Gunnedah Solar Farm Environmental Impact Statement

transport | community | mining | industrial | food & beverage | energy

Prepared for:	**Gunnedah Solar Farm Pty Ltd.**
Client representative:	**Robert Ibrahim**
Date:	**17 April 2018** **Rev02**

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Table of Contents

1. Introduction 1
   1.1 Project Overview 1
   1.2 Purpose and Scope of this document 9
   1.3 Environmental Assessment Process 10
   1.4 EIS Structure 10
2. Need and Justification for the Proposal 13
   2.1 Energy Context in Australia and NSW 13
   2.2 Strategic Direction of The Region and The State 14
   2.3 Benefits of the proposal 15
   2.4 Alternatives Considered 16
3. Proposal Description 19
   3.1 Overview 19
   3.2 Proposal Site 19
   3.3 Gunnedah Solar Farm 26
4. Statutory Assessment 38
   4.1 Planning Pathway 38
   4.2 Evaluation of The Development 38
   4.3 NSW Legislation 41
   4.4 Commonwealth Legislation 46
   4.5 Other Relevant Policies and Plans 48
   4.6 Summary of Licenses and Approvals 53
5. Stakeholder Consultation 55
   5.1 Overview 55
   5.2 Identified Stakeholders 55
   5.3 Government Agency Consultation 56
   5.4 Gunnedah Shire Council 60
   5.5 Aboriginal Consultation 62
   5.6 Mineral Titleholders Consultation 62
   5.7 Community Engagement 63
   5.8 Media 74
   5.9 Summary of Actions 74
   5.10 Changes in Design 78
   5.11 Ongoing Community Consultation 79
6. Environmental Impact Assessment 80
   6.1 Biodiversity (Flora and Fauna) 81
   6.2 Heritage 89
   6.3 Land use impacts (including mineral resources) 99
   6.4 Visual 112
   6.5 Noise 151
   6.6 Traffic, Transport and Road Safety 162
   6.7 Surface Water, Hydrology and Groundwater 174
   6.8 Soils, Geology and Contamination 191
   6.9 Bushfire risk 209
   6.10 Hazards 215
   6.11 Air Quality 219
   6.12 Socio-Economic & Property 223
   6.13 Waste 237
7. Cumulative Impacts 242
8. Environmental Management 253
   8.1 Summary of Environmental Mitigation Measures 253
9. Conclusion 264

9.1 Justification for Development 264
9.2 Objects of the EP&A Act 265
9.3 Ecologically Sustainable Development 266
10. References 268

List of figures

Figure 1-1 Locality map of the Proposal 3
Figure 1-2 The Subject Land and Site boundaries 5
Figure 1-3 Location of the Site relative to the Subject Land 6
Figure 1-4 Proposal layout in regard to site constraints 7
Figure 3-1 Existing electrical infrastructure 20
Figure 3-2 Map of Subject Land showing vegetated areas in relation to the Proposal footprint 22
Figure 3-3 Existing Environment of Gunnedah, patchwork of colours and paddocks 23
Figure 3-4 Existing Environment showing silos and farm buildings in the distance 24
Figure 3-5 Topographic map 25
Figure 3-6 Example of ground mounting arrangements 27
Figure 3-7 Example of Tracking Solar PV panels 27
Figure 3-8 Solar panel layout 28
Figure 3-9 Example inverter station 29
Figure 3-10 Example Substation 31
Figure 3-11 Example security fencing (chain link security fence) 32
Figure 5-1 Location of sensitive receivers identified through Visual Impact Assessment 69
Figure 6-1 Existing environment showing that the land has been largely cleared 82
Figure 6-2 Vegetation locations V2 showing signs of stress 83
Figure 6-3 Previously recorded Aboriginal Sites 94
Figure 6-4 Mineral titles and Mineral title applications near the proposal site. 101
Figure 6-5 Biophysical Strategic Agricultural Land (boundary shown in red) (extracted from SEPP Mining, Petroleum Production and Extractive Industries 2007, Strategic Agricultural land map – New England North West Region 008) 104
Figure 6-6 Typical rural landscape around Gunnedah – open paddocks, scattered trees, farm structures 114
Figure 6-7 Typical landscape character around Gunnedah – patchwork of colours and paddocks 115
Figure 6-8 Royalla solar farm showing colour change that can occur when viewed from the front. 117
Figure 6-9 Predicted visual impacts for identified viewpoints and photomontage locations 120
Figure 6-10 Predicted visual impacts for identified viewpoints with landscape screening 121
Figure 6-11 Photomontage of existing views from Viewpoint 1 134
Figure 6-12 Photomontage of Viewpoint 1 with the Proposal 135
Figure 6-13 Photomontage of existing views from Viewpoint 9 136
Figure 6-14 Photomontage of Viewpoint 9 with the Proposal 137
Figure 6-15 Photomontage of Viewpoint 9 with the Proposal and landscape screening 138
Figure 6-16 Photomontage of existing views from Viewpoint 13 139
Figure 6-17 Photomontage of Viewpoint 13 with the Proposal 140
Figure 6-18 Photomontage of Viewpoint 13 with the Proposal and landscape screening 141
Figure 6-19 Photomontage of existing views from Viewpoint OGR 142
Figure 6-20 Photomontage of Viewpoint OGR with the Proposal 143
Figure 6-21 Photomontage of existing views from Viewpoint 16 144
Figure 6-22 Photomontage of Viewpoint 16 with the Proposal 145
Figure 6-23 Photomontage of Viewpoint 16 with the Proposal and landscape screening 146
Figure 6-24 Photomontages of existing views from Viewpoint 17 147
Figure 6-25 Photomontage of Viewpoint 17 with the Proposal 148
Figure 6-26 Photomontage of Viewpoint 17 with the Proposal and landscape screening 149
Figure 6-27 Sensitive receiver locations (Figure 1 of MAC Noise Assessment, 2018) 153

Figure 6-28 Designated Heavy Vehicle route to Proposal site (*Source: Google maps via SECA TIA 2018*) 165
Figure 6-29 Light vehicle access in and out of the subject site (Source: Google maps via SECA TIA 2018) 166
Figure 6-30 Groundwater Dependent Ecosystem 178
Figure 6-31 1% AEP Flood Depth Existing Scenario 183
Figure 6-32 1% AEP Flood Depth Configuration 1 184
Figure 6-33 1% AEP Flood Depth Configuration 2 185
Figure 6-34 1% AEP Flood Depth Configuration 3 186
Figure 6-35 Location of the Subject Land in relation to the Namoi River 192
Figure 6-36 Geology of the area (Qa) (Extract from Manilla 1:250000 Geological Map).....193
Figure 6-37 Soil test pit locations 199
Figure 6-38 Test Pit Photos.....203
Figure 6-39 24-hour average PM10 concentrations (Department of Environment and Climate Change) 221
Figure 6-40 Support for and opposition to building wind/solar farm in three proximities – in NSW, within the respondent's local region, and within 1-2km of where the respondent lived. 230
Figure 7-1 Location of other major projects in the Gunnedah LGA in relation to the Proposal 243

List of tables

Table 1-1 Annual Rainfall (mm) (Source: Gunnedah Pool site 055023, BOM, 2017). 8
Table 1-2 EIS Structure 10
Table 2-1 Current Solar Projects (NSW) (Source: DP&E: Resources and Planning, 2016).....13
Table 2-2 Australian electricity generation, by fuel type (*Source: Department of Industry, Innovation and Science [2017] Australian Energy Statistics, Table O*) 13
Table 3-1 Main Construction Activities by Stage.....33
Table 3-2 Plant and equipment 35
Table 4-1 Matters of consideration.....38
Table 4-2 Relevant provisions from the Gunnedah LEP 2012 51
Table 4-3 Licences and Approvals.....53
Table 5-1 Summary of Agency Consultation through the development phase 56
Table 5-2 Key concerns raised by Gunnedah Shire Council during consultation 60
Table 5-3 Moderate concerns raised by Gunnedah Shire council through consultation.....61
Table 5-4 Engagement outcomes of consultation with potentially impacted mineral title holders 62
Table 5-5 Summary of community engagement performed to date 64
Table 5-6 Detailed summary of one on one consultation with sensitive receivers conducted 15th – 16th January 70
Table 5-7 Summary of one on one consultation with sensitive receivers conducted 12th – 14th March .71
Table 5-8 Summary of actions taken to date to address key concerns raised.....74
Table 6-1 EPBC Protected Matters Search Tool Results.....85
Table 6-2 Frequency of site types from AHIMS database search.....93
Table 6-3 Historic items within the vicinity of the site.....97
Table 6-4 Historic items along the haulage route 97
Table 6-5 Exploration licences currently in force over the proposed solar farm proposal boundary 100
Table 6-6 Comparison of BSAL criteria to the Gunnedah Site (Source: Interim Protocol for site verification and mapping of biophysical strategic agricultural land (*NSW OEH & OAS &FS 2013*)).....102
Table 6-7 Risk Evaluation, which considers the probability (P), consequence (C) of the activity and the residual risk rating (RRR). Definitions of probability and consequence are outlined in the Land Use Conflict Risk Assessment Guide' (*Department of Trade and Investment, 2011*).....107
Table 6-8 Level of Impact 113
Table 6-9 Assessed private viewpoints (all houses) and predicted visual impact levels (Source: Envisage 2018) 122
Table 6-10 Summary of identified potentially affected private viewpoints.....150

Table 6-11 Construction Equipment Sound Power Levels (Lw) dBA re 10^{-12} W 151
Table 6-12 Operational Equipment Sound Power Levels dBA re 10^{-12} W 152
Table 6-13 Noise Monitoring Locations.....154
Table 6-14 Unattended Noise Monitoring 154
Table 6-15 Existing Road Traffic Noise Levels.....154
Table 6-16 Noise management levels at residential receivers.....155
Table 6-17 Noise Management Levels.....156
Table 6-18 Intrusiveness, amenity and project noise trigger levels.....156
Table 6-19 NSW Road Noise Policy – Traffic Noise Assessment Criteria.....157
Table 6-20 Relative Increase Criteria for Residential Land Use.....157
Table 6-21 Predicted Construction Noise Levels 158
Table 6-22 Predicted Operational Noise Levels.....159
Table 6-23 Predicted Construction Road Traffic Noise Levels.....160
Table 6-24 Predicted Construction Road Traffic Noise Levels.....160
Table 6-25 Existing road environment 163
Table 6-26 Vehicle movements expected as a result of the proposal 168
Table 6-27 Intersection sight distances.....170
Table 6-28 Water Licenses and Approvals 179
Table 6-29 Flood model results at sensitive receivers – 1% annual exceedance probability (AEP) event 182
Table 6-30 Soil qualities and limitations.....194
Table 6-31 Registered contaminated sites within Gunnedah LGA (Source: NSW EPA) 195
Table 6-32 Soil Sample Descriptions.....196
Table 6-33 Laboratory analysis schedule 197
Table 6-34 Summary of laboratory results. 197
Table 6-35 Salinity Rating 200
Table 6-36 Site Electrical Conductivities (1:5 solution) 200
Table 6-37 Exchangeable Sodium and Magnesium in the Cation Exchange Complex (%). 201
Table 6-38 Particle size analysis and K factor.....202
Table 6-39 Revised Universal Soil Loss Equation. 204
Table 6-40 Potential pasture plant recommendations 208
Table 6-41 Average number of days per year of daily Grassland Fire Danger Rating.....210
Table 6-42 Number of days in each month of daily Fire Danger Rating and GFDI categories at 3pm at Gunnedah Pool 211
Table 6-43 ICNIRP reference levels for 50Hz for occupational and general public exposure to time varying electric and magnetic fields (*ICNIRP 2010*) 216
Table 6-44 Example magnetic and electrical field levels (Transgrid N.D, and EMF info) 216
Table 6-45 Dangerous goods criteria and SEPP 33 thresholds relevant to the construction and operation of the proposal 217
Table 6-46 Summary of PM10 levels from NSW OEH monitoring sites (µg/m³).....220
Table 6-47 Comparison of employment data averages from Gunnedah, NSW and Australia.....223
Table 6-48 Community services, facilities and Attractions available in Gunnedah LGA (adapted from Gunnedah Economic Development Strategy: Volume 1(*Gunnedah Shire Council, 2014a*)) 224
Table 6-49 Expected labour force during different stages of construction 234
Table 6-50 Accommodation options within the township of Gunnedah.....235
Table 6-51 Potential waste generated on-site during construction and operation.....238
Table 6-52 Material reuse, recycling and disposal facilities which can be used to dispose of waste and recyclables 240
Table 7-1 Developments that are proposed to be carried out within the Gunnedah LGA 244
Table 8-1 Summary of General Management and Mitigation Measures for Construction and Decommissioning 253
Table 8-2 Summary of Management and Mitigation Measures for Construction and Decommissioning 254
Table 8-3 Summary of general operational management and mitigation measures 261

Table 8-4 Summary of Management and Mitigation Measures for Operation 261
Table 9-1 Objectives of the EP&A Act.....265

Appendices

Appendix A: SEARs
Appendix B: Table of Summary SEARs
Appendix C: Visual Impact Assessment and Landscape Plan
Appendix D: Biodiversity Assessment Reports
Appendix E: Aboriginal Heritage Impact Assessment
Appendix F: Bushfire Risk Assessment
Appendix G: Draft Land Management Plan
Appendix H: Noise Impact Assessment
Appendix I: Traffic Impact Assessment
Appendix J: Flood Impact Assessment
Appendix K: Soil Log Sheets and Laboratory Results
Appendix L: Community Consultation

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Terms and Definitions

Term / Acronym	Description
ABS	Australian Bureau of Statistics
AC	Alternating current
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal heritage impact permit
APZ	Asset Protection Zone
AS	Australian Standard
ASS	Acid Sulphate Soils
AEMO	Australian Energy Market Operator
BCA	*Biodiversity Conservation Act* 2016, replaces the Threatened Species Conservation Act 1995 (TSC Act) as the key piece of legislation that identifies and protects threatened species, populations and ecological communities in NSW.
BDAR	Biodiversity development assessment report
BIA	Bushfire Impact Assessment
BSAL	Biophysical strategic agricultural land
CEMP	Construction Environmental Management Plan
CNVG	Construction Noise and Vibration Guideline
CSEP	Community and Stakeholder Engagement Plan
DA	Development Application
DC	Direct current
DECC	Department of Environment and Climate Change
DoEE	Department of Environment and Energy
DP	Deposit plan
DP&E	Department of Planning and Environment
DPI	Department of Primary Industries
DEC	Department of Environment and Conservation
EC	Electrical Conductivity
EEC	Endangered Ecological Community
EIA	Environmental impact assessment
EIS	Environmental impact statement
ELF	Extremely Low Frequency
EMF	Electromagnetic field
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW). Provides the legislative framework for land use planning and development assessment in NSW
EP&A Regulations	*Environmental Planning and Assessment Regulation 2000.*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth). Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
EPL	Environmental Protection Licence
ERP	Emergency Response Plan
ERSED	Erosion and Sediment
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes

Term / Acronym	Description
	on which life depends, are maintained and the total quality of life, now and in the future, can be increased
EWP	Elevated Work Platforms
FM Act	*Fisheries Management Act* 1994
GDE	Groundwater Dependent Ecosystem'
GFDI	Grass fire danger index
GHG	Greenhouse gas
GSF	Gunnedah Solar Farm Pty Ltd This project will be co-owned by: • Canadian Solar Energy Holdings Singapore 4 Pte. Ltd.: 51% • Photon Energy NV: 24.99% • Polpo Investments Limited: 24.01%
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICNG	Interim Construction Noise Guideline
IER	Index of Economic Resources
IEO	Index of Education and Occupation
INP	Industrial Noise Policy
IRSD	Index of Relative Socio-Economic Disadvantage
IRSAD	Index of Relative Socio-Economic Advantage and Disadvantage
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
kV	Kilo-volts
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LGA	Local Government Area
LGC	Large-scale generation certificates
LLS	Local Land Services
LRET	Large-scale Renewable Energy Target
LUCRA	Land use conflict risk assessment
MAC	Muller Acoustic Consulting
MNES	Matters of national environmental significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
MW	Megawatt
MWh	Megawatt hours
MWp	Megawatt peak
NCG	Noise Criteria Guideline
NEM	National Electricity Market
NEG	National Energy Guarantee
NML	Noise management level
NPI	Noise Policy for Industry
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
OEH	Office of Environment and Heritage (formerly DECCW)
OEMP	Operational Environmental Management Plan
OOH	Out of Hours
OPGW	Optical Ground Wire
PASS	Potential Acid Sulphate Soils
PCT	Plant Community Types

Term / Acronym	Description
PEA	Preliminary Environmental Assessment
Photon Energy	Photon Energy NV
PNTL	Project Noise Trigger Levels
POEO Act	*Protection of the Environment Operations Act* 1997
The "Proposal"	Develop and operate a 150-megawatt (MW) solar photovoltaic (PV) facility including ancillary works and associated infrastructure at 765 Orange Grove Road, Gunnedah, NSW 2380.
PV	Photovoltaic
REAP	Renewable Energy Action Plan
REC	Renewable energy certificates
RET	Renewable Energy Target
RFS	Rural Fire Service
RNP	Road Noise Policy
Roads and Maritime	NSW Roads and Maritime Services
RRR	Residual risk rating
SEARS	Secretary's Environmental Assessment Requirements
SEIFA	Socio-Economic Indices for Areas
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SDD	State significant development
SRD	State and Regional Development
SSDA	State Significant Development Application
The "Subject Land"	Parts of Lot 1 DP 1202625, Lot 153 DP 754954, Lot 264 DP 754954, Lot 2 DP 801762, Lot 151 DP 754954 and Lot 1 DP 186590.
SWMP	Soil and Water Management Plan
TMP	Traffic Management Plan
VIA	Visual Impact Assessment
WARR Act	Waste Avoidance and Resource Recovery Act
WM Act	*Water Management Act 2000*
WMP	Waste Management Plan

Statement of Authorship

Submission of Environmental Impact Statement (EIS)

Part 4, Division 4.1 of Environmental Planning and Assessment Act 1979

EIS prepared by:

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Development Application:

Proponent Name:	Gunnedah Solar farm Pty Ltd
Proponent Address:	204/55 Grafton Street Bondi Junction NSW 2022 Australia
Land to be Developed:	Lot 1 DP 1202625, Lot 153 DP 754954, Lot 264 DP 754954, Lot 2 DP 801762, Lot 151 DP 754954 and Lot 1 DP 186590 Gunnedah NSW, 2380 Gunnedah Local Government Area
Development Description:	Gunnedah Solar Farm

Declaration:

I declare that:

1. The statement has been prepared in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*.
2. The statement contains all available information that is relevant to the environmental assessment of the development, activity or infrastructure to which the statement relates.
3. That the information contained in this statement is neither false or misleading.

Name: **pitt&sherry** Pty Ltd

Signature:

Date: 17 April 2018

Executive Summary

This Environmental Impact Statement (EIS) has been prepared by pitt&sherry on behalf of Gunnedah Solar Farm Pty Ltd (GSF) to identify and assess the environmental issues associated with the construction, operation, and decommissioning of a 150MW (DC) (or 115MW AC) photovoltaic (PV) solar farm located approximately 9km north-east of the township of Gunnedah (the 'Proposal').

The EIS has been prepared in accordance with Part 4 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act) to support a Development Application (DA) for the Proposal. This EIS has been prepared pursuant to the Secretary's Environmental Assessment Requirements (SEARs) for the Proposal issued by the Department of Planning and Environment (DP&E) on 25 August 2017. A copy of the SEARs is included in **Appendix A** and a summary of where these have been addressed in the EIS is included in **Appendix B**.

The Proposal will be located at 765 Orange Grove Road, Gunnedah NSW on part of Lot 1 DP 1202625, Lot 153 DP 754954, Lot 264 DP 754954, Lot 2 DP 801762, Lot 151 DP 754954 and Lot 1 DP 186590 (the 'Site'). The Site is privately owned and zoned Primary Production (RU1) under the Gunnedah LEP 2011.

The solar farm will cover an area of 304 hectares and is estimated to consist of up to 460,000 PV panels installed on a single axis tracking system which will follow the movement of the sun through the course of the day. The PV panels will be fixed on mounting structures which would extend 2.5 to 4m below ground. The maximum height of panels during tracking movement is up to 3m.

In addition to the solar PV panels the Proposal will also include the construction of an access road from Orange Grove Road to the Site, installation of electrical infrastructure such as the on-site substation, overhead transmission lines, inverter station and landscaping works.

The Site and surrounding land is cleared agricultural land which has historically been used for grazing agriculture and is currently used for cropping agriculture. It is located on a floodplain and as such has a very flat topography. Highpoints in the area including the Kelvin Hills located 1.9km to the north of the Site and the residential receivers located at the base of the Kelvin Hills which have an elevated viewpoint of the Site.

Nearby water courses include the Namoi River which is located approximately 900m south of the Site surrounded by scattered stands of native vegetation. Other natural water courses in the area include: Mooki River; Carroll Creek, Rangria Creek and Kibah Creek which are all tributaries of the Namoi River. There are also several man-made agricultural dams in neighbouring plots.

