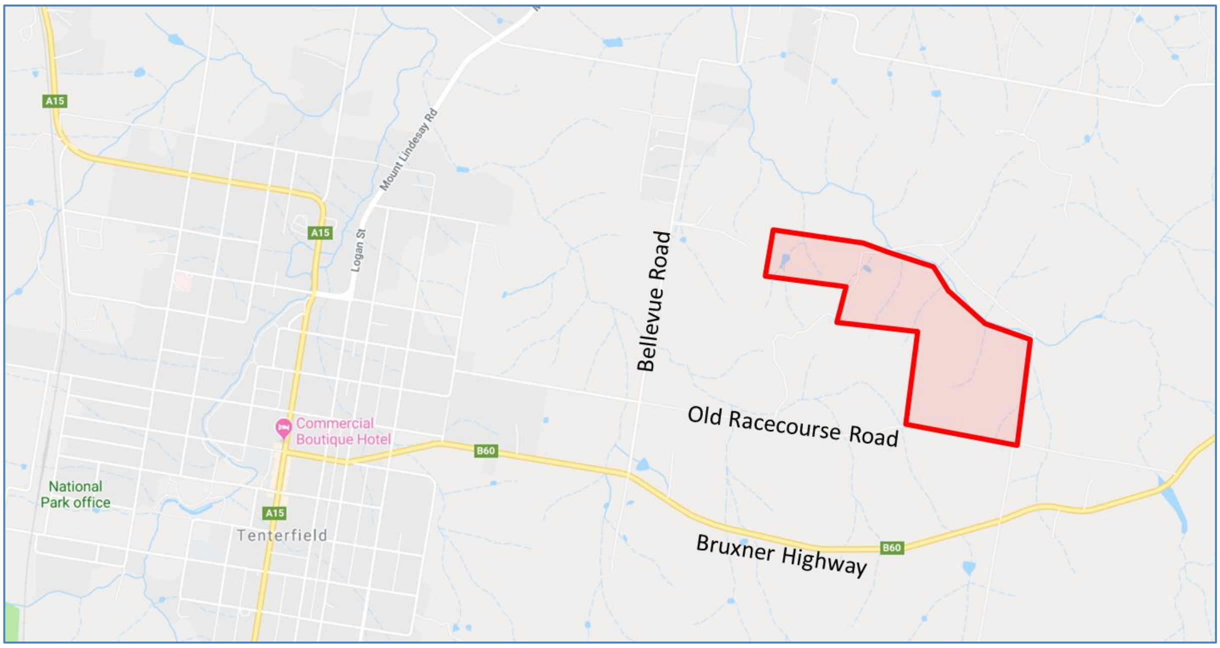


Figure 1-2 Solar farm location with surrounding roads

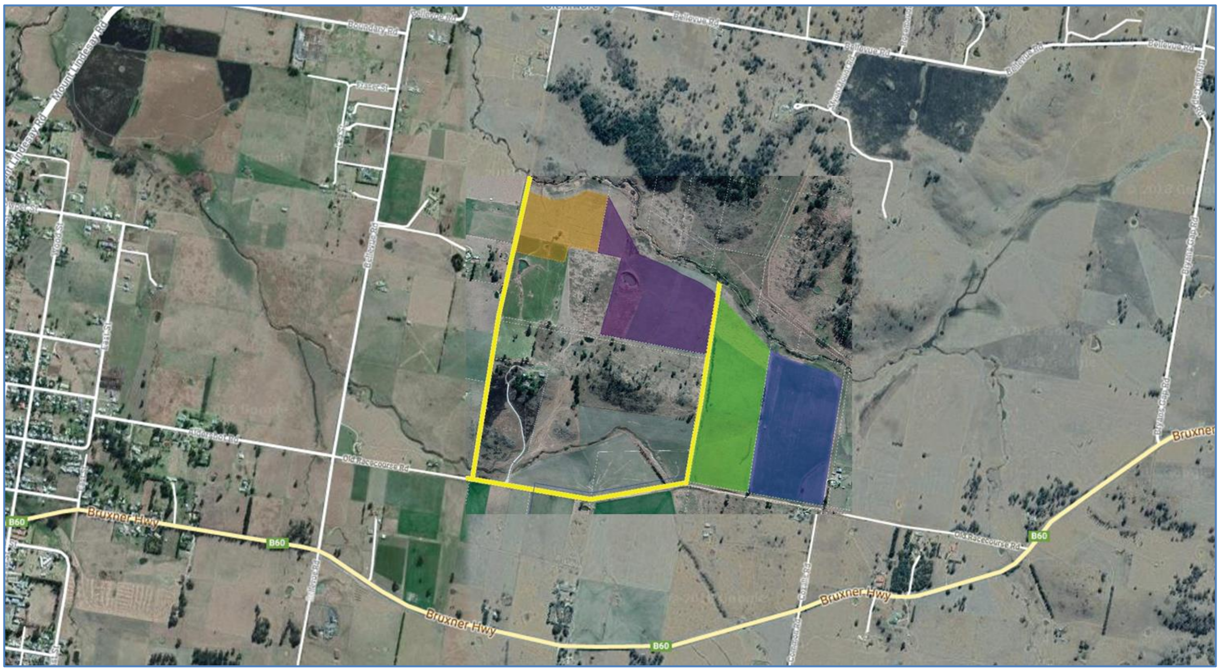


Figure 1-3 Solar farm location with roads in the immediate vicinity

1.3 Audit Stage

This report results from an Existing Stage Road Safety Audit, which has been undertaken in accordance with the requirements of Austroads' Guide to Road Safety: Part 6; Road Safety Audit Third Edition (2009). The audit report generally follows the format and topics outlined in the Austroads Checklist 6 for Existing stage audits.

This audit covers only the study area and has sought to identify potential safety hazards. However, the auditors would like to point out that no guarantee is made that every deficiency or hazard has been identified. Further, if all recommendations in this report were to be followed, this would not guarantee that the study area is 'safe'; rather, adoption of the recommendations should improve the level of safety at this location.

1.4 Audit Team

The persons undertaking in this road safety audit are;

- Richard V Jones – Senior Road Safety Auditor (Team Leader); TTM Consulting Pty Ltd
- Ben Williamson – Senior Road Safety Auditor; TTM Consulting Pty Ltd
- Baqir Husain –Road Safety Auditor, TTM Consulting Pty Ltd

1.5 Site Inspection

A site inspection of the audit area was conducted on Thursday 25th October 2018. The inspection was conducted in the day to assess the conditions noted in Austroads. The weather condition during the inspection was sunny with clear skies. The inspection was carried out on foot and by car.

1.6 Proposed Solar Farm

The proposed Tentefield Solar Farm (SSF) development is a 25 MW utility scale electricity generation works comprised of solar photovoltaic (PV) modules, steel racking and piled supports, electrical transformers and inverters, battery storage, electrical cabling, telecommunications equipment, security fencing, a site office, maintenance building and car park facilities.

The proposal is located on land within the Tenterfield Shire Council Local Government Area (LGA) 2km east of Tenterfield, and 125km west of Casino in northern NSW. Access to the site is via the New England Highway, Bruxner Highway, Bellevue Road and Old Racecourse Road. An existing substation is located on the southern side of Bruxner Highway, which will serve as the grid connection point. The identified land is currently used for grazing and/or cultivation by landholders included in the project.