The Site and its surrounds have been significantly disturbed by construction of roads, farming activities (including landform changes), and rural residential dwellings. Vegetation on the Site is restricted to planted crops with some grasses, weeds and several isolated remnant areas of trees and shrubs growing in patches.

The key benefit of the Proposal is the production of renewable electricity reducing greenhouse gas emissions and reliance on fossil fuels. The Proposal will contribute to renewable energy generation targets in NSW and nationally as well as contributing to various international agreements which Australia is a signatory, such as the United Nations Framework Convention on Climate Change and the Paris Agreement.

Demand for electricity is increasing and reliable energy supplies are often limited by inadequate energy supply infrastructure. Solar Farms are scalable and can be installed regionally, allowing for this type of infrastructure to be suitable for the predicted uncertain energy climate and provide some level of energy security.

The Proposal will also provide socio-economic benefits by generating 150 construction jobs at peak construction periods and will support six to ten operational jobs. It will encourage regional development through expenditure by personnel in the Gunnedah region during construction.

This EIS describes the key environmental risks related to the Proposal and provides a comprehensive assessment of these risks. The key potential environmental impacts have been identified through assessment of the Proposal scope, review of the SEARs issued by DP&E, and consultation with relevant stakeholders and the community.

An environmental risk assessment was undertaken as part of this EIS which identified key environmental risks of the Proposal these being:

- Flooding
- Visual Amenity
- Traffic and Transport
- Bush Fire
- Biodiversity
- Aboriginal Heritage
- Land Use.

A reduction of Biophysical Strategic Agricultural Land was also considered, and a draft land management plan developed to address this risk (refer **Appendix G**).

A number of features of the Proposal help to mitigate key environmental risks including:

- Suitability of the Site
  - The land is largely cleared of native vegetation
  - The land is flat with few elevated viewpoints
  - The land contains no natural watercourses
- Ability to implement buffer distances including:
  - An 800m buffer from the nearest residence
  - A 1km buffer from roads
  - 20m buffer around areas of retained vegetation
- The Proposal footprint has been adapted within the Subject Land to avoid or minimise the potential environmental impacts.

Several key environmental risks were identified and are summarised below:

Flooding
A flood impact assessment was conducted on a catchment basis to estimate flood levels for a range of design events, and to estimate the impacts the Solar Farm would have on flood levels. The modelling indicated that fencing conditions and blockages caused by build up of material at the fence boundary would have the greatest impact on flooding.

The Proposal will cause changes to flood depths, these changes have been modelled to be less than 18mm at the most affected sensitive receiver and this change in flood depth would be caused by the partial blockage or hindrance to flow created by the fences and build-up of debris, which tend to cause the floodwaters to back up on their upstream face.

The assessment concluded that that whilst there would be small changes in modelled flood behaviour the development would not cause appreciable changes to inundation, erosion, velocity of waters or siltation and would not impact upon riparian vegetation. Similarly, there would be no appreciable adverse social or economic costs to the community and the proposal would not affect emergency management, access procedures to the region or increase risk.

The current flood model for the proposal was completed on a catchment basis. The model will be further refined to include local terrain data. The refined model will be used to inform detailed design and identify additional mitigation measures to reduce potential flood risks and socio-economic costs as required.

Visual Amenity
The proposal would we visible to 22 potentially affected private viewpoints and passing traffic along Orange Grove and Tudgey Road, however the visual impact assessment (VIA) concluded that no viewpoints had a high impact and only three had a moderate – high impact. The VIA also concluded that these impacts could be further reduced to a moderate, or lower, impact through the implementation of mitigation strategies, such as landscape screening.

Traffic and Transport
A traffic impact assessment (TIA) was conducted to assess traffic impacts and recognised that as part of the project work, there will be an increase in the number of heavy vehicle movements associated with the construction work which will impact the local road network. Heavy vehicles will use a designated route which currently caters for a large number of heavy vehicles including B-double combinations. It is considered that this route can safely accommodate the additional traffic movements associated with the project.

The major road safety impact is associated with the heavy vehicles accessing the site and their impact upon the operation of the intersections along the haulage route. Several upgrade requirements on Old Blue Vale Road and Orange Grove Road have been proposed to address these risks.

Bush Fire
A Bushfire Impact Assessment (BIA) was undertaken by to investigate the potential construction and operational bushfire hazards of the Proposal and how these risks could be suitability reduced and managed. The land is not located on bushfire prone land and will have lower fuel levels as a result of the proposal by replacing crops with grazed grassland.

The solar panels are non-reflective and present no risk of ignitions however ignitions from other PV equipment is theoretically possible from electrical faults such as arc faults, short circuits, ground faults and reverse currents. These risks can be adequately managed through proper installation and testing of equipment.

The Proposal presents an unusual risk to firefighters from electrocution and the inhalation of flumes from any plastic components such as cables. An Emergency Response Plan (ERP) will be prepared for the solar farm that details the work health safety risks and procedures to be followed by fire-fighters which will be issued to local emergency responders. An asset protection zone (APZ) will be also be established around the site with adequate water storage to ensure that the fire control is more feasible or damage to the asset is reduced or eliminated.

Biodiversity
A biodiversity assessment was undertaken by flora and fauna specialists to assess the impacts of the development on biodiversity. It is recognised that as part of the project work, there will be minor land clearing to facilitate the installation of the solar PV panels. The Site has largely been cleared for agricultural use and all the remnant clusters of native vegetation will be retained as part of the proposal. No threatened species or EECs will be impacted as part of the proposal.

Aboriginal Heritage

An Aboriginal Cultural Heritage Assessment was undertaken to assess the impacts on aboriginal heritage and to determine the archaeological potential of the Site. Consultation with Aboriginal stakeholders was undertaken in accordance with the Proposal SEARs.

No Aboriginal objects/sites or areas of Aboriginal archaeological potential were identified within the study area. No significant Aboriginal cultural features were identified within the study area by the Red Chief Local Aboriginal Land Council (RCLALC). No further Aboriginal cultural heritage assessment is warranted for the Proposal. However, it is recommended that an unexpected Aboriginal heritage finds procedure is developed prior to construction.

Land Use

A land use conflict risk assessment (LUCRA) was conducted to assess the potential for land use conflict. The activities likely to cause the greatest land use conflict were flooding followed by visual impact, the potential impact on property values and impacts caused by noise and traffic during construction. These impacts have been assessed in individual specialist environmental assessments and have been summarised in their respective chapters.

The loss of agricultural land for 25 years during operation was also considered a key issue. This impact is reduced by the availability of water and irrigation and other land with the Subject Land to conduct agricultural activities. A draft land management plan (refer **Appendix G**) was prepared to outline how the land will be managed during operation of the solar farm to ensure continued agricultural production upon decommissioning.

Lower risk issues including noise, air quality, soils, waste generation, hazards, and cumulative impacts have also been addressed in the EIS in Chapter 6.

Impact avoidance and minimisation measures have been incorporated into the design of the proposal. These measures are considered practical and achievable by the proponent. They are set out for each area of investigation in Sections 6 and summarised in Section 8 of this EIS.

Mitigation measures identified would effectively reduce these impacts to an acceptable level of environmental risk and enable the project to be constructed, operated and decommissioned without impairment to existing or future land uses.

The solar farm is expected to operate for 25 years following which GSF would reassess the development with the landowner and either continue operations, upgrade the infrastructure or undertake decommissioning of the facility. Decommissioning would include removal of all ancillary works, associated infrastructure and remediation of the land (as required) to enable continued agricultural use. However, the substation may remain following decommissioning of the solar farm to continue to service the region.

1. Introduction

1.1 Project Overview

Gunnedah Solar Farm Pty Ltd (GSF) is owned by Photon Energy NV (Photon Energy), Canadian Solar Energy Holdings Singapore 4 Pte Ltd (Canadian Solar) and Polpo Investments Ltd (Polpo) (referred to herein as GSF). GSF propose to develop and operate a 150-megawatt (MW) (150 MW DC or 115 MW AC) solar photovoltaic (PV) facility including ancillary works and associated infrastructure at 765 Orange Grove Road, Gunnedah, NSW 2380 (Figure 1-1) ("the Proposal").

The facility would operate for a duration of approximately 25 years following which GSF would reassess the viability and in agreement with the landowner either continue operations, upgrade the infrastructure or undertake decommissioning of the facility. Decommissioning would include removal of all ancillary works, associated infrastructure and remediation of the land (as required) to enable continued agricultural use. However, the substation may remain following decommissioning of the solar farm to continue to service the region.

GSF will manage the development and operation of the Proposal. Canadian Solar will acquire a 51% shareholding, Photon Energy will retain approximately 25% and Polpo Investment Ltd will hold the balance of the shares.

The Proposal is a State Significant Development (SSD) under *the State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP). A development application (DA) for the Proposal is required to be submitted under Part 4, Division 4.7 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.1.1 The Proponent

The proponent is GSF (ABN 33 619 265 191) which is owned by three companies including Photon Energy, Canadian Solar and Polpo.

Photon Energy
Photon Energy is a highly experienced global solar energy solutions and services company covering the entire lifecycle of solar power systems. Photon Energy was founded in 2008 in Prague, Czech Republic and was co-founded by an Australian citizen. The headquarters of Photon Energy are located in Amsterdam, Netherlands and the company has offices in Australia, Hungary and Czech Republic. Photon Energy operates in Australia through wholly owned local subsidiaries. Photon Energy has been a publicly listed company since June 2013 on the NewConnect stock exchange in Warsaw, Poland and in the Free Market on the Prague Stock Exchange, Czech Republic.

Photon Energy is active across the globe and have a proven track record of developing PV projects and building and commissioning solar power plants. Photon Energy provides operations and maintenance services to hundreds of Megawatts peak (MWp) solar power plants worldwide. Photon Energy also manages its own proprietary portfolio of 26 solar power plants in three countries across two continents.

Photon Energy has several projects under construction or completed in Australia including:

- Leeton Solar Farm, NSW – Photon is currently in the process of constructing a 25 megawatt (MW) capacity solar farm in Leeton, NSW
- Leeton Sewage Treatment Plant PV – Photon have constructed a 99-kilowatt peak (kWp) PV facility to power the Leeton Sewage Treatment Plant. The PV system is now in operation and managed by Leeton Shire Council

- Sydney Post Australia – Photon have installed one of the largest rooftop power plants in Australia at the Sydney headquarters of Australia Post. The rooftop power plant has an annual production capacity of 371, 500 Kilowatt hours (KWh)
- BAI Communications (BAI) Muswellbrook – Photon has installed a solar PV system to power one of BAI's television and radio broadcast antennas, located in Muswellbrook NSW.

Canadian Solar
Canadian Solar is a global energy provider and leading manufacturer of solar PV modules and solar energy solutions. Canadian Solar was founded in 2001 in Ontario, Canada. The headquarters of Canadian Solar are located in Ontario and the company has business subsidiaries in 20 countries on six continents.

Canadian Solar has several projects under construction or completed in Australia including:

- International Convention Centre (ICC) Sydney – Canadian Solar have installed a large rooftop power plant at the ICC which has an annual production capacity of 545,000 KWh
- Oakley Solar Farm – Canadian Solar is in the process of constructing a 100 MW capacity solar farm in Oakey QLD
- Longreach Solar Farm – Canadian Solar has constructed a 17 MW capacity solar farm in Longreach, QLD
- Normanton Solar Farm – Canadian Solar constructed a 5MW capacity solar farm in Normanton QLD.

Polpo
Polpo Investments is an investments company focused on early stage and renewable energy investments. Polpo's founders have decades of experience in developing through to operating renewable energy projects in Europe, including wind and solar. Polpo targets markets where traditional electricity generators are aging and likely to be decommissioned in the short term. Polpo seek to identify renewable energy project sites and partner with other local developers to leverage each other's skills to bring projects from greenfield to operating. Polpo Investments was founded in London, United Kingdom (UK) and the headquarters are located in London.

1.1.2 Location

GSF is proposing to construct and operate a 150-MW solar farm using PV technology at 765 Orange Grove Road, located approximately 9km north-east of Gunnedah township in NSW and within the Gunnedah Local Government Area (LGA).

The Proposal would be located adjacent to Orange Grove Road, Orange Grove, NSW 2380 and contained within parts of Lot 1 DP 1202625, Lot 153 DP 754954, Lot 264 DP 754954, Lot 2 DP 801762, Lot 151 DP 754954 and Lot 1 DP 186590 (the "Subject Land"). The Subject Land totals approximately 795 hectares in area. However, the solar farm would only occupy a portion of the Subject Land, approximately 304 hectares (the "Site") (equivalent to approximately 38% of the Subject Land).

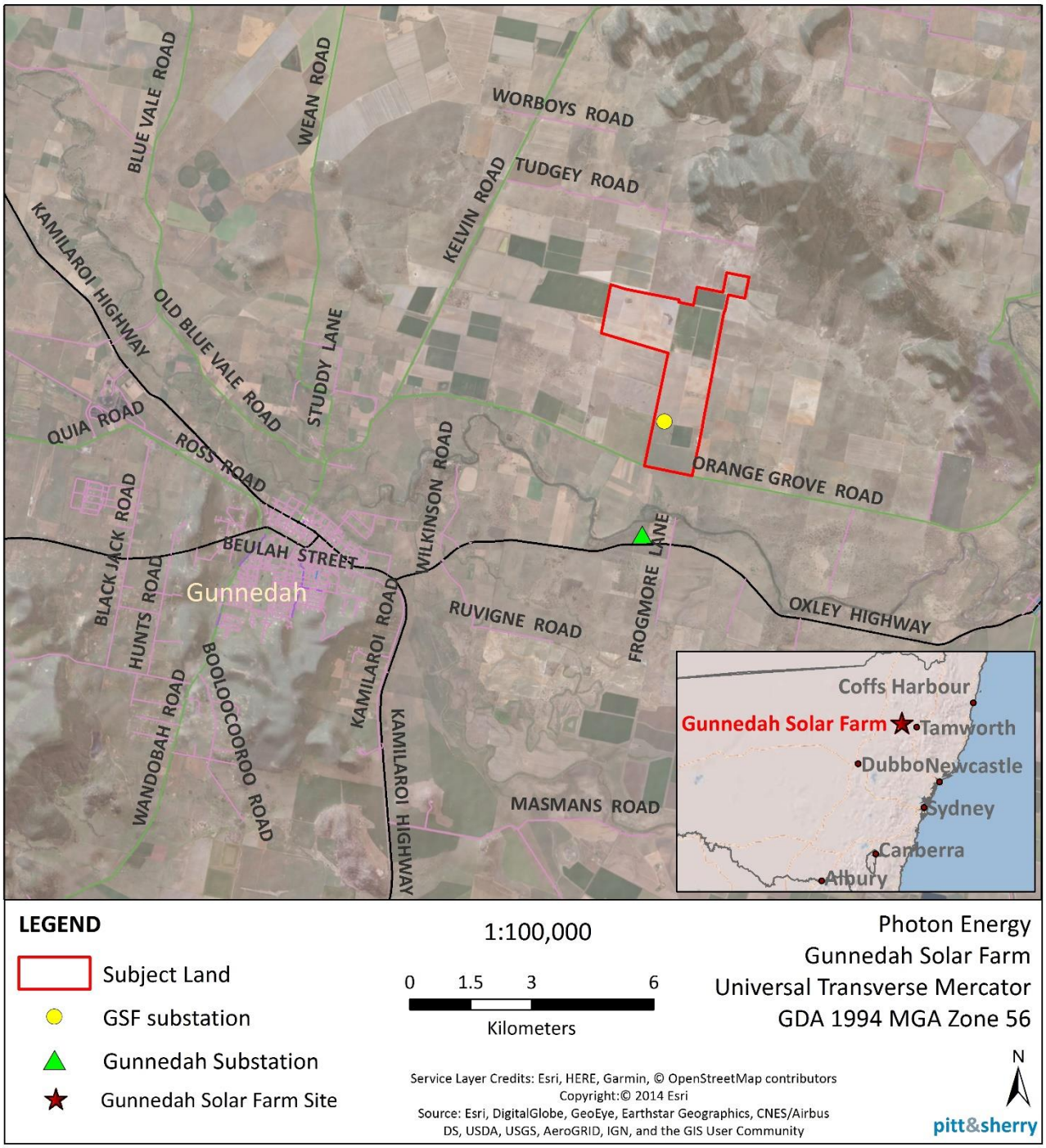

Figure 1-1 Locality map of the Proposal

Land ownership

The land required for the solar farm will be contained within part of: Lot 1 DP 186590; Lot 1 DP 1202625; Lot 153 DP 754954; Lot 264 DP 754954; Lot 2 DP 801762; and Lot 151 DP 754954 (refer Figure 1-2).

The land is privately owned and would be subject to a lease agreement between GSF and the landowner. A copy of the landowner's letter of consent was provided to Department of Planning and Environment (DP&E).

Catchment Description

The Proposal is within the Namoi River Catchment which is one of the Murray-Darling Basin's major sub-catchments. The main tributaries of the Namoi River are the Manilla and Peel rivers.

The town of Tamworth on the Peel River, is the largest town within the catchment and the Keepit Dam is the major irrigation storage for the Namoi catchment, with a capacity of 426,000 megalitres.

The catchment area is about 42,000km^2 from the Great Dividing Range near Tamworth, to the Barwon River near Walgett. It is over 350km long, stretching from Bendemeer in the east to Walgett on the western boundary. The river has developed an extensive floodplain, with around a quarter of the basin prone to flooding. The catchment of the Namoi River at the site is 9961km^2.

The Subject Land is located within the Namoi River Floodplain.

There are no natural waterways within the site however the site does contain irrigation channels on either side of several internal roads (refer Figure 1-3). These irrigation channels facilitate water movement from irrigation bores and from a large storage dam located within the Subject Land contained in the north-eastern corner of Lot 1 DP 1202625 which has an area of approximately 6.05 hectares (refer to Figure 1-3 and Figure 1-4). The Namoi River is located approximately 900m south of the Site and the Keepit Dam is situated some 40km to the north-east.

Shallow aquifers that are highly connected to the river system are common in the Peel and Upper Namoi rivers and as a result levels are highly dependent on surface water flows. A search of the Department of Primary Industries (Office of Water) water monitoring network found two groundwater bores near the Proposal Site. These identified groundwater depths of 6.7 to 7.6m in the area. The Site is not designated as groundwater vulnerable under the Gunnedah LEP.

Neighbouring Land Uses

The Site is surrounded by cleared agricultural land and rural-residential properties used for grazing or cropping agriculture. There is one residence within 1km of the Site, and six residences located between 1km and 2km of the Site (refer Figure 6-9).

The closest residence is located approximately 800m east of the Site boundary (refer Section 6.3.5).

Conservation Areas

An area of approximately one hectare within the Subject Land has been classified as an Endangered Ecological Community (EEC) being a small, isolated open woodland remnant within Lot 153 DP754954.

There are several conservation areas within the surrounding Gunnedah locality including Somerton National Park which is located 18.5km south-east of the site and Black Jack State Forest, which includes Porcupine Hill, which is located approximately 13km south-west of the site. Other places of natural significance include the Namoi River corridor located approximately 900m south of the Subject Land and 2.3km south of the Site. The river corridor is extensively wooded although the tree canopy is disrupted in places.

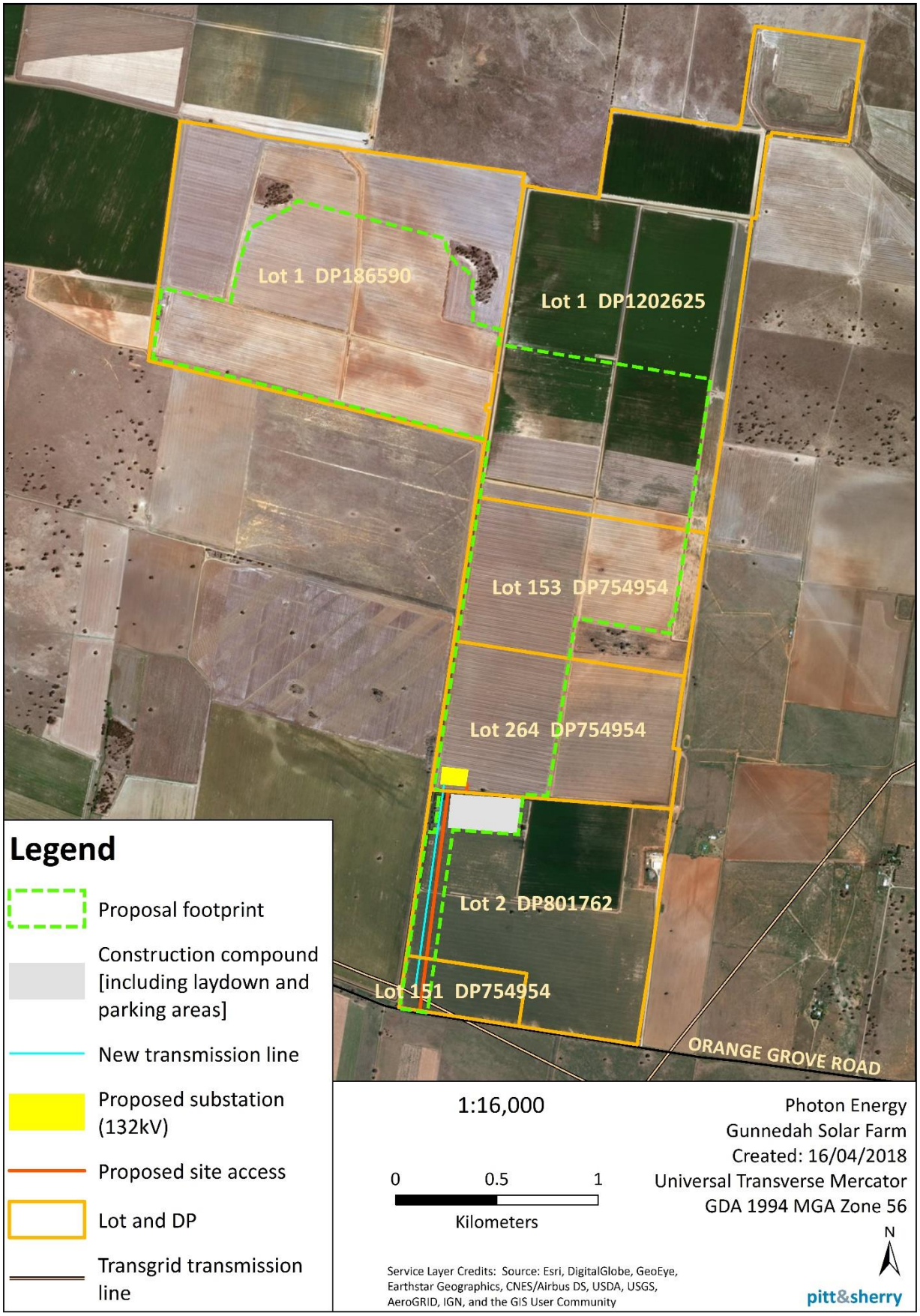

Figure 1-2 The Subject Land and Site boundaries

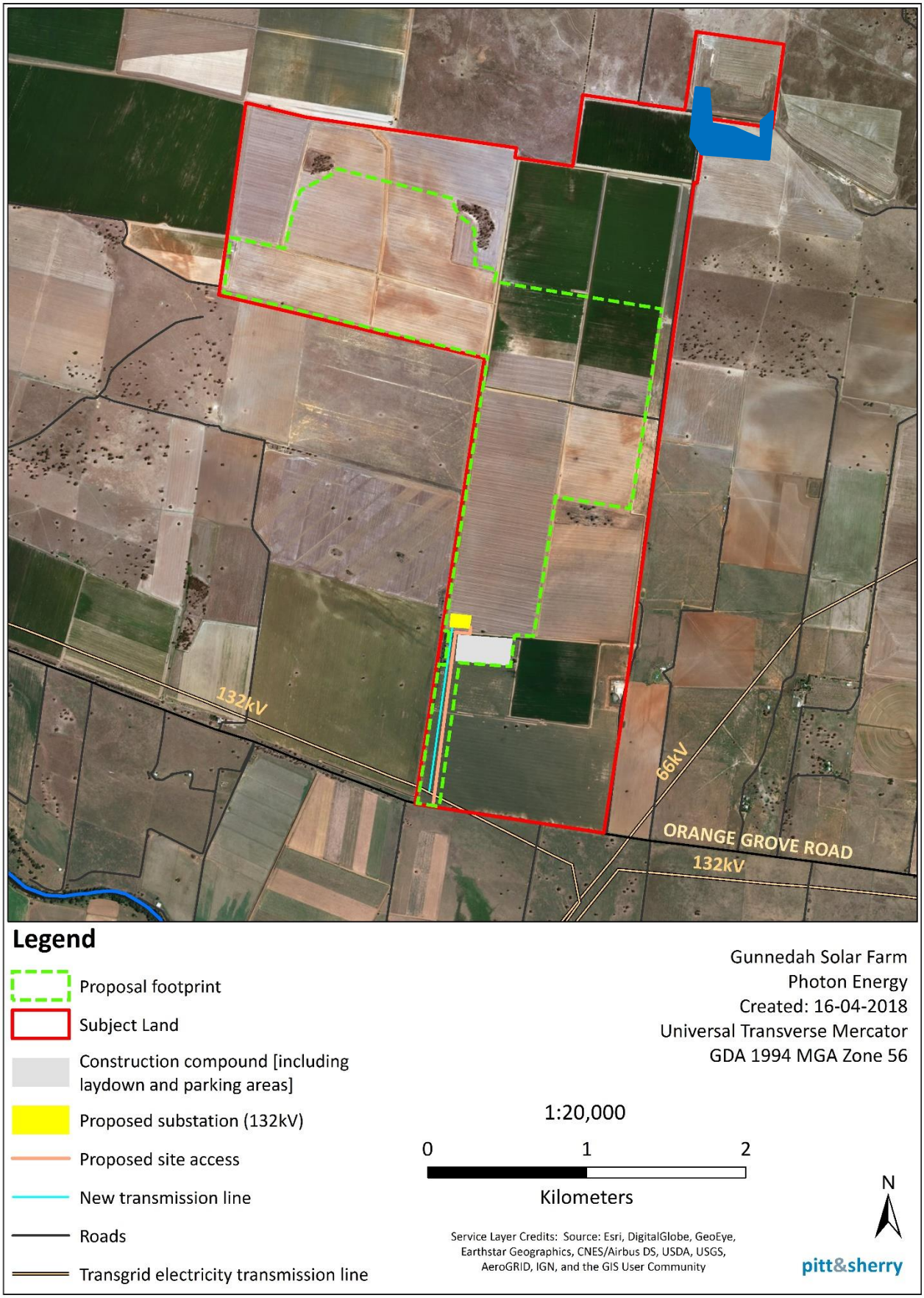

Figure 1-3 Location of the Site relative to the Subject Land

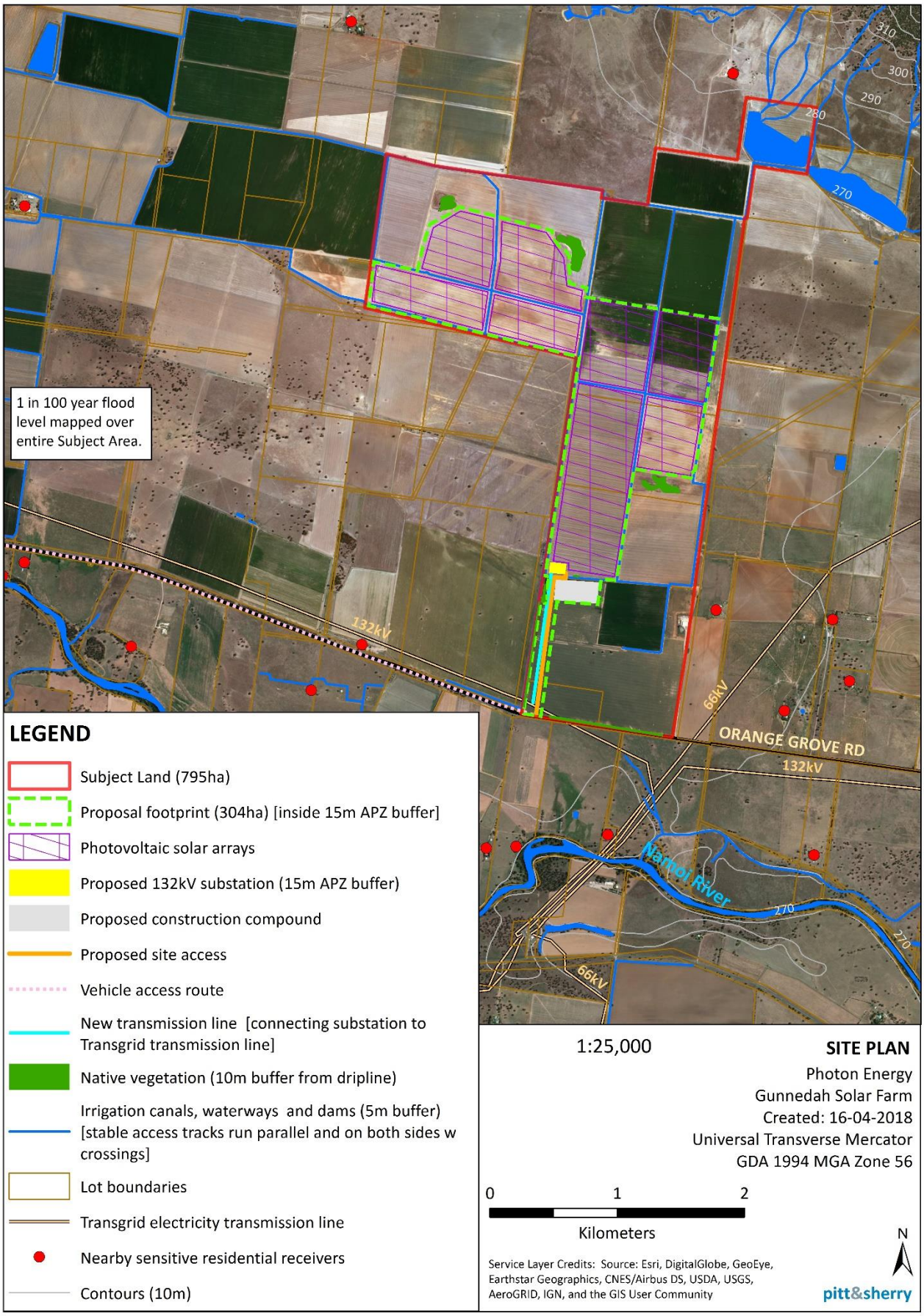

Figure 1-4 **Proposal layout in regard to site constraints**

Climate

Meteorological data recorded at the Gunnedah Pool weather station (Site number 055023) is outlined in Table 1-1. The Gunnedah Pool weather station is located about 8km south-west of the Site.

Table 1-1 Annual Rainfall (mm) (Source: Gunnedah Pool site 055023, BOM, 2017).

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Solar Exposure (MJ m^{-2})	26.6	23.9	20.6	16.2	12.5	10.3	11.3	14.6	18.8	22.5	24.6	26.6
Maximum solar exposure (MJ m-2)	31.5	26.9	23.8	18.3	14.2	11.9	13.4	16.6	21.2	25.8	27.9	29.8
Mean rainfall (mm)	71.2	66.1	48.7	37.1	42.2	44.6	41.9	41.1	40.4	54.7	61.5	70.3
Mean number of days of rain ≥ 1mm	5.6	5.0	4.0	3.4	4.1	4.9	4.8	4.7	4.5	5.3	5.7	6.0
Mean Max Temperature (°C)	34.0	32.9	30.7	26.4	21.3	17.6	16.9	18.9	22.8	29.7	30.3	32.9
Mean Min Temperature (°C)	18.4	18.1	15.8	11.4	7.1	4.3	3.0	4.2	7.0	10.8	14.2	16.8

The Gunnedah region experiences hot, wet summers and cool winters. Rainfall is dominant in the summer months with the highest rainfall typically received in December with a mean annual rainfall of 620.4 mm. The mean January temperature ranges from 18.4 to 34.0°C and mean July temperature ranges from 3.0 to 16.9°C (*Bureau of Meteorology, 2017*).

1.1.3 Key features of the Proposal

The Proposal would comprise the installation of a solar farm with an upper capacity of 150-MW that would supply electricity to the National Electricity Market (NEM). The power generated would be transmitted via new overhead powerlines within the Subject Land and existing overhead powerlines within an existing TransGrid easement to the Gunnedah substation.

The proposal would comprise installation of an array of solar panels, a 132kV substation, and related infrastructure as follows:

- PV panels mounted on a horizontal single axis tracking structure
- An onsite substation
- A Transmission kiosk
- Inverter stations (inverters within containers at the end of solar PV rows)

- 1.2km of overhead transmission line to connect the new substation to existing powerlines on Orange Grove Road
- Infrastructure upgrade works to existing 132kV transmission line
- A storage maintenance container
- A site access road off Orange Grove Road
- Perimeter security fencing
- A temporary construction compound.

Proposal details and further information on these components is outlined in Section 3.

Construction of the Proposal would be expected to take approximately 12 months and the Proposal would be operational for approximately 25 years.

After the initial 25-year operating period, the solar farm would either be decommissioned, removing all above ground infrastructure and returning the site to its existing land capability, or the PV infrastructure would be upgraded and the Site would continue to operate as a solar farm.

The Proposed Development is fully reversible and would not result in any long-term impacts to the inherent soil fertility, allowing existing farming activities to recommence following decommissioning, this is further discussed in Section 6.3.

1.1.4 Capital Investment Value

The solar farm at Gunnedah has an estimated capital investment value (CIV) of $200.6 million. A copy of the CIV report was provided to DP&E.

1.2 Purpose and Scope of this document

This Environmental Impact Statement (EIS) has been prepared to identify and assess the potential environmental impacts associated with the construction, operation and decommissioning of the Proposal including the solar farm, ancillary works and associated infrastructure.

The EIS will support a Development Application (DA) for the Proposal to be lodged with the NSW Department of Planning and Environment (DP&E) in accordance with Part 4, Division 4.1 of the EP&A Act.

This EIS has been prepared by pitt&sherry on behalf of GSF in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) and Section 4.15 of the EP&A Act and pursuant to the Secretary's Environmental Assessment Requirements (SEARs) issued on 25 August 2017. A copy of the SEARs is included in **Appendix A**.

Appendix B provides a table of the SEARs as they relate to the Proposal and identifies where the requirements are addressed in the EIS.

1.3 Environmental Assessment Process

Under Schedule 1 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation), the planning approvals process includes the following key steps:

- Submission of a State Significant Development Application (SSDA) with an accompanying Preliminary Environmental Assessment (PEA) lodged with the Secretary of the DP&E
- The Secretary is to prepare the SEARs in respect of the infrastructure under Schedule 2, Part 2 (3) of the EP&A Regulation
- Preparation and submission of an EIS under Schedule 2 of the EP&A Regulation, addressing the matters outlined in the SEARs
- Public exhibition of the EIS for a minimum of 30 days
- Preparation of a response to issues raised in submissions to be submitted to the secretary, if required
- Assessment of the application by the DP&E and preparation of the Secretary's environmental assessment report
- Determination of the proposal by the Minister for Planning or their delegate.

Section 4 describes the planning and approvals pathway in greater detail.

1.4 EIS Structure

An outline of the structure and content of this EIS is included in Table 1-2.

Table 1-2 EIS Structure

Chapter	Chapter Name	Content
N/A	Executive Summary	Key features of the report.
Chapter 1	Introduction	Purpose and scope of this document, proposal overview including the proponent, site location, summary of construction & operation and the planning pathway.
Chapter 2	Strategic Justification and Alternatives considered	Site suitability, Energy context in Australia and the National Electricity Market Scheme, strategic direction of the region and state, Proposal benefits, alternatives considered.
Chapter 3	Description of the Proposal	Detailed description of the Proposal site and proposed solar farm, including construction, operation and decommissioning.
Chapter 4	Statutory Context	Summary of consultation undertaken with Government agencies, stakeholders and the community.
Chapter 5	Stakeholder Consultation	Consideration of the relevant statutory provisions at the commonwealth and state levels, including the principals of ecologically sustainable development.
Chapter 6	Environmental Impact Assessment	Risk assessment, Detailed assessment of the potential impacts of the Proposal for a range of key environmental aspects.
Chapter 6.1	Initial Scoping and Risk Assessment	Risk assessment.

Chapter	Chapter Name	Content
Chapter 6.2	Biodiversity (Flora and Fauna)	Detailed assessment of the potential impacts of the Proposal for a range of key environmental impacts.
Chapter 6.3	Heritage (Aboriginal and Historic)	
Chapter 6.4	Land Use Impacts (Including Mineral Resources)	
Chapter 6.5	Visual	
Chapter 6.6	Noise	
Chapter 6.7	Traffic, Transport and Road Safety	
Chapter 6.8	Surface water, Hydrology and Groundwater	
Chapter 6.9	Soils, Geology and Contamination	
Chapter 6.10	Hazards and electromagnetic interference	
Chapter 6.11	Socio-Economic	
Chapter 7	Assessment of Additional Impacts	Detailed assessment of the potential impacts of the Proposal for Air Quality, Contamination & property and waste.
Chapter 8	Cumulative Impacts	Assessment of the cumulative impacts of the Proposal.
Chapter 9	Environmental Management	Environmental framework, and consolidated summary of recommended management and mitigation measures.
Chapter 10	Conclusion	Conclusion to the EIS including key findings.
References	References	
Appendix A	Secretary's Environmental Assessment Requirements	Supporting documentation including the technical specialist reports.
Appendix B	Table summarising where SEARs are addressed in the EIS	
Appendix C	Visual Impact Assessment and Landscape Plan	
Appendix D	Biodiversity Assessment Reports	
Appendix E	Aboriginal Heritage Impact Assessment	
Appendix F	Bushfire Risk Assessment	
Appendix G	Draft Land Management Plan	
Appendix H	Noise Impact Assessment	
Appendix I	Traffic Impact Assessment	
Appendix J	Flood Impact Assessment	

Chapter	Chapter Name	Content
Appendix K	Soil Log Sheets	
Appendix L	Community Consultation	

2. Need and Justification for the Proposal

2.1 Energy Context in Australia and NSW

2.1.1 Electricity generation in Australia & NSW

Electricity in NSW is generated from a wide range of fuel sources, including black coal, natural gas, coal seam methane gas and renewable energy sources such as hydro, wind, biomass and solar (*DoEE, 2017*).

The Australian Energy Update 2017 (*DoEE, 2017*) report highlighted an increase in electricity generation by 2% overall in 2015–16. This growth is largely attributed to increasing demand for electricity and growth in off-grid use, as well as increased residential and commercial demand, mainly for heating. In terms of fuel consumption oil represented the largest percentage of fuel consumed in 2015–16 (37.0%), followed by coal (32%), gas (24.8%) and renewables (6.0%) (*DoEE, 2017*).

NSW has around 20,000 megawatts (MW) of installed electricity generation capacity (including many small generators and roof top PV systems). Table 2-1 provides the number of major existing, under construction and proposed NSW power stations larger than 30MW (*DP&E: Resources and Planning, 2016*).

Table 2-1 Current Solar Projects (NSW) (Source: DP&E: Resources and Planning, 2016)

	Number of Power Stations	Total Capacity (MW)
Major existing power stations	54	18,740
Projects with Development Approval	51	10,641
Projects in the planning system	39	7,874

Australian Energy Statistics recorded that Solar PV use grew by 23.6% in 2015–16. Table 2-2 provides the Australian electricity generation, by fuel type for this period.

Table 2-2 Australian electricity generation, by fuel type (*Source: Department of Industry, Innovation and Science [2017] Australian Energy Statistics, Table O*)

	2015 -16		Average Annual Growth	
	GWh	Share (%)	2015-16 (%)	10 years (%)
Fossil Fuels	**219,283**	**85.2**	**0.4**	**-0.1**
Black Coal	114,295	44.4	6.2	-1.6
Brown Coal	48,796	19.0	-4.3	-1.2
Gas	50,536	19.6	-4.5	5.3
Oil	5,656	2.2	-17.2	7.7
Renewables	**38,146**	**14.8**	**12.1**	**6.8**
Hydro	15,318	6.0	13.9	0.6
Solar PV	6,838	2.7	23.6	59.1
Wind	12,199	4.7	6.4	18.7
Bioenergy	3,790	1.5	5.5	-0.5
Total	**257,429**	**100.0**	**2.0**	**0.6**

2.1.2 National Electricity Market

The Australian Energy Market operator's (AEMO's) 2017 Electricity Forecasting Insight stated *that 'forecast growth in maximum demand in the medium to longer term may require investments in generation, network, or demand-side solutions to ensure reliability and security of supply'.*

The three projected scenarios of strong, neutral or weak economic growth, range considerably by almost 70,000 GWh across the three differing scenarios, highlighting the uncertainty of the outlook for grid-supplied electricity. AEMO highlights that this uncertainty can be mitigated through:

- Careful and improved system wide grid planning, accounting for the uncertain future
- Considering projects that can be up-scaled or staged in development
- Reducing political and regulatory uncertainty.

Solar Farms are scalable and can be installed regionally, allowing for this type of infrastructure to be suitable for the unpredictable energy climate.

2.2 Strategic Direction of The Region and The State

Australia is a signatory to various international agreements relating to climate change and greenhouse gas emissions, such as the United Nations Framework Convention on Climate Change and the Paris Agreement. Both the NSW and the Australian Government have developed renewable energy targets and strategies to meet these targets, reduce greenhouse gas emissions and provide reliable energy to the public. The proposal will contribute to the market aiming to reach NSW and Australian Government targets and international agreements.

Electricity prices are increasing in NSW and Australia due to increased demand and limited existing supply. In many parts of NSW, constraints on energy supply infrastructure result in energy shortages or uncertainty of reliable supply. Renewable energy generated from large scale solar farms in regional areas allow for distributed generation meaning the energy can be generated in the regions it is needed rather than from large fossil fuel power stations situated many miles away. This increases energy efficiency and reduces energy loss that occurs during transmission of electrical energy across powerlines.