2 Existing Road Environment

2.1 Road Network

The Road Safety Audit was carried out in the area that covers the following roads and their classification:

Table 2-1: Road Classifications

Road	Speed Limit	Lanes	Classification	Management
New England Highway	40 km/h*	2 (Undivided, Asphalt Road, 8.5m wide)	State	RMS
Bruxner Highway	100 km/h	2 (Undivided, Asphalt Road, 7.2m wide)	State	RMS
Bellevue Road		2 (Undivided, Asphalt Road, 7.4m wide)	Rural	Tenterfield Shire Council
Old Racecourse Road		160m of 2 (Undivided, Asphalt Road, 5-6m wide) 550m of 2 (Undivided, Gravel Road, 6-7m wide) 740m of 1 (Gravel/Unmade Dirt Road, 3-3.5m wide)	Rural	Tenterfield Shire Council

*Posted speed limit in central Tenterfield

The posted speed limit on the New England Highway out of the built-up area of Tenterfield is 100km/h. The other roads noted in Table 2-1 are not sign posted and therefore are assumed to have a rural speed limit of 100km/h.

2.2 Traffic Counts

Traffic counts for 2018 were obtained from the RMS Traffic Volume Viewer website, which provided the following information. (Table 2-2)

Table 2-2 : Traffic Volumes on New England Highway

Road	Location	Station ID	Daily Northbound Vol	Daily Southbound Vol
New England Hwy	67km south of Wagga Road	T0259	1,011 (23.34%)	1,092 (26.28%)

The closest station was on New England Highway, 67km south of Tenterfield. The heavy vehicle volume is close to 25%.

2.3 Construction Traffic

The Tenterfield Solar Farm proposes to utilise around 700 heavy vehicles over a construction period of 7 months. The average number of daily construction vehicles visiting the site will be 5. A total of 10-15 heavy vehicles per day are expected during the peak of construction when delivery and waste collection occur at the same time. The construction traffic will consist of low loader trailers, truck and dog, B double trucks and waste collection trucks. There will be up to 30-40 light vehicles for labour and staff transportation.

The Bruxner Highway is not suitable for B-double vehicles that travel from Casino to Tenterfield. Therefore, as the site is only 2km from Tenterfield, it is advisable to request permission from RMS to allow temporary access during the construction period on the Bruxner Highway for B-doubles between the New England Highway and Bellevue Road. Therefore, it is assumed that the solar farm construction traffic haulage route may be accessed via the following locations.

- New England Highway / Bruxner highway intersection
- Bruxner Highway / Bellevue Road intersection
- Bellevue Road / Old Racecourse Road intersection
- Old Racecourse Road / Site Access intersection

The expected construction traffic haulage route is shown in Figure 2-1.