2.2.1 Australia's Renewable Energy Target Scheme

In 2001, the Commonwealth Government introduced the Renewable Energy Target (RET) Scheme to increase the amount of renewable energy being used in Australia's electricity supply. The RET aims to (*DEE, 2016*):

- Produce 33 000 GWh from renewable energy sources by 2020
- Reduce emissions of greenhouse gases in the electricity sector
- Provide for increased energy security through diversifying the energy mix and transitioning to low carbon intensive energy sources.

The Proposal would produce an estimated 300 gigawatt hours (GWh) per year of renewable electricity which would assist in meeting the RET objectives. Additionally, the proposed solar farm will not generate greenhouse gas emissions through the process of energy generation, and would contribute to energy diversity.

2.2.2 The National Energy Guarantee (NEG)

The Australian Government has recently introduced its new energy policy the "*National Energy Guarantee*" (NEG) to ensure that reliable, affordable power is available. To achieve this power companies would be required to use a percentage of electricity from sources such as coal and gas to ensure a reliable power supply is available, but also buy a percentage from renewables and efficient power supplies to ensure that Australia meets its international obligations made at the Paris climate change conference. The Proposal will contribute to the renewable energy supply.

2.2.3 NSW Renewable Energy Action Plan

The NSW Renewable Energy Action Plan was created to guide NSW's renewable energy development and to support the former national target of 20% renewable energy by 2020. This plan aims to align with Goal 22 of the 'NSW 2021' Plan, to "*contribute to the national renewable energy target by promoting energy security through a more diverse energy mix, reducing coal dependence, increasing energy efficiency and moving to lower emission energy sources*."
The Plan also aims to:

- Attract renewable energy investment and projects
- Build community support for renewable energy
- Attract and grow expertise in renewable energy technology.

The Proposal aligns with Goal 22 of the 'NSW 2021' Plan, as it promotes a renewable energy, will not generate greenhouse gas emissions through the process of energy production and offers a competitive alternative to coal derived energy sources.

2.2.4 Paris Agreement

A global agreement to tackle climate change was made in November 2015 at the COP21 conference in Paris. At the Paris COP21 conference, Australia committed to the following:

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

Renewable energy helps to reduce emissions associated with electricity generation.

2.3 Benefits of the proposal

The key benefit of the Proposal is the production of renewable electricity reducing our greenhouse gas emissions and reliance on fossil fuels. The production of renewable electricity will help contribute to NSW Governments Renewable Energy Action Plan and other schemes and agreements made. On an annual basis, the Proposal will produce enough electricity to meet the needs of approximately 48,000 households.

Additionally, the proposal will reduce greenhouse gas emissions by over 290,000 tonnes of CO2 equivalent per annum (based on 0.948t/MWh from fossil fuels). This is roughly equivalent to removing approximately 125,000 cars from the road.

The Proposal would also provide the following national benefits:

- Develop the solar power industry and supply chain in Australia
- Develop Australian intellectual property and expertise in solar power
- Assist with Australia's commitments under national and international agreements
- Diversify sources of income for the agricultural sector, allowing financial resilience for farmers

- Provide energy security.

The proposal would also generate regional and local benefits including:

- Generating employment:
  - 150 construction jobs (at peak) as well as indirect supply chain jobs
  - Support up to ten operational jobs.
- Encouraging regional development:
  - Employee expenditure in the Gunnedah region (fuel supply, vehicle servicing, uniform suppliers, hotels/motels, B&B's, cafés, pubs, catering and cleaning companies)
  - Maximising the use of local contractors and equipment hire
  - Increasing local skills and trades through project experience.

2.4 Alternatives Considered

2.4.1 Alternative site locations

A desktop assessment was undertaken by pitt&sherry in May 2017 for nine proposed locations across NSW. The desktop assessment aimed to identify environmental aspects that may require additional, detailed and/or specialist assessment, may be impacted significantly or have the potential impact upon the scope, construction or operation of a solar farm.

The desktop assessment considered a range of environmental aspects via analysis of aerial imagery and desktop search tools including:

- Biodiversity
- Aboriginal and Non-Aboriginal Heritage
- Zoning and Local Environmental Plan provisions (i.e. floodplain, bushfire)
- Surface and ground water resources
- Landscape features
- Access
- Current and previous land use.

The desktop assessment formed part of the site selection process undertaken by GSF which also considered:

- Availability of land
- Access, proximity to and capacity of electrical infrastructure
- Commercial viability.

The Gunnedah Solar Farm Site was considered a preferred location due to:

- The suitability of commercial scale solar electricity generation on the land, in terms of solar yield
- Availability of suitably sized lots
- Aspect of the land (north facing)
- Ease of access to major transport networks such as the Kamilaroi and Oxley Highways
- Limited site vegetation present
- Limited potential for aboriginal or historic heritage items to be present

- Flat landscape requiring minimal earthworks
- Fewer sensitive receivers within 2km of the Site than other locations considered
- Location relevant to natural waterways
- Proximity to and capacity of connection infrastructure (132kV transmission line and Gunnedah substation)
- Lease agreement with landowner
- Water licencing constraints reducing the agricultural use of the site by the landowner.

2.4.2 The 'do nothing' option

The consequences of not proceeding with the Proposal would be to forgo the benefits of the Proposal, resulting in:

- The loss of a source of renewable energy that would assist the Australian and NSW Government to reach their targets such as 20% renewable energy by 2020, '*attract renewable energy investment and Proposals, build community support for renewable energy, and attract and grow expertise in renewable energy technology*' (*DPI 2013*)
- The loss of cleaner energy and reduced greenhouse gas emissions
- The loss of additional electricity generation and supply into the Australian grid
- The loss of energy security through diversification of energy sources
- Loss of social and economic benefits through the provision of direct and indirect employment opportunities locally and regionally during construction and operation of the solar farm
- Loss of opportunity for the diversification of income streams.

The '*do nothing*' option may avoid any potential environmental impacts associated with the proposal however, as outlined in Section 9, no significant environmental impacts have been identified. It is considered the benefits of the Proposal significantly outweigh any potential environmental impacts whilst contributing to ecologically sustainable development.

2.4.3 Alternative layout options

The design and configuration of the Proposal has taken into account the environmental and social considerations of the locality to minimise the potential environmental impacts of the Proposal including:

- Identifying and avoiding/mitigating any environmental constraints including:
  - Avoiding existing clusters of trees to retain native vegetation
  - Moving the Site north within the Subject Land to avoid the higher predicted flood levels across the site
  - Locating the substation further north than originally intended and on a raised bed to avoid the higher predicted flood levels across the site
  - Locating the substation away from sensitive receivers to the east and north of the Site
  - Utilising tracking panels to minimise flood risks associated with the infrastructure
  - Creating separately fenced areas of PV panels to provide channels for water to flow unimpeded across the site and enable continued access for the landowner to continue cropping on Site.
- Implementing buffer distances including:
  - An 800m buffer from the nearest residence
  - A 1km buffer from roads

- 20m buffer around areas of retained vegetation
- An asset protection zone (APZ) of 15 m around the entire perimeter of the solar farm footprint, and 20 m for areas abutting the areas of remnant trees and the substation
- 5m buffer either side of the existing irrigation channels.

2.4.4 Size of proposal

The Proponent has undertaken extensive grid modelling to determine the optimal size of the solar farm, to ensure constraint free operation and dispatch into the NEM. Through the finalisation of the connection application planning process, GSF will continue to liaise with TransGrid. This will ensure the final plant layout and size is adequate for the existing grid infrastructure.

2.4.5 The preferred option

The preferred option is detailed in Section 3.

3. Proposal Description

3.1 Overview

The construction of the Proposal is estimated to consist of up to 460,000 PV panels installed on a single axis tracker system across the Site.

The single axis tracker system option would consist of groups of east-west facing PV modules tilted at +/-60° angle from horizontal (each approximately 2m x 1m in area) on mounting structures up to 2m in height. The mounting structure would be piled steel posts that would extend 2.5m to 4m below ground, depending on geological conditions. The maximum height of panels during tracking movement is up to 3m.

The following works and infrastructure would be required to support the construction and operation of the solar farm:

- Construction of an access road for all access and egress for the Site and substation
- Installation of electrical infrastructure including:
  - A 132kV Substation
  - A new overhead transmission line (powerlines and poles for a distance of approximately 1.2km)
  - Inverters to convert energy from DC to AC
  - Cabling and other electrical infrastructure (e.g. security systems)
- Ancillary works on the existing 132kV transmission line adjacent the site

  (Note: These would be undertaken by TransGrid and subject to separate environmental approvals to be obtained by TransGrid)
- A maintenance compound and buildings
- Fencing, landscaping and environmental works.

Power generated by the facility will be transmitted via existing 132kV transmission lines, in an easement owned by TransGrid south of the Site along Orange Grove Road, to the local energy grid via the Gunnedah substation which is located 2.3km south of the Site on the Oxley Highway (refer Figure 1-1).

A tee in connection will be used to connect into the existing grid located 1.2km from the Site via a new above ground 132kV powerline. A tee connector is an electrical connector that joins three cables together.

The operational life of the solar farm is expected to be approximately 25 years at which point the panels are either replaced and operations continue or removed and the site is decommissioned and rehabilitated as required.

3.2 Proposal Site

The Subject Land, as described in Section 1.1.2, totals approximately 795 hectares in area and is currently used for agriculture specifically cropping (irrigated cotton and chick pea). Due to current restrictions on available water (Water Licence allocations), the landowner is only able to effectively crop an estimated 180 hectares of the Subject Land resulting in areas remaining fallow. As such, the use of the land for a solar farm and accompanying grazing activities will provide sustainable socio-economic benefits for the landowner and region associated with this land use.

The solar farm and associated grazing activities would occupy 38% of the Subject Land with the remaining land (approximately 62%) to continue to be used solely for agricultural cropping purposes.

There is an existing TransGrid easement which runs along Orange Grove Road at the southern boundary of the Site. This easement contains existing TransGrid 132kV powerlines on wooden pole structures (refer Figure 3-1) connecting to the Gunnedah substation approximately 2.3km to the south of the Site.

Figure 3-1 Existing electrical infrastructure

Orange Grove Road is a local road (managed by Gunnedah Shire Council) which runs parallel to the southern border of the Site. The north, east and west boundaries of the Subject Land are defined by neighbouring agricultural lots with some sections of unnamed, unsealed rural roads.

Access to the Site would be from Orange Grove Road a single lane, partly sealed, partly unsealed local road. The section of the road directly south of the Site is un-sealed, however the access to the Site is on the sealed portion of Orange Grove Road.

All heavy vehicles will access the Site from the Kamilaroi Highway via Blue Vale Road, Old Blue Vale Road, Kelvin Road and Orange Grove Road (refer Figure 6-28 in Section 6.6). Orange Grove Road intersects with Kelvin Road approximately 6.3km west of the Site.

An existing unsealed unnamed access road off Orange Grove Road will be used to access the Site. The access road is located near the western boundary and would be upgraded as part of the works.

The Site comprises a series of fenced paddocks (1.2m high wire fences) which have been largely cleared for agricultural purposes and now contain irrigated crops (specifically cropping – irrigated cotton, wheat and chickpea). The Subject Land also contains a number of built structures including agricultural sheds, a temporary residential dwelling and a permanent residential dwelling which is currently under construction. The house site is also surrounded by a 2m levee bank to divert flood waters around the residence.

There are several clusters of native vegetation located in the Site (refer to Figure 1-4 and Figure 3-2). The largest two clusters are in Lot 1 DP 186590 and are roughly 1.51 hectares (V1) and 2.96 hectares in area (V2), respectively. Other vegetation on-site includes:

- A row of native trees along the boundary of the Site and Orange Grove Road (V3)
- A row of native trees along the western boundary of Lot 151 DP 754954 and Lot 2 DP801762 (V4)
- A sparse group of trees located in lot 153 DP 754954 (V5).

A detailed Biodiversity Assessment has been prepared as part of this EIS (refer section 6.1) which provides further details on existing vegetation and biodiversity.

The site is located in the Namoi River catchment and has been identified as flood prone land (Gunnedah Local Environmental Plan [LEP] 2012). Surface hydrology, landform and soils have been heavily modified by the paddock development and irrigation works.

There are no waterways within the Site and waterways on the Subject Land surrounding the Site are limited to a large dam contained in the north-eastern corner of Lot 1 DP 1202625 which has an area of approximately 6.05 hectares. At the time of the site inspection this dam was dry (October 2017). Irrigation channels located on either side of several existing internal roads are present throughout the Site to facilitate water movement for cropping from five irrigation bores and the storage dam using pumps.

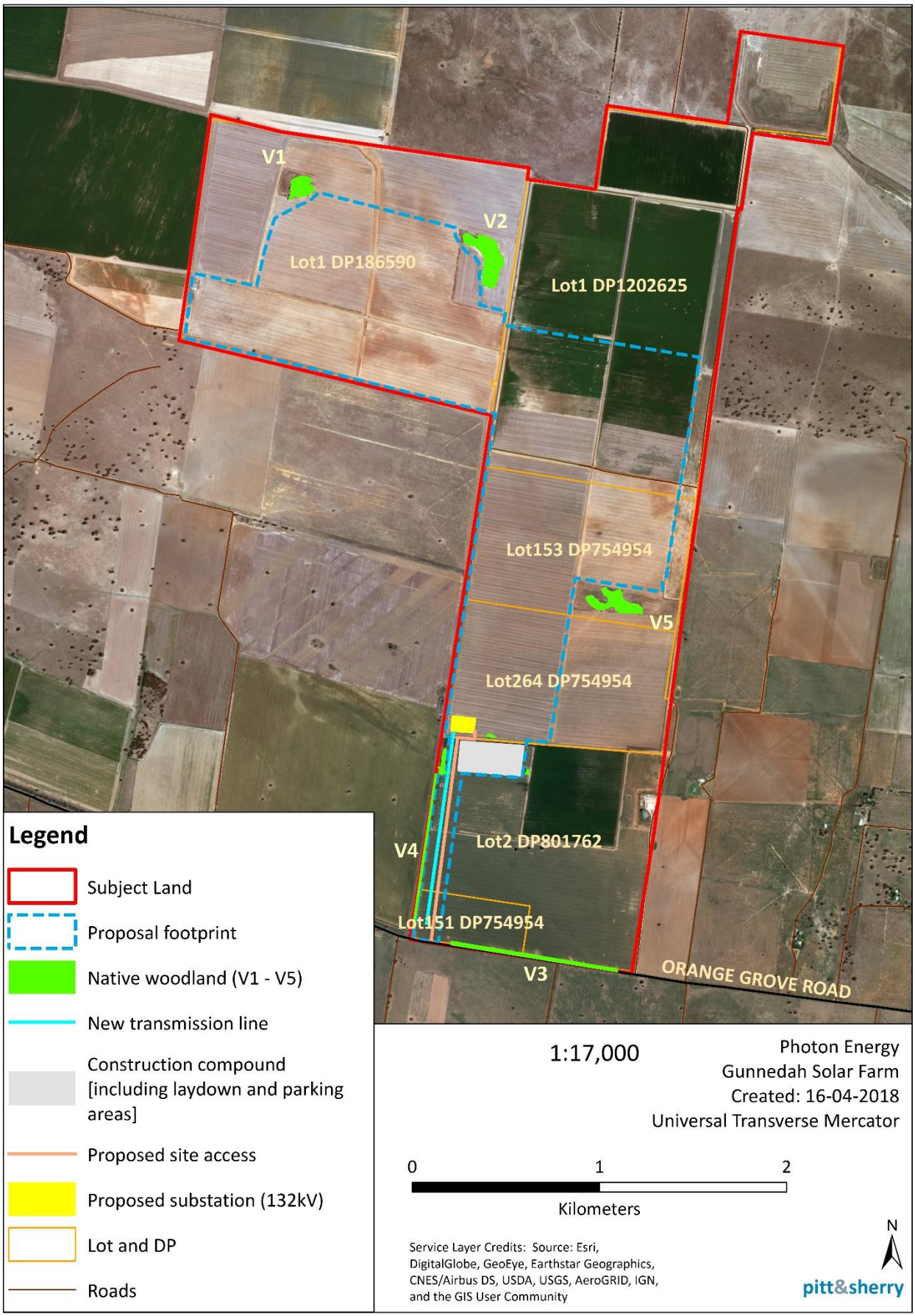

Figure 3-2 Map of Subject Land showing vegetated areas in relation to the Proposal footprint

3.2.1 Surrounding Locality

The Proposal is located in an agricultural region on the boundary of the suburbs of Gunnedah and Orange Grove approximately 9km north-east of the township of Gunnedah in the north-west region of NSW.

Gunnedah is the closest town to the Proposal and covers an area of 4,994km^2. The population of Gunnedah was 9,726 in the 2016 Census (*ABS, 2017a*). The main industries are coal mining (14.2%), Supermarket and Grocery Stores (3.3%), cafes, restaurants and takeaway food services (3.2%), Local Government Administration (3.1%) and secondary Education (2.8%) (*ABS, 2017b*).

Settlement of the area dates from 1834, with the land used for agriculture including wheat growing and sheep farming. Prior to European settlement the Gunnedarr people occupied the area. Growth in the area took place during the late 1800s, aided by the opening of the railway line in 1879 (*Australian Heritage, n.d.*).

There are currently 18 buildings/lots, within the town of Gunnedah, listed under Gunnedah LEP as Heritage items. No Heritage items have been listed within 1km of the Site (*Gunnedah LEP, 2012*).

The Site is in close proximity to major haulage routes with access from the Oxley Highway which is 1.9km south of the Site and the Kamilaroi Highway, 6.8km to the south-west of the Site. Additionally, Gunnedah Airport is located approximately 8km west of the Site and there is a small private, rural airstrip located approximately 4.3km west of the Site.

The majority of built structures in the region are in the town of Gunnedah which consists mostly of low density residential areas or large lot residences. Outside the township, built structures include sparsely distributed rural-residences which are usually located some distance from roads (refer Figure 3-3 and Figure 3-4).

Figure 3-3 Existing Environment of Gunnedah, patchwork of colours and paddocks

Figure 3-4 Existing Environment showing silos and farm buildings in the distance

Residences in proximity to the Site generally occur on large rural properties used for agriculture predominantly grazing and some cropping activities. One resident is located within 1km of the site and six residences are located within 1km and 2km of the proposed Solar Farm (refer Section 6.3.5).

Local topography is very flat with the slopes estimated to be ≤1 degree and an elevation of 280m as the Site is located on a flood plain. However, there are several highpoints in the area including the town of Gunnedah which is located on a hilly region, Black Jack Mountain located south of Gunnedah town, and the Kelvin Hills located 1.9km to the north of the Site (refer Figure 3-5). There are also residential receivers located at the base of the Kelvin Hills which have an elevated viewpoint of the Site.

Nearby water courses include the Namoi River which is located approximately 900m south of the Site surrounded by scattered stands of native vegetation. Other natural water courses in the area include: Mooki River; Carroll Creek, Rangria Creek and Kibah Creek which are all tributaries of the Namoi River. There are also several man-made agricultural dams in neighbouring plots.

The environment around the Site is dominated by cleared agricultural land which is the dominant industry in the region. There are also several large mines in the region, the nearest of which is the RocGlen Mine 17km to the north-west of the Site.

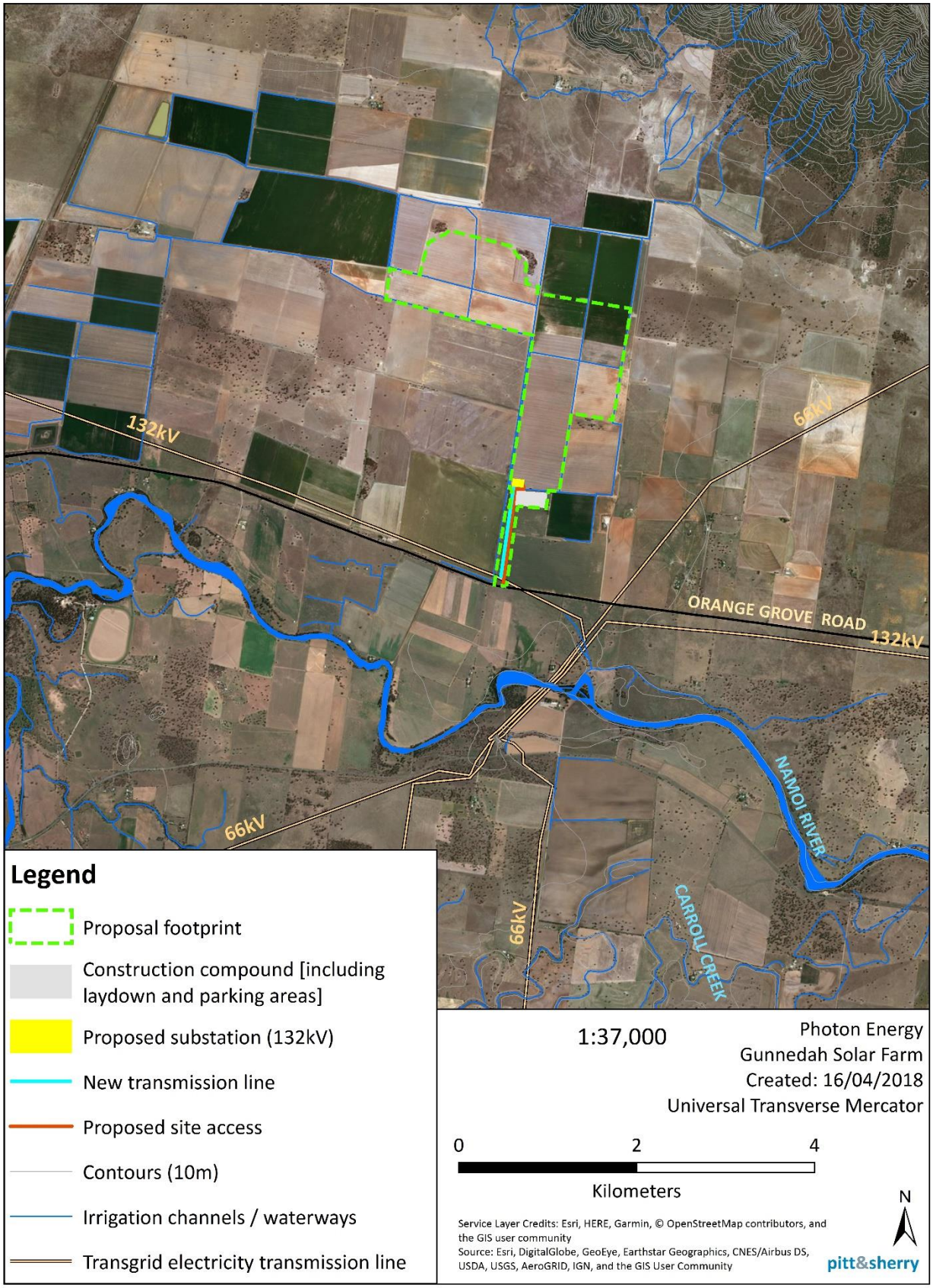

Figure 3-5 Topographic map

3.3 Gunnedah Solar Farm

3.3.1 Key infrastructure components

The Proposal would consist of the following elements:

- Solar Components including:
  - Up to 460,000 PV panels on mounting structures
  - Electrical connections and inverter stations (where the inverters are within containers at the end of solar PV rows)
  - Underground cabling / collection circuits.
- Electrical infrastructure including:
  - Transmission kiosk
  - A 132kV Substation
  - 33kV switchgear
  - Ancillary works on the existing 132kV transmission line adjacent the site.

    (*Note: These would be undertaken by TransGrid and subject to separate environmental approvals to be obtained by TransGrid)*
- An access road
- Ancillary facilities and construction compounds
- Perimeter security fencing
- Two maintenance storage containers.

During the construction period, some additional temporary facilities would be located within the Site including:

- Material laydown area
- Construction site offices
- Parking area.

Further details have been provided below for indicative key infrastructure components however the detailed design including suppliers for all components would be confirmed during the construction contract Request for Proposal (RFP).

Solar Components
The solar modules will consist of a mounting system, PV solar panels and cabling. The support structures for mounting the PV panels will stand up to 3m high with steel posts as foundations. Piles would be driven or screwed in to the ground using pile drivers to a maximum depth of 2.5m to 4m, depending on geological conditions.

The Proposal will comprise of up to 460,000 PV panels, using a single axis tracking system, facing east-west and tilted 60° along the north-south axis. The PV modules (2m x 1m) will consist of 72 high efficiency monocrystalline cells with glass and aluminium frames. The modules will be arranged in strings and connected to inverters located adjacent to PV arrays. The PV arrays will be fitted with an earthing and lightning protection system connected to the main earth link. All PV modules would be installed in accordance with the relevant Australian Standards including AS 5033.

Figure 3-6 and Figure 3-7 provide an indication of what the proposed solar modules would look like. An indicative layout of the PV panels is shown in Figure 3-8.

Figure 3-6 Example of ground mounting arrangements

Figure 3-7 Example of Tracking Solar PV panels

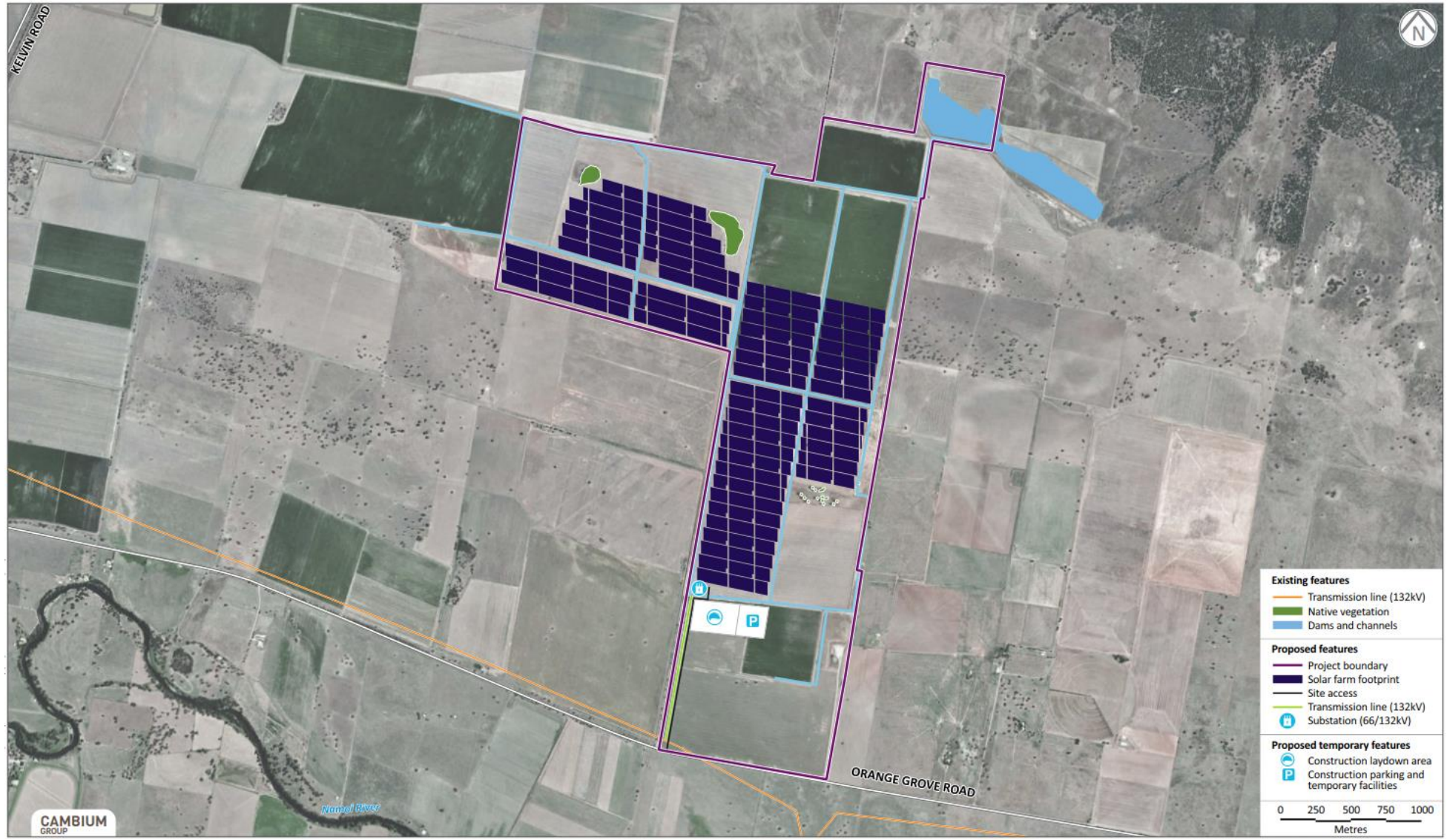

Figure 3-8 Solar panel layout

Electrical connections and inverters

Electrical cabling would be attached beneath the modules and would connect the individual PV modules to each other. Groups of panels will be connected to each other by underground cables. Inverters will be located centrally to groups of PV panels with approximately 8,736 PV panels per double inverter. Inverters would be located within containers at the end of solar PV rows (inverter stations). The inverters stations would be placed on hard stands and raised up to 1.2m off the ground.

Inverter stations collect electricity from an area of panels, convert it from direct current (DC) to alternating current (AC). The energy is conveyed from the inverter station to the transformer to be located within the substation via electrical cabling.

Each inverter station will house 2-3 inverters and will be fitted with an overvoltage protection device at each DC and AC input/output. This would result in approximately 30 to 45 inverter stations across the Site.

The type of inverters to be installed across the site would be one of the following options:

- 30 x 4.92 MW Ingeteam CON40 inverter station (Dimensions: 12.2m (l) x 2.4m (w) x 2.9m) – housed in a 40’ container
- 45 x 3.20 MW Ingeteam CON20 inverter station (Dimensions: 6.1m (l) x 2.4m (w) x 2.6m) – housed in a 20’ container.

The inverter stations would be delivered as a fully containerised solution. These stations will be installed on a concrete foundation, elevated above the ground to enable the installation of the AC and DC cabling (Figure 3-9) and fitted with:

- Inverters (2 inverters for the CON20 inverter station or 3 inverters for the CON40 inverter station)
- Cable glands
- Transformer
- Oil retention safety tank
- HV switchgear
- Cooling fans.

Figure 3-9 Example inverter station

Electrical Cabling

The majority of electrical cabling required for the Proposal would be installed underground and is considered high voltage (>1kV) and as such would be installed at a depth of approximately 1.2m (in accordance with AS3,000 and AS3,0008) (subject to detailed design) including all DC power cabling connecting the panels. All underground cabling would be installed in accordance with the relevant Australian Standards including mechanical protection in accordance with AS 3000.

Any low voltage cabling required for auxiliary loads on site may be installed at a depth of between 500-600mm (subject to detailed design). Some electrical cabling may be above ground to enable crossing of irrigation channels however this will be determined during detailed design.

Prior to excavating the cable trench, the topsoil would be stripped and stockpiled for use in the rehabilitation of the trench following the cable installation. A sand bed will be placed in the trench before and after laying of the cables, followed by additional backfilling with excavated material.

Substation

A new 132 kV substation would be established on Site in the south west corner of Lot 264 DP754954 (Figure 3-8). The substation footprint is approximately 60m x 80m and set back approximately 1.2km from Orange Grove Road. The substation switchyard would include a transformer, 33kV switchgear building and auxiliary services building. New overhead transmission lines would connect the existing 132kV transmission line located near Orange Grove Road to the substation. An example of a similar substation can be seen in Figure 3-10.

The new substation would include (subject to detailed design):

- 1 x 132kV 140MVA transformer
- 33kV switchgear building
- Auxiliary services building
- Elevated busbar
- A lightning protection system
- Circuit breakers
- Disconnectors
- Current transformers
- Voltage transformers
- Diesel Generators
- Communications pole with microwave dish and antennas.

A chain link fence with upper barbed strands approximately 3m high would be installed around the substation to maintain security of the site and ensure safety for the public and the ongoing agricultural activities surrounding the substation. The substation would have a 20m asset protection zone (APZ) in accordance with TransGrid design and safety standards.

The substation would be constructed on a concrete pad, approximately 60m x 80m, and the concrete pad will be raised off the ground, in accordance with TransGrid requirements, to mitigate risks of flood waters affecting safe and reliable operation of the substation. Consistent with existing TransGrid substation designs, gravel will be placed around the substation equipment and fence to restrict vegetation growth and provide a safe working environment in accordance with Australian Standards (AS 2067, AS 1025.1 and 1025.2). The substation will include 33kV switchgear which controls the flow of electricity within an electrical system to prevent overloads and short circuits, and to de-energize circuits for testing and maintenance.

The connection will be made via new 132kV overhead transmission lines using towers or poles for a distance of approximately 1.2km. This connection is subject to TransGrid detailed design however it is expected that 6 towers or poles, distanced approximately 150m-200m apart would be erected to suspend conductors from the substation to the existing 132kV transmission line.

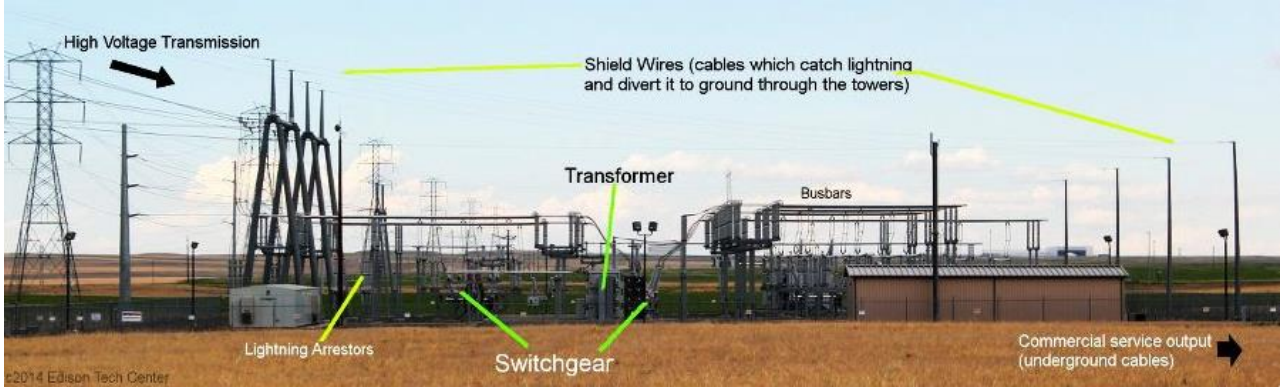

Figure 3-10 Example Substation

TransGrid Infrastructure Works

Works required to facilitate the connection from the Proposal to the existing Transgrid Gunnedah Substation would be undertaken by TransGrid and are subject to separate environmental assessments. The works would include:

- Approximately 1km of existing TransGrid transmission line between structures 315 and 310 will be restrung with higher rated conductors
- Installation of a high capacity fibre is also required to ensure that necessary communication and protection systems are in place for safe and reliable operation of the solar farm and TransGrid's continued operation of its high voltage transmission network. The installation of this fibre would occur by means of retrofitting approximately 1.6km of optical ground wire (OPGW) onto TransGrid's existing transmission line back to the Gunnedah Substation. Installation of the OPGW would replace the existing overhead earth wire on the transmission line with a fibre that is visually consistent with the existing transmission line arrangement.

The works required to undertake this would occur wholly within the existing transmission line easement and readily occur as part of general maintenance and upgrade works undertaken by TransGrid across its network. The proposed works within the easement would not result in any change to existing land use and would be located within a corridor that has been subject to major ground and vegetation disturbance activities during the construction and operation of the transmission line.

Access Road

The current access road to the Site is an unnamed, unsealed road off Orange Grove Road near the western boundary of the Site in the south-west corner of Lot 151 DP754954. This access road would be upgraded to provide access to the Site and Substation including installation of a rumble grid/shaker and sealed pavement for a minimum 30m from the edge of Orange Grove Road.

Access would also be required between the modules and inverter stations onsite for maintenance, however these would utilise existing internal roads located between the irrigation channels or land between panel infrastructure that would not need to be constructed or delineated due to the low frequency of access.

All access roads would be maintained throughout the construction and operation of the solar farm.

Ancillary facilities and construction compound

The proposed works will require the installation and use of a compound site to be located within the south-western corner of the Site on Lot 264 DP754954 and a material laydown area to be located along the southern boundary of the Site on Lot 264 DP754954, to the east of the compound site (Figure 3-8).

Temporary ancillary facilities associated with the compound site would include:

- Construction offices (one 12m x 3m site office, five 12m x 3m break rooms and four 12m x 3m change rooms)
- Parking area
- Staff amenities
- CCTV (Security purposes).

Perimeter Security Fencing

The Solar Farm will be fenced in four separate lots (see Figure 3-8) with a 1.8m chain link security fence with three barbed wires at the top.

The fence would be designed to ensure adequate access and egress points are provided during both the construction phase and ongoing operational life of the proposal. An example is provided in Figure 3-11.

Figure 3-11 Example security fencing (chain link security fence)

Operations

Once operational the Solar Farm will be monitored and operated remotely therefore requiring minimal on-site maintenance personnel. A small area will be maintained for parking of utility vehicles during operation of the solar farm. Two 40' shipping containers for storage of maintenance equipment will be permanently situated within the Site on the compound areas used during construction.

3.3.2 Construction and Commissioning

Construction Activities

The construction and commissioning phase is expected to last approximately 12 months. The main construction activities are outlined in Table 3-1.

Table 3-1 Main Construction Activities by Stage

Stage	Main activities
Site Establishment	• Installation of security measures including fencing • Establishment of site compound, material layout and equipment wash down areas • Ground preparation • Installation of environmental controls in accordance with a detailed Construction Environmental Management Plan (CEMP) • Minor vegetation clearing (grasses, shrubs and groundcover) • Targeted clearance of low laying vegetation around trenching areas • Pile driven installation of PV mounting structures to minimise disturbance to existing ground cover • Establishment of tree and vegetation protection measures as required • Establishment of additional sedimentation and erosion controls as required.
Preliminary civil works	• Setting up foundations for the substation and inverter stations • Drainage works (as required).
Install PV systems and cables	• Installation of steel post and rail foundation system for the solar panels • Installation of PV panels and DC wiring beneath the panels • Installation of electrical cabling including trenching for underground cabling and installation of inverter stations.
Construction of 132kV substation and new transmission line	• Site Establishment and clearing (if required) • Bulk earthworks • Detailed civil works including earthing and foundations • Erection of steelwork, equipment, demountable buildings and transformers • Electrical connections • Install new poles • Transmission line stringing for new conductor and OPGW from substation to existing 132 kV transmission line.
Rehabilitation and Commissioning	• Testing of electrical infrastructure • Removal of temporary construction facilities and rehabilitation of disturbed areas • Landscaping works based on the Landscape Plan (refer **Appendix C**).

Earthworks

While extensive earthworks are not proposed, some land forming (including localised cut and fill areas) may be undertaken to achieve more consistent gradients beneath the PV modules. However, irrigation channels and associated buffers will isolate areas of different levels negating the need for levelling.

Additionally, earthworks are required for trenching works.

Ground disturbance, resulting from earthworks would be minimal and limited to:

- The installation of the piles supporting the solar panels, which would be driven into the ground to a depth of approximately 2.5m to 4m (depending on geological conditions)

- Concrete or steel pile foundations for the inverter stations, substation and maintenance storage containers
- Trenches up to 1.2m deep for the installation of cables
- Disturbance within the construction laydown area (approximately 5ha area) including works to flatten the surface. The construction laydown area will likely be lined with gravel over the top, this will be removed when the construction phase is complete
- Establishment of temporary staff amenities for construction
- Construction of perimeter security fencing
- Minor vegetation clearance.

The ground disturbance from pile foundations is estimated to equate to less than 1% of the total site area. Additional ground disturbance would result from trenches for cabling and footings for any other infrastructure.

Panels within the solar array area would sit above the ground and existing ground cover would be maintained underneath the panels.

Construction Hours and Duration

Construction hours for the proposal will be in accordance with the ICNG recommended standard hours as detailed below:

- Monday to Friday – 7am to 6pm
- Saturdays – 8am to 1pm
- Sundays or Public Holidays – No construction.

No audible out of hours or night works are proposed excluding emergencies. In the event that construction is required outside of these hours, approval from relevant authorities and notification to the community would be undertaken.

Resourcing Requirements

Water
Water use during construction would be limited to staff amenities (temporary portable toilets) and dust suppression. Water for dust suppression would be sourced on site from existing irrigation channels or trucked onto site. A diluted organic polymer agent is proposed to be used to reduce the quantity of water required for dust suppression activities.

Potable water would be trucked to the Site on as needs basis and stored within temporary water tanks at the staff amenities area.

Labour
It is estimated that approximately 150 construction personnel would be required on site during peak construction period. Construction supervisors and construction labour force, made up of labourers and technicians are intended to be hired locally, where possible.

Plant and equipment
A range of plant and equipment would be used during construction including earth-moving equipment for civil works, cable trenching equipment, trucks and cranes. An indicative list of plant and equipment is provided in Table 3-2 below. The final list of plant and equipment would be determined by the construction contractor.

Table 3-2 Plant and equipment

Equipment	Quantity	Model Type
Pile Driver	10	Gayk HRE 1000 or similar
All terrain fork-lift (tele handler)	10	Manitou MHT-X or similar
All terrain utility vehicle	10	John Deere XUV560 or similar
Backhoe	5	New Holland LB90B or similar
Excavator	4	Cat C13 ACERT or similar
Bulldozer	4	Cat C9.3 ACERT or similar
Scraper	2	Open Bowl Scrapers or similar
Roller	4	Vibratory Soil Compactors
Winches	4	Attached to medium sized dozers or similar
Flatbed truck	5	Isuzu FVZ 1400 or similar
Mobile crane	1 – 2	KATO NK550VR or similar
Elevated work platforms	1	Bravi Lui 460 Elevated Work Platform 280kg Capacity or similar

Traffic volumes and requirements

Section 6.6 provides an indication of the total overall one-way traffic movements anticipated throughout the construction and operational periods. The final traffic haulage route and number would be further detailed in the traffic management plan.