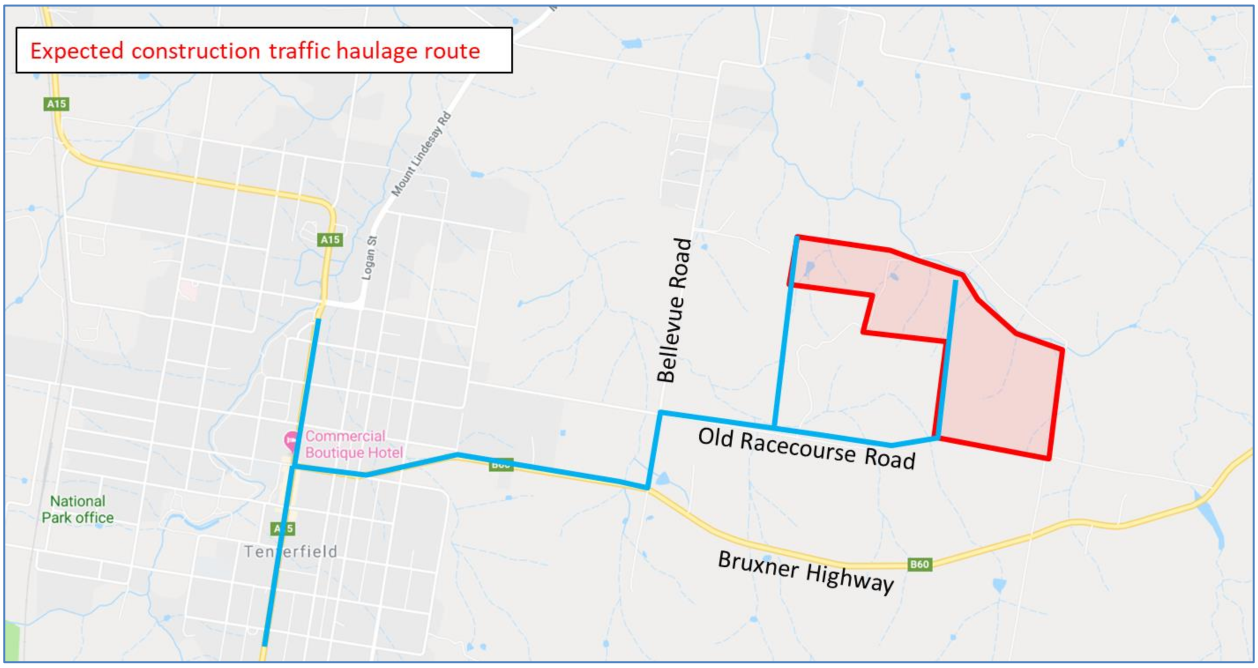


Figure 2-1 Expected construction traffic haulage route

The expected construction traffic haulage route is approved for up to 26m B-double trucks as shown in NSW combined higher mass limits and restricted access vehicles map in Figure 2-2; with an extension along the 2km section of the Bruxner Highway from the New England Highway, also utilising Bellevue Road and Old Racecourse Road.

Figure 2-2 NSW combined higher mass limits and restricted access vehicles map

2.4 Crash History

TTM obtained crash data for the past five years from the Transport for NSW Centre for Road Safety crash and casualty statistics website for the locality of the area. The extent of the crashes in the area are indicated in Figure 2-3 and Figure 2-4