Materials

It is anticipated that PV infrastructure and associated materials would be transported via road from either Newcastle or Port Botany. This will include:

- Galvanized steel and Aluminium solar support structures
- Up to 460,000 Crystalline silicon solar PV panels with Aluminium frame
- Inverters
- 2 x maintenance storage shipping containers
- Copper and Aluminium interconnection cabling
- Chain link perimeter fence with lockable access gates and three barbed wires at the top (1.8m in height)
- CCTV security system
- Substation components.

Materials associated with earthworks would likely include:

- Gravel to seal the access road and construction laydown area
- Sand for the bedding of cables that are to be buried throughout the Site
- Imported fill to construct the raised platforms for the substation and inverter stations

3.3.3 Operation

The construction phase of the proposal is anticipated to commence in the first quarter of 2019 and subsequently operational phase is anticipated to commence in the first quarter of 2020.

Once operational, activities would include daily operations and maintenance including:

- Remote 24/7 on-line monitoring
- Scheduled visual inspections and general maintenance
- Repair and cleaning operations of the PV arrays (as required)
- Replacement of equipment and infrastructure (as required)
- Land management monitoring and activities including
  - Management of sheep
  - Maintenance of groundcover vegetation
  - Weed control
  - Erosion and Sediment control
  - Pest and vermin control.

The site will be monitored for site security including 24hr response should a security event occur.

Hours of Operation

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

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

Emergency response, inspections and maintenance activities may be required to be undertaken out of hours or at night however these would be minimised where practicable.

Electricity would be produced by the solar panels during daylight hours and as such may continue to produce electricity outside of standard hours during summer months (i.e. longer days).

There would be no permanent night lighting operating on the Site however, the Substation will contain lighting to be utilised during emergency response.

Resourcing Requirements

During the operational phase the proposal will support up to ten operational jobs. Minimal operational plant and equipment will be required for operation of the facility including ad hoc maintenance vehicles (Utility Vehicle Mazda BT-50 or similar) and other equipment associated with the activities outlined above.

There would some occasions, such as during a major substation shutdown, that additional maintenance staff may be required on site. During operation of the solar farm water would be required for stock watering and vegetation management which would be supplied from existing on-site dams and irrigation systems. Bore water would also be used for cleaning the solar panels (if required).

Emergency firefighting water would be stored in a tank (approx. 50,000L) located adjacent to the maintenance storage containers.

3.3.4 Decommissioning

The solar farm has an operational timeline of approximately 25 years following which the infrastructure would be reviewed and either

- Updated – the plant would be updated for continued use
- Decommissioned – the plant will be permanently removed.

Should the decision be made to remove the plant, then the Site would be returned as close as possible to its existing condition and will be decommissioned as per standard solar plant isolation and disconnection procedures. Key elements of proposal decommissioning would include:

- The PV arrays would be removed, including the foundation posts
- Materials would be sorted and packaged for removal from the site for recycling or reuse. Much of the solar PV panels would be recyclable
- All equipment would be removed and materials recycled or reused, wherever possible
- All posts and cabling, and stabilising infrastructure (concrete footings) would be removed and recycled
- All areas of soil disturbed during decommissioning would be rehabilitated with the aim of meeting the existing (pre-construction) land capability
- Traffic required for decommissioning would be similar in type but considerably less in quantity than that required for the construction phase.

The substation would remain in place to service the locality subject to review of viability by TransGrid.

4. Statutory Assessment

4.1 Planning Pathway

Under Schedule 1, Part 20 of the State Environmental Planning Policy (State and Regional Development) 2011 electricity generating works with a capital investment value of more than $30million, or a capital investment of more than $10million and located in an environmentally sensitive area of State significance, are deemed State Significant Developments (SSDs). The Proposed solar farm exceeds the $30million capital investment value, and is therefore declared SSD.

The proposal to construct and operate the Gunnedah Solar Farm requires development consent under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). In accordance with section 4.12 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), a SSD requires an EIS to be submitted in tandem with the development application.

On 28 July 2017, the proponent submitted a Preliminary Environmental Assessment (PEA) along with a request to the Secretary for the Secretary's Environmental Assessment Requirements (SEARs), as required by clause 3 of Schedule 2 of the EP&A Act Regulations 2000. The PEA provided information about the proposed development and preliminary assessment of the potential environmental impacts. In formulating the SEARs, requests were sent to relevant public authorities and agencies to inform the key issues raised in Section 5. The SEARs were issued to GSF on the 25 August 2017 refer **Appendix A** and are summarised in **Appendix B** including cross reference to where it has been addressed within this EIS.

This EIS complies with the requirements prescribed within the SEARs, and the environmental assessment requirements contained in Schedule 2 of the EP&A Regulations.

Part 4, Section 4.37 of the EP&A Act designates the Minister for Planning and Infrastructure as the approval authority for SSD however section 2.4 of the EP&A Act enables the Minister to delegate the consent authority function to the Independent Planning Commission (IPC), the Secretary or to any other public authority.

4.2 Evaluation of The Development

Section 4.15 of the EP&A Act applies to the determination of development applications for a SSD. Under Section 4.15, the consent authority is required to consider a number of matters when determining a development application under Part 4 (EP&A Act). These matters are listed in Table 4-1 and assessed in terms of their relevance to the proposal.

Table 4-1 Matters of consideration

Provision	Relevance to the Proposal
Any environmental planning instrument	Relevant environmental planning instruments (EPIs) are discussed in Section 4.5. They include: • *State Environmental Planning Policy (State and Regional Development) 2011* • *State Environmental Planning Policy (Infrastructure) 2007* • *State Environmental Planning Policy (Rural Lands) 2008* • *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* • *State Environmental Planning Policy No. 44 - Koala Habitat Protection*

Provision	Relevance to the Proposal
	• *State Environmental Planning Policy No. 55 – Remediation of Land* • *Gunnedah Local Environmental Plan 2012.*
Any proposed instrument that is or has been the subject of public consultation under the EP&A Act and that has been notified to the consent authority	There are no draft instruments relevant to the proposal.
Any development control plan	Clause 11 of the *State and Regional Development (SRD) SEPP 2011* prescribes that development control plans do not apply to SSD.
Any planning agreement that has been entered into under Section 7.4, or any draft planning agreement that a developer has offered to enter under Section 7.4	There are no planning agreements that have been entered into or proposed, with regards to this proposal.
The regulations (to the extent that they prescribe matters for consideration)	Clause 92 within Division 8 provides a list of additional matters that the consent authority must consider. This list includes: • The Government Coastal Policy, for development application in certain local government areas • The provisions of AS 2601 for development applications involving the demolition of structures • The provisions of a subdivision order and a development plan for development of land that is subject to a subdivision order • The Dark Sky Planning Guideline. None of the above-mentioned developments are proposed in the Gunnedah Solar Farm. The Gunnedah Local Government Area (LGA) is not listed in the table under this clause. The additional provisions provided by the EP&A Regulation are not relevant to the Proposal.
Any coastal zone management plan (within the meaning of the *Coastal Protection Act 1979*), that apply to the land to which the development application relates	The Proposal is not within an area mapped as a Coastal Zone under the *Coastal Protection Act 1979*. Therefore, any additional considerations under this act are not relevant to the Proposal.
The likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality	The likely impacts of the Proposal, including environmental (built and natural), social and economic impacts in the locality, are detailed in Section 6 of the EIS. The Proposal has undergone multiple rounds of design changes so that identified environmental

Provision	Relevance to the Proposal
	impacts of the Proposal have, wherever feasible, been avoided or minimised. Mitigation measures, summarised in Section 8.1, will be implemented to reduce any residual impacts.
The suitability of the site for the development	The suitability of the Site for the proposal is discussed in Section 2.4.1.
Any submissions made in accordance with this Act or the regulations	The proponent is committed to address any submission made in relation to the Gunnedah solar farm. Consultation with stakeholders that has been undertaken to date is summarised in Section 5.
The public interest	The proposal is in the interest of the public for the following reasons: • It will assist in the reduction of greenhouse gas emissions to further combat climate change • It will provide a source of clean electricity generation • It will directly contribute to aiding Australia in meeting the RET • It will create localised economic benefits for the region, including employment, stimulation of local business' and diversification of land use, developing new skills in a growing industry. A Community and other Stakeholder Engagement Plan was prepared and the outcomes of consultation undertaken in accordance with the plan is provided in Section 5.6. This plan aims to inform the community and stakeholders about the proposal and their role in providing input into the assessment and development process.

4.3 NSW Legislation

4.3.1 Environmental Planning and Assessment Act 1979

The Environmental Planning and Assessment Act 1979 (EP&A Act) is the principal piece of legislation covering assessment and determination of development proposals in NSW. It aims to encourage the proper management, development and conservation of resources, environmental protection and ecologically sustainable development. The development assessment and approval system in NSW is set out in Parts 4 and 5 of the EP&A Act.

As noted in Section 4.1 of this EIS, the Proposal is classified as SSD in accordance with the State and Regional Development (SRD) SEPP and development consent is being sought under Part 4 of the EP&A Act.

The relevant objectives under the EP&A Act for this development are to:

- To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources
- To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment
- Encourage the promotion of and co-ordination of the orderly and economic use and development of land
- Encourage the protection of the Environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats
- To promote good design and amenity of the built environment
- Provide increased opportunity for public involvement and participation in environmental planning and assessment.

These objectives have been considered throughout the site selection and environmental assessment process. The Proposal aims to promote the orderly and economic use of land through the provision of utility services (power generation). During the site selection process, the location and design of the solar farm were considered, such that it would avoid protected areas and generally minimise the use of natural and artificial resources. Stakeholder consultation and engagement with the community began as early as feasible, to allow for public involvement and participation throughout the environmental assessment process.

Authorisations not required for approved SSD
Section 4.41 of the EP&A Act identifies authorisations that are not required for approved SSD. These are:

- Concurrence under Part 3 of the *Coastal Protection Act 1979* of the Minister administering that Part of that Act.
- A permit under sections 201, 205 or 219 of the *Fisheries Management Act 1994*
- An approval under Part 4, or an excavation permit under Section 139, of the *Heritage Act 1977*
- An Aboriginal heritage impact permit (AHIP) under Section 90 of the *National Parks and Wildlife Act 1974*
- A bush-fire safety authority under Section 100B of the *Rural Fires Act 1997*
- A water use approval under Section 89, a water management work approval under Section 90 or an activity approval (other than an aquifer interference approval) under Section 91 of the *Water Management Act 2000.*

Authorisations required for approved SSD

Under Section 4.42 of the EP&A Act, certain approvals that may normally be required for carrying out certain development '*cannot be refused if it is necessary for carrying out State significant development that is authorised by a development consent…*', these being:

- An aquaculture permit under Section 144 of the *Fisheries Management Act 1994*
- An approval under Section 15 of the *Mine Subsidence Compensation Act 1961*
- A mining lease under the *Mining Act 1992*
- A production lease under the *Petroleum (Onshore) Act 1991*
- An environment protection licence under Chapter 3 of the *Protection of the Environment Operations Act 1997* (for any purposes referred to in section 43 of that Act)
- A consent under section 138 of the *Roads Act 1993*
- A licence under the *Pipelines Act 1967.*

4.3.2 Environmental Planning and Assessment Regulations 2000

The EP&A Act and the EP&A Regulation provide the overarching structure for planning in NSW.

Clause 256P of the EP&A Regulation requires an accurate estimate of the capital investment value (CIV) of the development. CIV is defined in Clause 3. The Proposal will also require consent in writing of the owner of the land (Clause 8). A copy of the CIV report and the letter of landowner consent was provided to DP&E.

Division 6 (clauses 82 to 85B) specifies the conditions for public participation in SSD proposals. The Proposal and accompanying information (including this EIS) will be placed on public exhibition by DP&E for at least 30 days and the public must be appropriately notified of the application. Preparation of a response to issues raised in submissions is to be submitted to the secretary, if required.

Clause 92 of the EP&A Regulations requires that the consent authority must consider certain matters when determining development applications (refer Section 4.2).

Clause 228 of the EP&A Regulation lists the factors that must be taken into account concerning the impact of an activity on the environment. These factors have been considered during preparation of the EIS.

Schedule 2 of the EP&A Regulation provides the requirements of Environmental Impact Statements, which provide the basis for the Secretary's Environmental Assessment Requirements (SEARs) issued for proposals. The relevant sections in the EIS are referenced against each of the SEARs in **Appendix B**. Clause 6 and 7 of Schedule 2 specifies the form and content requirements of the EIS.

4.3.3 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is administered by the Environmental Protection Authority (EPA) and includes provisions relating to the protection of the environment.

One of the objectives of the Act is to protect, restore and enhance the quality of the environment in NSW, having regard to the need to maintain ecologically sustainable development. There are serious offences under this Act for causing pollution of air, noise, water or land and obligations to notify Office of Environment and Heritage (OEH) when a "pollution incident" occurs that causes or threatens "material harm" to the environment. GSF and the construction contractor would ensure that the construction, operation and decommissioning of the Proposal is managed to prevent pollution and any "pollution incidents" would be notified in accordance with the Act.

Section 48 of the POEO Act requires an Environmental Protection Licence (EPL) for premises which a scheduled activity is carried on. Scheduled activities are defined in Schedule 1 of the POEO Act. General electricity works, as described in Clause 17 of Schedule 1, requires an EPL where the activity has the capacity to generate more than 30 MW of electrical power. Wind power and Solar power are excluded from the definition of 'General electricity works,' hence an EPL is not required under the POEO Act for the proposed Solar Farm.

The POEO Act and *POEO (Waste) Regulations 2014* specify the legal requirements for the management of waste. There are serious offences under the POEO Act for the unlawful transportation and deposition of waste (Section 143). Waste management should be undertaken in accordance with the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act) such as ensuring that resource management options are considered against a hierarchy (avoidance, reuse, reprocess, recycle, energy recovery and disposal). Waste aspects of the Proposal are covered in section 6.13.

4.3.4 Roads Act 1993

Roads Act 1993 (Roads Act) provides for the classification of roads and for the declaration of the Roads and Maritime Services (Roads and Maritime) and other public authorities as roads authorities for both classified and unclassified roads.

The objectives of the Roads Act are to set out the rights of the public to access and use public roads, to establish procedures for opening and closing public roads, to provide for the classification of roads, to confer function of carrying out road work on Roads and Maritime and on other roads authorities and to regulate the carrying out of various activities on public roads.

An access road off Orange Grove will provide a means of entry into the Site. The proposal includes road upgrades including: a minimum 30m seal from Orange Grove Road, to the Site access road and increasing the extent of two-lane seal for 100m at the eastern and western ends of the Old Blue Vale Road.

Section 138 of the Roads Act requires consent be obtained from the Roads Authority prior to disturbing or undertaking work in, on or over a public road. As Orange Grove and Old Blue Vale Road are both local roads the roads authority is Gunnedah Shire Council and all works on these roads will require approval from Council.

4.3.5 Local Land Services Act 2013

The *Native Vegetation Act 2003* was repealed on 25 August 2017. Legislation now governing the clearing of native vegetation is the *Local Land Services Act 2013*, and the *Biodiversity Conservation Act 2016*.

The *Local Land Services Amendment Act No 64*, Division 3 prescribes the regulation of clearing of native vegetation in regulated rural areas. In Section 60O of the Amendment, clearing of native vegetation in a regulated rural area is authorised under Part 4 of the EP&A Act 1979. As development consent is being sought under Part 4 of the EP&A Act, authorisation for clearing of native vegetation is not required.

4.3.6 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BCA Act) aims 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. The BCA Act replaces the *Threatened Species Conservation Act 1995* (TSC Act) as the key piece of legislation that identifies and protects threatened species, populations and ecological communities in NSW.

Under the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* this proposal is to be assessed in accordance with the Framework for Biodiversity Assessment (FBA), given the SEARs have been issued and the field data has been collected under the FBA.

As the proposal is a SSD and the Planning Agency Head and/or Environment Agency Head have not specified that the proposal is unlikely to have any significant impact on biodiversity values, as such a flora and fauna assessment has been prepared as part of the EIS.

The proposed works would involve removal of ground cover vegetation however, the landscape of the subject site has been heavily modified. Comprehensive surveys undertaken during 2017 and 2018 by an ecological specialist, identified a remnant patch of native vegetation that was analogous to three 'Endangered Ecological Community' (EEC) listings under the BC Act. The proposed development is unlikely to have an adverse effect on the extent of an ecological community as these regions have been protected, and will not be disturbed during construction, operation and decommissioning of the Proposal. A detailed Biodiversity Assessment has been prepared and lodged with the EIS (refer Section 6.1 and **Appendix D**).

4.3.7 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) provides the basis for the legal protection and management of Aboriginal sites within NSW. The Director-General of the National Parks and Wildlife Service (NPWS) is responsible for the management of all national parks, historic sites, nature reserves, reserves, Aboriginal areas and State game reserves listed under the NPW Act. The Director-General is also responsible for the protection and care of native fauna and flora throughout NSW.

The Site is not in or in close vicinity to a protected area, as defined in the NPW Act however, the provisions of the Act have been considered and addresses in Section 6.2.

Part 6 of the NPW Act provide statutory protection for Aboriginal objects and places.

An assessment of the potential to impact Aboriginal Heritage is provided in Section 6.2.1 and **Appendix E** and includes the management and mitigation measures that will be implemented as part of the Proposal to ensure protection of any existing or un-expected Aboriginal heritage finds.

It is noted that under Section 4.41 of the EP&A Act, an Aboriginal Heritage Impact Permit (AHIP) under Section 90 of the NPW Act is not required for a SSD.

4.3.8 Crown Lands Act 1989

The *Crown Lands Act 1989* ensures that Crown land is managed for the benefit of the people of NSW. The Crown Lands Act 1989 provides for the administration and management of Crown Land in the eastern and central divisions of NSW. Crown land may not be occupied, used, sold, leased, dedicated, reserved or otherwise dealt with unless authorised by this Act or the *Crown Land (Continued Tenures) Act* 1989. The Minister may grant a "*relevant interest*" such as a lease, licence of permit, over Crown Land for the purposes of any infrastructure, activity or other purpose that the Minister thinks fit.

There is no Crown land within the Subject Land including the access road and transmission lines. On this basis, the Proposal would not require a licence to use Crown Land under the provisions of the *Crown Lands Act 1989*.

4.3.9 Heritage Act 1977

The *Heritage Act 1977* provides for the conservation of items of environmental heritage in NSW. The Act defines heritage as items or places that are of state and/ or local heritage significance and include: places, buildings, works, relics, moveable objects and precincts. As part of NSW heritage protection and management the Act establishes a register including an inventory and list to protect the listed items.

According to the OEH, there are no historic heritage sites located within the site. No items of state significant heritage have been found on the site, as listed in the NSW Heritage and Conservation Register.

An assessment of impact to Heritage is provided in Section 6.2.1.

4.3.10 Rural Fires Act 1997

The *Rural Fires Act 1997* (Rural Fires Act) provides for the preparation, mitigation and suppression of bush and other fires in local government areas and to provide protection of persons, infrastructure and environment, economic, cultural, agricultural and community assets from damage arising from fire.

The requirement to obtain a Bushfire Safety Authority under s100B of the *Rural Fires Act* 1997 is triggered for developments on bushfire prone land for a 'special fire protection purpose', which does not include the development of a Solar farm. On the basis that the proposal is SSD, and is not listed as a 'special fire protection purpose', this approval will not be required in accordance with Section 4.41 of the EP&A Act.

Additionally, a search of the Rural Fire Service (RFS) was conducted on 23 January 2018 which concluded that the Site is not mapped as fire prone land (*RFS 2017*). An assessment of bush fire impacts is provided in Section 6.9 and **Appendix F**).

4.3.11 Water Management Act 2000

The objectives of the *Water Management Act 2000* (WM Act) are to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations. The provisions of the WM Act are being progressively implemented in NSW, repealing various other pieces of legislation in the process. Under this Act, licences and approvals are required for certain activities and works, including dewatering excavations and groundwater interference.

The Proposal is within the area applicable to the *Water Sharing Plan for Lachlan Unregulated and Alluvial Water Sources 2012*, prepared in accordance with the provisions of the WM Act. The plan includes rules for protecting the environment, water extractions, managing licence holders' water accounts, and water trading in the plan area. However, the region surrounding the Site is not mapped within the Department of Primary industries 'high priority Groundwater Dependent Ecosystem' (GDE) map.

GSF have approval from the land owner to use water from bores on the Subject Land and will have a water use arrangement in place for the volumes required. There will be no works within 40m of a natural waterway. Clause 4.41 of the EP&A Act states that the Proposal does not need to apply for a water use approval, a water management work approval or an activity approval as it is SSD.

4.3.12 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) aims to conserve native fish stocks and key habitats to conserve the biological diversity of aquatic fauna and flora. The FM Act also intends to promote viable commercial fishing, aquaculture industries and recreational fishing opportunities. Threatened species, populations and ecological communities, and key threatening processes are listed in the FM Acts' Schedules.

Section 192 of the FM Act claims that a habitat protection plan may be determined for the protection for critical habitat declared under Part 7A. The proposed site location is not identified by the Department of Primary Industries Register of critical habitat. There are no natural waterways or areas of fish habitat within the Site.

4.3.13 Biosecurity Act 2015

The *Biosecurity Act 2015* aims to provide modern, flexible tools and powers that allow effective, risk-based management of biosecurity in NSW. The *Biosecurity Act* replaces the *Noxious Weeds Act 1993* as the key piece of legislation that identifies and manages State and regional priorities for weeds in NSW, Australia.