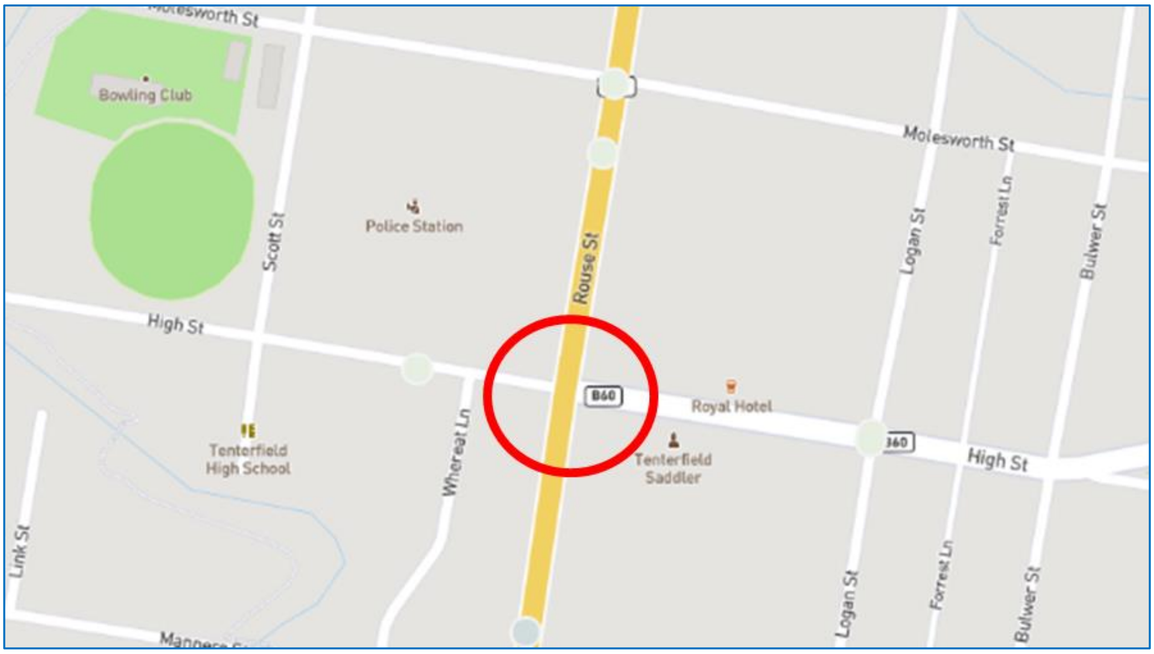


Figure 2-3 : RMS 5 Year Crash Data (2013 to 2017) – New England Hwy / Bruxner Hwy

Figure 2-4 : RMS 5 Year Crash Data (2013 to 2017) – Other Intersections

There were three crashes along the section of the Bruxner Highway from Bellevue Road to New England Highway. Two were non-casualty crashes and one was moderate injury. All of these occurred at locations other than the intersections proposed for the construction traffic od the solar farm.

3 Road Safety Audit Findings

3.1 Audit Criteria

A ranking system for each of the issues has been adopted using the following priority ratings in Table 3-1:

Table 3-1 Road Safety Audit – Priority Ratings

Priority	Risk Ranking	Suggested Treatment Approach
A	High	Highest priority for action from a safety view point
B	Medium	Action needs to be taken from safety view point
C	Low	Action is desirable from a safety view point
D	Comment	An observation which may improve overall performance or safety, Be of wider significance and possibly outside the scope of this RSA, but where action should be considered

It is noted that the priority ranking is based on the subjective assessment of the audit team.

4 Formal Statement

4.1 Audit Team Statement

We, the undersigned, declare that we have reviewed the material and data listed in this report and identified the safety and operational deficiencies outlined in the preceding sections.

It should be noted that while every effort has been made to identify potential safety hazards, no guarantee can be made that every deficiency has been identified. We recommend that points of concern be investigated, and necessary corrective actions are undertaken.

Richard V Jones – Senior Road Safety Auditor (Team Leader) 13/11/18

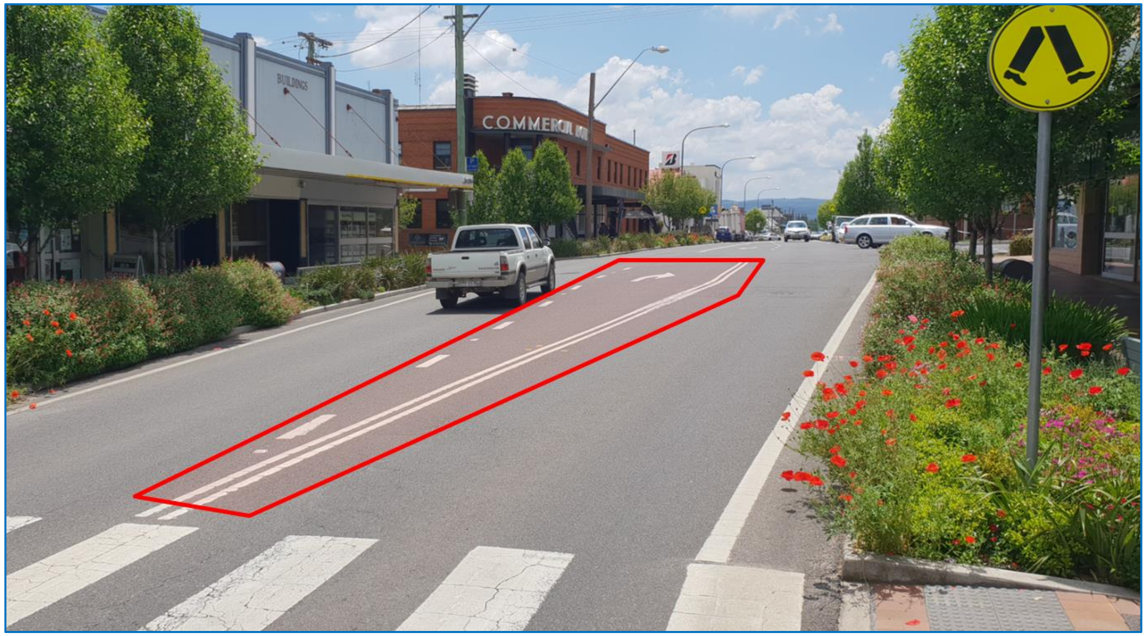
Ben Williamson – Senior Road Safety Auditor...13/11/18