In NSW, all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. According to this Act, any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

Upon inspection of the strategic weed management plan for the Gunnedah region (North West Regional Strategic Weed Management Plan 2017 – 2022), one listed priority weed species have been identified to exist on the Site, *Lycium ferocissimum* (African Boxthorn) which is a weed of national significance (WoNS). The impact of the proposed development on land use with regard to biosecurity risk is assessed in Section 6.4.

4.4 Commonwealth Legislation

4.4.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Commonwealth Department of the Environment (DoE) and provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as '*matters of national environmental significance*' (MNES). An action that "*has, will have or is likely to have a significant impact on a matter of National Environmental Significance*" (MNES) may not be undertaken without prior approval from the Commonwealth Minister, as provided under Part 9 of the EPBC Act.

A referral must be made for actions that are likely to have a significant impact on the following matters protected by Part 3 of the EPBC Act:

- World heritage properties
- National heritage places
- Wetlands of International importance
- Listed nationally threatened species and ecological communities
- Listed migratory species
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions including uranium mining
- Water resources in relation to coal seam gas or large mining development.

World Heritage Properties

The site does not contain any World Heritage Properties and is not in close proximity to any such area. On this basis, the Proposal will not impact upon any World Heritage Property either directly or indirectly.

National Heritage Places

The site does not contain any National Heritage Places and is not in close proximity to any such area. On this basis, the Proposal will not impact upon any National Heritage Place either directly or indirectly.

Wetlands of International Importance (declared RAMSAR Wetlands)

The site is not located within Wetlands of International Importance and is not in close proximity to any such area, as the closest is 900 – 1,000km upstream. On this basis, the Proposal will not impact upon any Wetlands of International Importance (declared RAMSAR Wetlands) either directly or indirectly.

Great Barrier Reef Marine Park

The Great Barrier Reef Marine Park does not occur within or near to the site. On this basis, the Proposal will not impact upon any areas of the Great Barrier Reef Marine Park.

Commonwealth Marine Areas

The site is not located within a Commonwealth Marine Area and is not in close proximity to any such area. On this basis, the Proposal will not impact upon any Commonwealth Marine Area.

Listed Threatened Ecological Communities

Six threatened ecological communities listed under the EPBC Act have been recorded within a 10km radius of the Proposal. The Proposal would not involve any native vegetation removal so there is unlikely to be any impacts to threatened ecological communities.

Nationally Listed Threatened Species

A total of 29 threatened species listed under the EPBC Act have been recorded or have suitable habitat within a 10km radius of the Proposal, 10 of these are flora and 19 were fauna.

Of the 10 threatened flora species, three have the potential to occur (Ooline, Bluegrass, and Slender Darling Pea). All three species are wide ranging and would be unlikely to be exclusively reliant on-site habitats for their life cycle requirements. Regardless, the proposal would not result in a loss of potential habitat for these three flora taxa as the native vegetation stands would be retained.

Of the 19 threatened fauna species, five have the potential to occur (Regent Honeyeater, Swift Parrot, Painted Honeyeater, Corben's Long-eared Bat and the Grey-headed Flying Fox). The main type of impact on fauna that would occur as a result of the Proposal would be the removal of native trees. However, no native vegetation is proposed to be removed and the fauna impact assessment identifies that no threatened fauna is likely to be affected to the point that a local population would be placed at risk of extinction (see **Appendix D**).

Nationally Listed Migratory Species

A total of 10 migratory species listed under the EPBC Act have been recorded or have potential suitable habitat within a 10km radius of the Proposal.

No migratory species listed under the EPBC Act was recorded nearby the Subject Land during the current surveys. The Proposal is unlikely to significantly impact any listed migratory species under the EPBC Act, as no important habitat exists within the Subject Land and the Proposal would not result in an invasive species that is harmful to any migratory species becoming established in an area of important habitat.

Nationally Listed Marine Species

A total of 16 marine species listed under the EPBC Act have been recorded or have potential suitable habitat within a 10km radius to the Proposal. However as there is no suitable habitat onsite for these marine species no potential impact has been identified.

4.4.2 Native Title Act 1993

The *Native Title Act* 1993 recognises that Aboriginal people have rights and interests to land and waters which derives from their traditional laws and customs. Native title may be recognised in places where Indigenous people continue to follow their traditional laws and customs and have maintained a link with their traditional country.

It can be negotiated through a Native Title Claim, an Indigenous Land Use Agreement (ILUA) or future act agreements.

An ILUA is an agreement between a native title group and other parties who use or manage the land and waters. The ILUA process allows for negotiation between indigenous groups and other parties over the use and management of land and water resources, and the ability to establish a formal agreement. An ILUA is binding once it has been registered on the Native Title Tribunal 's Register of Indigenous Land Use Agreements.

Searches of the National Native Title Register, the Register of Native Title Claims, and Native Title Applications Registration Decisions and Determinations, in June 2017 identified no current applications or determinations within Gunnedah LGA. The site visit did not identify any indigenous archaeological sites on site.

Section 6.2 outlines management and mitigation measures that will be implemented as part of the Proposal to ensure protection of any un-expected Indigenous heritage finds.

4.4.3 Renewable Energy (Electricity) Act 2000

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

- Encourage the generation of electricity from renewable sources
- Ensure renewable energy sources align with the principals of Ecologically Sustainable Development
- Reduce GHG emissions produces by the electricity sector.

Solar energy is listed as an eligible renewable energy source under Section 17 of this Act.

The proposed Solar Farm aligns with the aims of the *Renewable Energy (Electricity) Act*, such that it will generate significant quantities of renewable energy, whilst emitting negligible GHG emissions. The principles of Ecologically Sustainable Development have been addressed in Section 9.3.

4.5 Other Relevant Policies and Plans

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

Under Schedule 1, Part 20 of the *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP) electricity generating works with a capital investment value of more than $30million or a capital investment of more than $10million and located in an environmentally sensitive area of State significance are deemed state significant developments.

The solar farm has an estimated capital investment value of $200.6 million which is greater than $30 million and therefore the Proposal is classified as '*state significant development*'.
Under Part 4, clause 4.39 of the EP&A Act, an EIS must be prepared and submitted to DP&E for approval. The EIS is to be prepared in accordance with the SEARs issued by DP&E.

4.5.2 State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to enable the efficient delivery of infrastructure across NSW, provide a consistent planning regime for infrastructure, providing greater flexibility in the location of infrastructure and service facilities and identifying the environmental assessment category into which different types of infrastructure and services development fall.

Clause 34(7) of the SEPP provides that development for the purpose of '*solar energy systems*' may be carried out with consent on any land, except as prescribed by sub clause 34(8). The solar farm is located within a Primary Production (RU1) zone and is permissible with consent under the ISEPP.

Clause 45 of the ISEPP will also apply as the Site intends to connect with existing transmission lines that traverse the boundary of the Site and as such has the potential to affect an electricity transmission line.

Clause 104 of ISEPP refers to traffic generating developments. Schedule 3 lists the types of developments that must be referred to RMS. Clause 104 also applies to developments with ancillary parking accommodation that have the capacity for 200 or more motor vehicles accessing the site. During construction, the proposal anticipates up to 110 vehicles will access the site daily. Clause 104 does not apply as traffic generated is below the trigger and Schedule 3 does not include electricity generating works.

4.5.3 State Environmental Planning Policy (Rural Lands) 2008

State Environmental Planning Policy (Rural Lands) 2008 aims to identify Rural Planning Principles to assist in the proper management, development and protection of rural lands for the purpose of promoting the social, economic and environmental welfare of the State. This Policy encourages the identification and protection of natural resources, having regard to maintaining biodiversity, the protection of native vegetation, the importance of water resources and avoiding constrained land. Local Environmental Plans developed by councils with land relevant to this Policy must consider a list of Rural Planning Principles stated within Part 2 Clause 7 of this Act.

Part (a) of Clause 7 states that councils should consider '*the promotion and protection of opportunities for current and potential productive and sustainable economic activities in rural areas*.' The proposed Solar Farm complies with this Clause as this development will provide socioeconomic benefits during the duration of the proposal, as well as agricultural land use opportunities (grazing) occurring throughout the proposal life cycle, and subsequent to decommissioning.

The proposal complies with the SEPP objectives as it facilitates agricultural land use through sheep grazing and continued cropping on other parts of the Subject Land and has considered land use conflicts by completing a land use risk assessment (Section 6.3).

Schedule 2 of this SEPP does not list any land that is considered State significant agricultural land, therefore this site is not considered to be state significant agricultural land.

4.5.4 State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

This policy recognises the importance of mining, petroleum production and extractive industries to NSW. This policy aims to:

- Provide for the proper management and development of mineral, petroleum and extractive material resources for the purpose of promoting the social and economic welfare of the State
- Facilitate the orderly and economic use and development of land containing mineral, petroleum and extractive material resources
- Establish a gateway assessment process for certain mining and petroleum (oil and gas) development:
  - To recognise the importance of agricultural resources
  - To ensure protection of strategic agricultural land and water resources
  - To ensure a balanced use of land by potentially competing industries
  - To provide for the sustainable growth of mining, petroleum and agricultural industries.

The land within the site is not mapped as being the location of State or regionally significant resources of minerals, petroleum, or extractive materials. The Gunnedah area does have a history of coal mining operations however currently there are no extraction related activities on surrounding land which will be affected.

The land is mapped as biophysical strategic agricultural land (BSAL) and has a petroleum exploration licence (PEL)0001 held by AUSTRALIAN COALBED METHANE PTY LIMITED and Santos QNT Pty Ltd and coal exploration license (EL)7241 held by the Secretary, NSW Department of Planning and Environment.

This is addressed in Section 6.3 of the EIS.

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

This Policy aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline. This policy achieves this aim by:

- Requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat
- Encouraging the identification of areas of core koala habitat
- Encouraging the inclusion of areas of core koala habitat in environment protection zones.

The Gunnedah LGA has been identified within Schedule 1 of SEPP 44 as land to which the SEPP applies.

Three Schedule 2 Koala feed trees occur in the Gunnedah area, namely River Red Gum (*Eucalyptus camaldulensis)*, White Box (*Eucalyptus albens)* and Poplar Box (*Eucalyptus populnea*). The Site contains no Schedule 2 Koala feed trees. The Site therefore does not contain potential Koala habitat.

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

State Environmental Planning Policy No. 55 – Remediation of Land (SEPP 55) was enacted to provide a State-wide approach to the remediation of contaminated land for the purpose of minimising the risk of harm to the health of humans and the environment. In accordance with clause 7(1) of SEPP 55, a consent authority must not consent to the carrying out of any development on land unless:

- It has considered whether the land is contaminated
- If the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or would be suitable, after remediation) for the purpose for which the development is proposed to be carried out
- 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 would be remediated before the land is used for that purpose.

A search of the NSW EPA Contaminated Land Register of notices on 29 September 2017 identified four sites within the Gunnedah LGA. The Subject land does not appear on the List of NSW contaminated sites. The closest contaminated site is located approximately 7.9km south-west of the site.

Due to its existing agricultural use, there is a risk contamination associated with agricultural activities (pesticides, herbicides etc.) could be present on the site. However, no contaminated sites have been recorded near or adjacent to the proposed site and no signs of contamination were observed during the site assessment. The risk of contamination was therefore considered to be low.

4.5.7 Gunnedah Local Environment Plan 2012

The Proposal is located within the Gunnedah Local Government Area (LGA) and the relevant local planning instrument is the Gunnedah Local Environmental Plan (LEP) 2012.

Subdivision of land

GSF has a lease agreement with the landholders for Lot 1 DP 1202625, Lot 153 DP 754954, Lot 264 DP 754954, Lot 2 DP 801762, Lot 151 DP 754954 and Lot 1 DP 186590.

As per Section 7A of the *Conveyancing Act 1919*, the project is expected to require reconfiguration of the lots, since the proposed lease with the landholder will exceed 5 years. The reconfiguration of lots proposed by GSF are shown in Figure 1-2.

It is proposed that the area leased by GSF for the solar farm (including access road) would create a new lot (304 ha), and would encompass parts of Lot 1 DP 1202625, Lot 153 DP 754954, Lot 264 DP 754954, Lot 2 DP 801762, Lot 151 DP 754954 and Lot 1 DP 186590.

The Gunnedah LEP designates the Site as 'AE' on the Lot Size Map Sheet LSZ_005, where the minimum lot size is 200ha. Section 2.6 of the Gunnedah LEP states that the size of any lot resulting from subdivision of land to which this clause applies is not to be less than shown on the Lot Size Map.

The residual land remaining outside of the solar footprint would be reconfigured to the following new lots, each less than 200ha as follows:

- Approximately 93ha of Lot 1 DP 1202625
- Approximately 165ha of Lot 153 DP 754954
- Approximately 14ha of Lot 264 DP 754954
- Approximately 40ha of Lot 2 DP 801762
- Approximately 114ha of Lot 151 DP 754954
- Approximately 151ha of Lot 1 DP 186590.

No new dwelling entitlement will be attached to any of the newly created lots and the land ownership will remain unchanged for all lots. Furthermore, the reconfiguration can be reverted after the proposal has been decommissioned and would not result in permanent fragmentation of rural land.

As the Gunnedah LEP dictates that no new subdivisions are to be less than the designated lot size of 200ha, the proposal is not compliant with this clause. However, Section 4.38 of the EP&A Act allows the consent authority to grant development consent to a State Significant Development which may be partly prohibited by an environmental planning instrument. Accordingly, development consent may be granted, inclusive of this subdivision.

Relevant provisions of the LEP

As the proposal, will be assessed under Part 4 of the EP&A Act the consent and land use provisions of the LEP do not apply. Relevant provisions of the LEP to the development are listed in Table 4-2.

Table 4-2 Relevant provisions from the Gunnedah LEP 2012

Relevant objectives	Relevance to the Proposal
Land use zones	The LEP designates the site of the proposed works is zoned as Primary Production (RU1).

Relevant objectives	Relevance to the Proposal
	The objectives of this zone are: • To encourage sustainable primary industry production by maintaining and enhancing the natural resource base • To encourage diversity in primary industry enterprises and systems appropriate for the area • To minimise the fragmentation and alienation of resource lands • To minimise conflict between land uses within this zone and land uses within adjoining zones • To provide for a range of ecologically sustainable agricultural and rural land uses and development on broad acre rural lands • To protect significant agricultural resources (soil, water and vegetation) in recognition of their value to Gunnedah's longer term economic sustainability • To conserve and enhance the quality of valuable environmental assets, including waterways, riparian land, wetlands and other surface and groundwater resources, remnant native vegetation and fauna movement corridors as part of all new development and land use. The Proposal is generally complaint with these objectives as it: • Is complementary to surrounding land uses • Is an ecologically sustainable rural land use which provides socio-economic benefits to the region, generates renewable energy and enables limited agricultural use of the Site to continue • Is highly reversible and will not impact the future productivity of the land. Electricity generation is not listed among developments which are permitted consent for this zone however, under clause 34(7) of the ISEPP the Proposal is permissible with consent.
Minimum Lot Size	See Subdivision of land section above.
Heritage conservation	The objectives of this clause are to: • Conserve the environmental heritage of Gunnedah • Conserve the heritage significance of heritage items and heritage conservation areas, including associated fabric, settings and views • Conserve archaeological sites • Conserve Aboriginal objects and Aboriginal places of heritage significance. The area is not expected to have any items of heritage value and there are no listed items of heritage value in close proximity to the Site. Refer to Section 6.2.
Bush fire hazard reduction	The land of the proposed site is not mapped as bush fire vulnerable. Potential impacts are addressed in section 6.9.

Relevant objectives	Relevance to the Proposal
Flood Planning	The objectives of this clause are to: • Minimise the flood risk to life and property associated with the use of land • Allow development on land that is compatible with the land's flood hazard, taking into account projected changes as a result of climate change • Avoid significant adverse impacts on flood behaviour and the environment. The Site is located within a flood planning area. Potential flood impacts are addressed in Section 6.7.
Essential services	Development consent must not be granted to development unless the consent authority is satisfied that any of the following services that are essential for the development are available: • The supply of water • The supply of electricity • The disposal and management of sewage • Storm water drainage or on-site conservation • Suitable road access. The development will not require a permanent water supply or sewage disposal and management. These services will be transported onto and off the site temporarily during construction. A permanent 50,000L water tank will be located near the substation for fire-fighting purposes. The development will supply electricity and will not impact existing storm water drainage. Road access is addressed in section 6.6.

4.6 Summary of Licenses and Approvals

Table 4-3 provides a summary of the licenses and approvals required for the proposed Gunnedah Solar farm.

Table 4-3 Licences and Approvals

Legal Instrument	License or Approval
EP&A Act 1979 – Part 4	Development consent is required under Part 4 of the EP&A Act.
EP&A Act 1979 – Section 4.38	Section 4.38 of the EP&A Act allows the consent authority to grant development consent to a SSD which may be partly prohibited by an environmental planning instrument. Accordingly, development consent may be granted, inclusive of this subdivision.

Legal Instrument	License or Approval
Roads Act 1993	Section 138 approval for work within a public road, Orange Grove Road and Old Blue Vale Road.

5. Stakeholder Consultation

5.1 Overview

A Community and Stakeholder Engagement Plan (CSEP) was prepared in October 2017 in accordance with The *Community and Stakeholder Engagement Draft Environmental Assessment Guidance Series June 2017* (Draft Guidelines) prepared by DP&E. The CSEP documented the objectives of engagement, identification of relevant stakeholders, as well as the community and potential issues associated with the development. The CSEP also included an implementation plan which was updated as required through the duration of the community and stakeholder engagement. Table 6 from the CSEP outlines the implementation plan, which has been the guiding document used throughout stakeholder engagement (**Appendix L**).

The objectives of the Community and Stakeholder Engagement included:

- Developing a process for listening to the community and stakeholders regarding concerns over the development
- Providing information of the proposed development including the rationale
- Identifying stakeholders and engaging with them
- Providing the community and other stakeholders with the opportunity to inform design, where required
- Seeking feedback and comments on the proposed development
- Identifying engagement requirements through the EIS, Submission, Determination and post approvals stage of the proposed development.

The following is a summary of the engagement undertaken with stakeholders and the community. As a result of the engagement several elements of design were reconsidered and incorporated into the final design (refer to Section 5.10).

5.2 Identified Stakeholders

The following stakeholders were identified:

- Adjacent landholders (referred to as Sensitive Receivers see Figure 5-1)
- Gunnedah community
- Gunnedah Shire Council
- Government Agencies including:
  - DP&E
  - Office of Environment and Heritage (OEH)
  - Department of Primary Industries (Water & Lands)
  - Department of Resources and Geosciences
  - Roads and Maritime Service
  - State Emergency Service
  - Rural Fire Service
- Neighbouring Industry
  - Gunnedah Airport
  - Civil Aviation Safety Authority (CASA)
  - TransGrid

- Mineral Titleholders.

5.3 Government Agency Consultation

pitt&sherry undertook further consultation with relevant government agencies, subsequent to consultation conducted by DP&E. This consultation aimed to seek additional guidance from relevant authorities and clarify items identified in the SEARs.

Table 5-1 Summary of Agency Consultation through the development phase

Stakeholder	Date	Details of Engagement	Key Aspects	Outcomes
DP&E	19/12/2017	Meeting A review of the seven GSF and Photon Energy projects were presented to DP&E, including Gunnedah.	• Flooding • Visual • Community engagement plans • Transport and access to the site • Biophysical Strategic Agricultural Land (BSAL).	Fencing was highlighted as the key issue in regard to flooding and the potential impact on surrounding residents. GSF has commissioned detailed flood modelling, to inform the options for fencing design, where impact will aim to be mitigated. DP&E were interested in the visual impact, however they noted visual impact is subjective and DP&E for assessment purposes wanted to understand what people perceived the impact to be.
	14/02/2018	Meeting Update of progress on each property including Gunnedah	• General project update.	Information regarding key issues i.e. flooding and visual.
Roads and Maritime Services (Roads and Maritime)	October 2017	Phone call Roads and Maritime Manager of Land Use Assessment	• Impact of construction through truck movements on the road network • Access to the property • Intersection performance • Potential reflection of the solar panels causing driver nuisance	The potential transport route was assessed in Traffic Impact Assessment (TIA). It is considered the potential impact on the Kamilaroi Highway will be minimal. Refer to **Appendix I** for the TIA. Access to the property via local roads was discussed with Gunnedah Shire Council (16/01/2018). The proposed solar farm is at minimum 1km from Orange Grove Road.