Baqir Husain – Road Safety Auditor...13/11/18

Appendix A Road Safety Audit Findings

Auditor: Richard V Jones (TTM Consulting)

Date: 09/11/18

Item	Audit Findings/Recommendations	Rankings
1	It is proposed to utilise access for B-double vehicles from the New England Highway into Bruxner Highway. The existing right turn on the New England Highway only provides a 12m turn lane (3.5m wide) and a 20m taper. This does not allow enough space for a B-double to stand clear of traffic. There is an increased risk of a side swipe crash by following vehicles as they try to pass a B-double waiting to turn right here.  Consideration could be given to restricting B-double traffic from the northern approach of New England Highway. The provision of trucks tuning signs will also advice other drivers of this movement during the construction period.	Low

Item	Audit Findings/Recommendations	Rankings
2	The Bruxner Highway / Bellevue Road intersection and Bellevue Road / Old Racecourse Road intersection will be used by delivery and staff vehicles to access the site. There will be increased construction traffic and it is expected that heavy vehicles will be making right turns from Bellevue Road to Bruxner Highway. These turn movements will be a significant increase in comparison with the existing scenario. Therefore, there is an increased risk of other road users not being aware of a potential higher turn traffic in and out of these roads. This could lead to potential crashes by some drivers not expecting these turn movements and result in a rear end or t-bone crash.  Consideration could be given to installation of truck turning signs on all approaches to these intersections.	Low

Item	Audit Findings/Recommendations	Rankings
3	The existing intersections of Bellvue Road with Bruxner Highway and Old Racecourse Road with Bellvue Road have give-way signs on the approaches, but do not have any line marking to provide assistance to drivers. Many of the construction drivers and workers will not be familiar with the local road network. There is an increased risk that drivers will not position the vehicles correctly when waiting to give-way. This may result in the opposing vehicle turning into the side road side swiping the stationary vehicle. This is more likely to occur with larger vehicles. Given the increase in turning traffic and some of these drivers being unfamiliar with the road network, some driver may not give-way sufficiently to exit the intersection, thus resulting in a side swipe crash.  Consideration could be given to providing stop sign and line marking to improve safety at these locations.	Low

Item	Audit Findings/Recommendations	Rankings
4	There are locations were some existing hazards occur, such as this culvert on the Bruxner Highway between Bellevue Road and Tenterfield. There have been no crashes recorded at this location, and there are hazard markers spaces at 5m to delineate this hazard. If these are not maintained, there is an increased risk that a drive may veer onto the verge and then drop into the culvert, with a 1.5m drop and 2.m from the edge line. This may result in a serious injury.  Ensure that all existing infrastructure, signs and line marking are maintained throughout the construction period. Consider providing ribbed white edge line marking on the approach to this hazard.	Medium

Item	Audit Findings/Recommendations	Rankings
5	The intersection of Old Racecourse Road and Bellevue Road has a culvert located at each corner. With the increased right turn in and left turn out at this location, there is an increased risk of left turning vehicles trying to turn tightly when another vehicle is turning right into Old Racecourse Road. This will increase the risk of vehicles crashing into the culvert, possibly sustaining minor to serious injury. This is more likely to occur with larger vehicles.  Additional hazard markers will need to be provided at these locations to ensure driver can clearly see where the hazard lies. .	Low

Item	Audit Findings/Recommendations	Rankings
6	The intersection of Bellevue Road and Old Racecourse Road will be used by all construction vehicles and workers vehicles, as the main access to the solar farm. The main movement will be right turn in from Bellevue Road to Old Racecourse Road and left turn from Old Racecourse Road to Bellevue Road. There is some restricted sight distance along Bellevue Road to the north (190m due to the brow of the hill). There is a risk that driver will enter or exit Old Racecourse Road when there is insufficient sight distance to oncoming vehicles. This can result in a T-bone crash at this location leading to serious injury.  Consideration could be given to installation of advance warning sign or truck crossing signs, together with a advisory speed on this approach.	Medium

Item	Audit Findings/Recommendations	Rankings
7	The existing gravel section of Old Racecourse Road (distance of about 550m) varies between 5m to 7m in width. At locations where the width is at 6m or less, there is an increased risk of a side swipe crash as drivers will not wish to drive in the verge, in particular when the ground is soft after heavy rainfall.  Consideration could be given to provide localised shoulder widening to ensure a total width of 7m along this section of the road. Due to the increase in construction traffic, the construction of the gravel road will need to be checked and be sufficient for the loads being carried along these roads. An alternative would be to consider a number of passing places suitable to cater for the construction traffic on this road.	Low

Item	Audit Findings/Recommendations	Rankings
8	The section of unmade / poor gravel road of Old Racecourse Road (distance of about 740m) is only 3m to 4m wide, is very uneven and poorly made with areas of ponding water. There is a high risk that drivers will lose control of their vehicle along this section of road, leading to crashing into the verge or side swiping an approaching vehicle. The road is likely to be unusable after period of heavy rainfall.  Construction of a new gravel road to a minimum width of 7m (including shoulders) should be provided along this section to the far eastern site access. An alternative would be to consider a number of passing places suitable to cater for the construction traffic on this road.	Medium

HEAD OFFICE
Suite 2, Level 3
668-672 Old Princes Highway
Sutherland NSW 2232
T 02 8536 8600
F 02 9542 5622

CANBERRA
Level 2
11 London Circuit
Canberra ACT 2601
T 02 6103 0145
F 02 9542 5622

COFFS HARBOUR
22 Ray McCarthy Drive
Coffs Harbour NSW 2450
T 02 6651 5484
F 02 9542 5622

PERTH
Level 1, Bishop's See
235 St Georges Terrace
Perth WA 6000
T 08 6218 2200
F 02 9542 5622

MELBOURNE
Level 1, 436 Johnston St
Abbotsford, VIC 3076
T 9209 7173
F 02 9542 5622

SYDNEY
Suite 1, Level 1
101 Sussex Street
Sydney NSW 2000
T 02 8536 8650
F 02 9542 5622

NEWCASTLE
Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
T 02 4910 3412
F 02 9542 5622

ARMIDALE
92 Taylor Street
Armidale NSW 2350
T 02 8081 2685
F 02 9542 5622

WOLLONGONG
Suite 204, Level 2
62 Moore Street
Austinmer NSW 2515
T 02 4201 2200
F 02 9542 5622

BRISBANE
Level 5, 12 Creek Street
Brisbane QLD 4000
T 07 3503 7192
F 02 9542 5622

HUSKISSON
Unit 1, 51 Owen Street
Huskisson NSW 2540
T 02 4201 2264
F 02 9542 5622

NAROOMA
5/20 Canty Street
Narooma NSW 2546
T 02 4302 1266
F 02 9542 5622

MUDGEE
Unit 1, Level 1
79 Market Street
Mudgee NSW 2850
T 02 4302 1234
F 02 6372 9230

ADELAIDE
2, 70 Pirie Street
Adelaide SA 5000
T 08 8470 6650
F 02 9542 5622

1300 646 131
www.ecoaus.com.au