Stakeholder	Date	Details of Engagement	Key Aspects	Outcomes
			• Potential for a "Works Authorisation Deed" (WAD) for any works that may be necessary on a classified (state) road • Driver code of conduct, and protocol for drivers travelling long distances to and from site (driver fatigue) • Impact on road safety, including to pedestrians, cyclists and any bus routes impacted.	Due to this, reflection causing a nuisance to drivers is not considered to be an issue. A WAD will not be required. A traffic management plan will be developed as part of the CEMP. The driver code of conduct is provided in the TIA (refer **Appendix I**). It specifically addresses driver fatigue management and hours of vehicle movements. Following consultation with Gunnedah Shire Council & the community, GSF are assessing the feasibility of vehicle movement exclusion times during school start/ends times.
State Emergency Services (SES) Namoi North West Headquarters	06/02/2018 and 28/02/2018	Letter Requesting a response to prosed development (see **Appendix L**).	• Review the potential development impacts on community emergency management arrangements for flooding.	No response from SES has been received as of 02/04/2018.
Office of Environment and Heritage (OEH)	Ongoing	Phone calls and emails Flora specialist contacted OEH via phone call to discuss biodiversity assessment and tree removal. Heritage specialist liaised with OEH to inform Aboriginal consultation process and outcomes.	• Biodiversity and potential offsetting • Aboriginal cultural heritage items have the potential to occur on site • Water (potential impact on hydrology and water quality) and soils (potential for	Detailed discussions around biodiversity offsetting were held with OEH. The proposed solar footprint was revised to minimise any tree clearing. As a result, no paddock trees will be removed from the site. The Aboriginal Heritage specialist has addressed concerns raised by OEH during consultation within the Aboriginal Heritage

Stakeholder	Date	Details of Engagement	Key Aspects	Outcomes
			acid-sulphate soils) • Flooding – impact of the proposed development on existing flood behaviour.	Assessment, located in **Appendix E** of the EIS. Section 6.7 and 6.8 of the EIS addresses the proposed developments' potential impacts and mitigation methods for hydrology and soils. GSF has commissioned detailed flood modelling, to inform the impact of the proposed development on existing flood behaviour. Mitigation methods including the undertaking of further flood modelling as described in Table 5-8.
Department of Primary Industries (DPI)	06/02/2018	Letter DPI-Water: Request to comment on the proposed development.	• Rehabilitation of the site post development • Justification for use of Biophysical Strategic Agricultural Land (BSAL) • Consultation with Gunnedah Shire Council also recognised that DPI Water may have concern with impact of proposed substation development on Namoi River behaviour.	A Land-use Conflict Risk Assessment (LUCRA) has been included as part of the EIS in Section 6.3. This assessment addresses justification for use of BSAL and rehabilitation of the site post development. DPI Water responded on 13/02/2018 stating that they will provide comment to DP&E during the exhibition period. See **Appendix L** for response.
Rural Fire Services (RFS)	30/10/2018	Bushfire impact specialist consulted with the Rural Fire Services, as well as Fire and Rescue NSW at Gunnedah to be advised on fire history, resources, mitigation measures and fire suppression.	• Grass/cropping fire impacts • Potential hazards to firefighters • Vehicle access and defendable space	The Bushfire specialist has addressed concerns raised by RFS during consultation within the Bushfire Risk Assessment, **Appendix** F.

Stakeholder	Date	Details of Engagement	Key Aspects	Outcomes
			• Impacts on community emergency management arrangements.	
TransGrid	09/10/2017 17/10/2017 24/10/2017	Meeting pitt&sherry met with TransGrid to discuss substation design Letter Request for Information Letter TransGrid response to RFI Multiple Emails Were exchanged as further information as required	• Location of the substation • Capacity of the current infrastructure to receive proposed volts • Cumulative impacts.	Continual engagement with TransGrid, has allowed for them to provide input throughout the design process. This has mitigated the potential for the final solar farm design to not align with the expectations of TransGrid.
Civil Aviation Safety Authority (CASA)	23/11/2017	Phone call The CASA Tamworth region contacted to discern method for further information	Ensure that the solar PV panels are safe and pose no risk to pilots, air traffic controllers, or airport operations.	pitt&sherry received an unofficial email response on 24/11/2017, saying there are no concerns with the proposed development. Refer to **Appendix L**.
	23/11/2017	Letter Request to comment on the proposal		
Gunnedah Airport	23/11/2017	Phone call Gunnedah Airport was contacted to discern method for further information	Ensure that the solar PV panels are safe and pose no risk to pilots, air traffic controllers, or airport operations.	Gunnedah Airport response to letter on 23/11/2017 outlined that the letter had been received and would be forwarded to the private clients of the airport. There has been no further response.
	23/11/2017	Letter Requesting comment on the proposal		

5.4 Gunnedah Shire Council

GSF and pitt&sherry have held a number of meetings with Gunnedah Shire Council to discuss the development. Meetings have been held at the Gunnedah Shire Council offices with the following council representatives:

25 October 2017

- Wade Hudson – Town Planner
- Carolyn Hunt – Planning Manager.

16 January 2018

- Carolyn Hunt – Planning Manger
- Charlotte Hoddle – Economic Development Manager
- Daniel Noble – Engineering Manager.

12 March 2018

- Carolyn Hunt – Planning Manager.

Table 5-2 includes the key concerns raised by Gunnedah Shire Council from their response to the SEARs and subsequent consultation.

Table 5-2 Key concerns raised by Gunnedah Shire Council during consultation

Key concern	Outcome of Engagement
Identification of all safety concerns for all proposed routes.	A Road Safety Audit was requested to be performed by Council. The Traffic Impact Assessment has identified through its assessment of the proposed routes that there are no safety concerns, and therefore a Road Safety Audit does not need to be conducted, **Appendix L**. A letter of update was sent to Gunnedah Shire Council 05/02/2018 to inform the council of the report's findings. Response was received 05/03/2018, confirming that a Road Safety Audit will not need to be completed with the submission for development approval, **Appendix L**.
Heavy vehicle access route into site. There are weight restrictions on potential routes that will prohibit heavy vehicle access.	The proposed access was discussed with Council on 16/01/2018. The proposed access route is described in the Traffic Impact Assessment **Appendix I**. The Council generally agreed with the proposed route. It was agreed in principle that a minimum 30m seal is required from Orange Grove Road, to the Site access road. A design will be developed upon approval, if it is granted for the development.
Degradation of the condition of the Orange Grove Road due to increased traffic.	A minimum 30m seal is required from Orange Grove Road, to the Site access road to prevent dust. A dilapidation survey will be carried out before construction.
Fencing around site and impact on the flood prone land.	Impact on flood flow path due to chain wire security fence has been highlighted as a major concern for Council. Council are concerned about the impacts an obstruction to flow paths will have on neighbouring properties. This concern has been echoed by community stakeholders who have been engaged. GSF has commissioned detailed flood modelling, to inform the options for fencing design, where obstruction impact will aim to be removed or mitigated.

Key concern	Outcome of Engagement
	Outcome from flood modelling indicated that the greatest impacts on flood levels would arise from the security fencing and the blockage caused by the accumulation of vegetative debris mats on the fencing. The impacts can be mitigated by dividing the fenced areas into paddocks with laneways between the fencing that allow flood flows to pass through the site. The modelled impacts decrease with increasing distance from the site and depend on undulations in the ground surface and the pattern of flow around the site. Outcomes of the flood modelling are described further in Table 5-8.
Local employment, accommodation and transport. Including the cumulative impact of annual events and other proposed developments.	Opportunities for local employment and accommodation have been addressed within the Socio-Economic Impact Assessment, Section 6.12 All attempts will be made to hire local resources for undertaking the construction. If this is not possible, skilled employment will be sourced from further afield, most likely Tamworth. Some of the temporary workers will stay in Tamworth and be transported to site each day. Annual events, such as Agquip that draw larger crowds to Gunnedah have been assessed within the Socio-Economic Impact Assessment.
Sourcing skilled workers. Potential opportunities for sponsorship in workforce training programs.	Gunnedah Shire Council is embarking on a skills program however, it is not in action. Advice from Council was to watch this space. The council has expressed that there is a small number of local electricians.
Potential to impact on Koala habitat.	An assessment of the presence of koala habitat on the site was performed as part of the Fauna Impact Assessment, **Appendix D**. The assessment concluded that the vegetation existing within the site is not classified as koala habitat. These findings have been supported by anecdotal evidence provided during consultation with neighbouring residents.
Noise and dust during construction	Dust mitigation has been addressed within the Air Quality Impact assessment, Section 6.11. Noise impacts and mitigation measures have been assessed in the Noise Impact Assessment, **Appendix H.** Mitigation will include, standard construction hours, a water truck on site to wet down the site if required, and coordinated drilling activities to minimise impact.

Consultation with Gunnedah Shire Council revealed other concerns to be addressed within the assessment of environmental impacts. Although these concerns were not identified as major, they were still addressed as part of the consultation process. Concerns and how they were addressed are outlined in Table 5-3 below.

Table 5-3 Moderate concerns raised by Gunnedah Shire council through consultation

Concern	Outcome
Waste management / waste disposal.	Upon conducting the waste management assessment, it was identified that Gunnedah's capacity for waste disposal and processing may be insufficient to service proposed construction waste. This concern was raised with Gunnedah Shire Council during the meeting held on the 16/01/2018. Council commented that the waste could be accepted at their landfill, on the grounds that it does not contravene the EPA Licence and sufficient notice is given.

Concern	Outcome
Construction traffic impact on the local School bus run.	Council had been contacted by community members voicing their concerns regarding heavy vehicles driving the same route as the local school bus during construction. This concern was addressed in the meeting held on the 16/01/2018. GSF has agreed to minimise truck movements through these periods.
Discussion with DPI Water regarding height of substation.	Concern was raised that DPI Water had not yet been contacted to provide comment on the proposal. It was agreed DPI Water would be contacted to request their input. A letter was sent to DPI Water on 06/02/2018. DPI Water responded saying they would comment during the public exhibition phase of the project.
Bush fires as a result of construction activities such as welding; angle grinding etc.	All bushfire related impacts of construction activities during the development have been covered in the Bushfire Risk Assessment, **Appendix F.**
Alternate use of agricultural land.	A Land-use Conflict Risk Assessment (LUCRA) has been included in Section 6.3. This assessment addresses justification for use of agricultural land and rehabilitation of the site post development. As a part of the LUCRA, a draft land management plan has been prepared to ensure long term viability of the land for future agricultural use, **Appendix G**. The Land Management Plan will form part the Operational Environmental Management Plan (OEMP).

5.5 Aboriginal Consultation

The Local Aboriginal Land Council (LALC) completed a site inspection on 30/01/2018 with Matthew Kelleher from Kelleher Nightingale. A confirmation letter of concurrence is provided in **Appendix E**. The LALC did not identify any issues with the proposed development.

5.6 Mineral Titleholders Consultation

As requested by DP&E in the SEARS, Table 5-4 outlines the engagement outcomes of consultation with potentially impacted exploration licence holders, quarry operators and mineral title holders.

Table 5-4 Engagement outcomes of consultation with potentially impacted mineral title holders

Title Holder	Outcome of Engagement
Australian Coalbed Methane Pty Ltd and Santos QNT Pty Ltd Petroleum Exploration Licence (PEL)001	The Team leader of Santos Gunnedah was contacted via phone on 07/11/2017. The Team Leader requested further information. A letter was sent to the Team Leader on 08/11/2017 with a description of the project and draft solar footprint. A response was received 15/11/2017 to say there are no issues regarding the development of the solar farm. See **Appendix L** for the response.
Secretary NSW Department of Planning and Environment: The Division of Resources and Geoscience (DRG)	The Senior Planning Officer at DP&E, Rose-Anne Hawkeswood was contacted by phone 09/11/2017. A follow up email was sent 14/11/2017 to see if appropriate contact details for the manager of the Coal Exploration Licence was found. Rose-Anne responded to request 16/11/2017 with contact details for representative of the DRG, Tully Matthews.

Title Holder	Outcome of Engagement
Coal Exploration Licence (EL) 7241	A letter was sent to Tully Matthews on 28/11/2017 with a description of the project and draft solar footprint. After no response was received, a follow-up email was sent 08/12/2017. Response received by Tully Matthews on 15/12/2018 detailed that there were no current plans to conduct exploration within the Site locality, refer to **Appendix L.**

5.7 Community Engagement

The Community Stakeholder Engagement Plan (CSEP) documents the methodology for community engagement refer **Appendix L**. During the progression of the project, the engagement methodology was adapted to maximise outcomes.

Table 5-5 provides a summary of the engagement conducted to date across multiple communication platforms, highlighting concerns. In addition to stakeholders identified within the CSEP, other receivers were identified by undertaking the following actions:

- Development of an attendance register at the Community meeting held on the 16/08/2017
  - An attendance register allowed for the collection of contact details for interested community members, for future direct updates
  - 29 attendees at the community meeting provided their contact details
  - From this list, contact details for nine out of the twelve sensitive receivers identified as Low-moderately visually impacted or above were obtained. This allowed for one on one meetings with these receivers to be organised
  - The list of community members who attended the meeting, were overlaid with the sensitive receivers from the visual assessment. This then gave a more accurate reflection of the residents potentially impacted by the proposed development and those interested in the proposed development
  - During the development of the flood modelling potentially impacted receivers were also identified. These receivers were also contacted by phone (if details were known) or letter to the property address.
- Regular updates provided by the Gunnedah Solar website (http://www.photonenergy.com.au/current-projects/gunnedah/), and the option for contact through the website as well as a dedicated hotline (1300 881 045), also allowed for interested community members to voice their queries and/or concerns
- pitt&sherry contact details were provided during one on one meetings with impacted receivers (listed in Table 5-6). These contact details have since been shared with community members through word of mouth, offering the community another mechanism to provide input
- Development of a project update. Copies of this was given to Council and residents, as well as emailed to the community members who registered at the community meeting. The update was also placed on the website (**Appendix L**).

Table 5-6 provides a detailed summary of the concerns raised for each of the sensitive receivers visited during one on one consultation (15/01/2018-16/01/2018).

Table 5-7 provides a detailed summary of the second round of one on one consultation conducted 12/03/2018 – 14/03/2018. During this round of consultation photomontages, a draft landscape plan and project update factsheet were provided for discussion with the sensitive receivers.

Over the course of the consultation period to date, 29 community members were present during the community consultation, 34 residents within the locality of the site were contacted either through letters, emails or phone calls, and 26 community members (15 neighbouring residents) have participated in a group or one on one meeting. A summary is provided in Table 5-5.

Table 5-5 Summary of community engagement performed to date

Stakeholder	Communication method	Date	Community Responses
General Community	Newspaper Advertisement	8/08/2017	One advertisement has been posted by GSF in the Namoi Valley Independent. The post invited members of the community to participate in the community meeting held 16/08/2018.
General Community	Community Meeting Smithurst Theatre, Gunnedah	16/08/2017	29 local residents attended the initial meeting. A presentation was given by GSF on the proposed development. Feedback from the residents included questions around the flooding issues and the type of fencing, construction noise and dust and visual impacts. Meeting minutes are provided in **Appendix L**.
Adjacent Landholders	Email	21/11/2017 – 23/11/2017 Request for meetings 7/01/2018 – 10/01/2018 Confirmation of meetings 23/01/2018 – 25/01/2018 Request for permission to access 12/02/18 Update on EIS progress 27/02/2018 Request for meetings (2) 28/02/2018 Notification 03/03/2018 – 08/03/2018 Confirmation of meetings	Emails were used as the initial form of communication with residents who were identified as sensitive receivers' due to their vicinity and potential visual impact of the proposed development. As email exchange was a method of organisation, limited concerns were raised through this platform. Emails were also sent to sensitive receivers to update them of current flood modelling, photomontage and landscape work being undertaken. An email as sent out to neighbouring receivers 28/02/2018 to notify them of the geotechnical surveys to be performed the week of the 12/03/2018. A key concern was raised through email from sensitive receiver 1 (25/01/18), who denied permission to access their property for the visual specialist to take another round of photos to aid in the preparation of photomontages. This was due to the uncertainty of the solar footprint, as design was being updated, as a result of community consultation.

Stakeholder	Communication method	Date	Community Responses
Adjacent Landholders	One on One	16/08/2017	GSF met with sensitive receiver 16 following the community meeting. The key concern raised was visual impact. Methods of visual mitigation (vegetation screening) were discussed.
		18/08/2017	GSF met with sensitive receivers 9, 13 and 17. Key concerns raised were visual impacts and property value. Receivers were notified that another meeting in the 2018 would be arranged to discuss in further detail.
		15/01/ 2018	GSF and pitt&sherry met with sensitive receivers' 7 and 1. Table 5-6 provides a detailed summary of the concerns raised by these receivers.
		16/01/ 2018	GSF and pitt&sherry met with sensitive receivers' 2, 4, 9, 13, 16, 17 and 21. Table 5-6 provides a detailed summary of the concerns raised by these receivers.
		12/03/2018	GSF and pitt&sherry met with sensitive receivers' 4, 9, 13, 17 and 27. Table 5-7 provides a detailed summary of the concerns raised by these receivers.
		13/03/2018	GSF and pitt&sherry met with sensitive receivers' 1, 2, 6, 16 and 29. Table 5-7 provides a detailed summary of the concerns raised by these receivers.
		14/03/2018	GSF and pitt&sherry met with sensitive receivers' 3, 30 and 33. Table 5-7 provides a detailed summary of the concerns raised by these receivers.
Adjacent Landholders	Letter	20/12/2017	A letter was sent to all registered attendees (29) of the community meeting detailing a project update. This letter included a summary of work achieved to date, as well as an anticipated timeline for the next steps in accordance to the approval pathway. Letter provided in **Appendix L.**

Stakeholder	Communication method	Date	Community Responses
		9/01/2018	Three letters were sent to the remaining sensitive receivers identified, who had not attended the community meeting. These letters were to notify and request a meeting with the residents for one on one engagement held between 15/01/2018 – 16/01/2018. Sensitive receiver 21 responded and confirmed a meeting. Their concerns are provided in Table 5-6.
		22/03/2018	Letter sent to receiver 10 following no response from number sourced from white pages.
		28/02/2018	Five letters were sent to sensitive receivers who pitt&sherry or GSF did not have contact details for. These letters were to notify and request a meeting with the residents for one on one engagement held between 12/03/2018 – 14/03/2018. Sensitive receiver 27 responded and confirmed a meeting. Their concerns are provided in Table 5-7. Letter provided in **Appendix L**.
Adjacent Landholders	Phone Call	11-12/12/2017	Sensitive receiver 16 contacted GSF to raise concern for flooding impacts. pitt&sherry called receiver 16 back, to inform that one on one meetings will be held early in 2018.
		8/01/2018	pitt&sherry contacted sensitive receivers' 17, 13, 9 and 1, to confirm one on one meeting times. Sensitive receiver 17 asked for a group meeting with 13 and 9. This group meeting was organised.
		10/01/2018	Sensitive receiver 2 called to organise meeting time. An email was sent to receiver 2 following this call to suggest different times.
		15/01/2018	Sensitive receivers' 21 and 9 called to organise meeting time (in response to letter) and confirm meeting time, respectively.
		16/01/2018	pitt&sherry contacted receiver 2 to re-arrange meeting time.
		23/01/2018	pitt&sherry contacted receivers' 17, 16, 13 and 9 to request permission for visual specialist to access property. No concerns were raised, all receivers granted permission.
		24/01/2018	Sensitive receiver 1 rang to voice concern about potential solar footprint design change. It was explained to receiver 1, that as a result of stakeholder consultation, elements of the proposed footprint were

Stakeholder	Communication method	Date	Community Responses
			being reviewed to address concerns raised. pitt&sherry committed to updating receiver 1, upon the confirmation of the reviewed solar footprint.
		30/01/2018	pitt&sherry received a call from a concerned community member. This community member lived in the local area, and was concerned about the impact the development would have on flood pathways. pitt&sherry committed to updating this community member following the finalisation of the flood modelling.
		02/02/2018	Sensitive receiver 9 contacted pitt&sherry for a copy of the current solar footprint design. pitt&sherry committed to updating receiver 9, upon the confirmation of the reviewed solar footprint.
		28/02/2018	pitt&sherry contacted receivers 4, 6, 21 and 29 to see if they would like to have a meeting during the second round of one on one consultation occurring 12/03/2018 – 14/03/2018. Receivers 4 and 29 did not answer.
		6/03/2018	pitt&sherry contacted receivers' 1, 2, 9, 16, 17, 28 and 29 to follow up on email meeting requests, and organise one on one consultation occurring 12/03/2018 – 14/03/2018.
		12/03/18	Sensitive receiver 27 called pitt&sherry to confirm meeting to be held that afternoon.
		13/03/2018	pitt&sherry contacted receivers 3 and 33 after receiving their contact details through one on one consultation with neighbouring residents. Meetings were organised for 14/03/2018.
		19/03/2018	Receiver 34 contacted pitt&sherry through the enquiries hotline (1300 881 045). Receiver 34 had not received information of the proposed development at this point and requested information. Details of consultation with receiver 34 are provided in Table 5-7.
		20/03/2018	pitt&sherry contacted receiver 14 after receiving their contact details through one on one consultation with neighbouring residents. Contact details were obtained to send through Project Update and site location information.
		23/03/2018	pitt&sherry spoke to a Gunnedah resident who has previously farmed the land on adjacent properties to the proposed site. The resident provided insight into the flood behaviour of the site, and clarified that the

Stakeholder	Communication method	Date	Community Responses
			site layout has changed due to new irrigation channels, and this will impact the flood behaviour.
		23/03/2018	pitt&sherry spoke to receiver 34 to further explain the detail of flood modelling conducted to date. Further detail of consultation with receiver 34 is provided in Table 5-7.

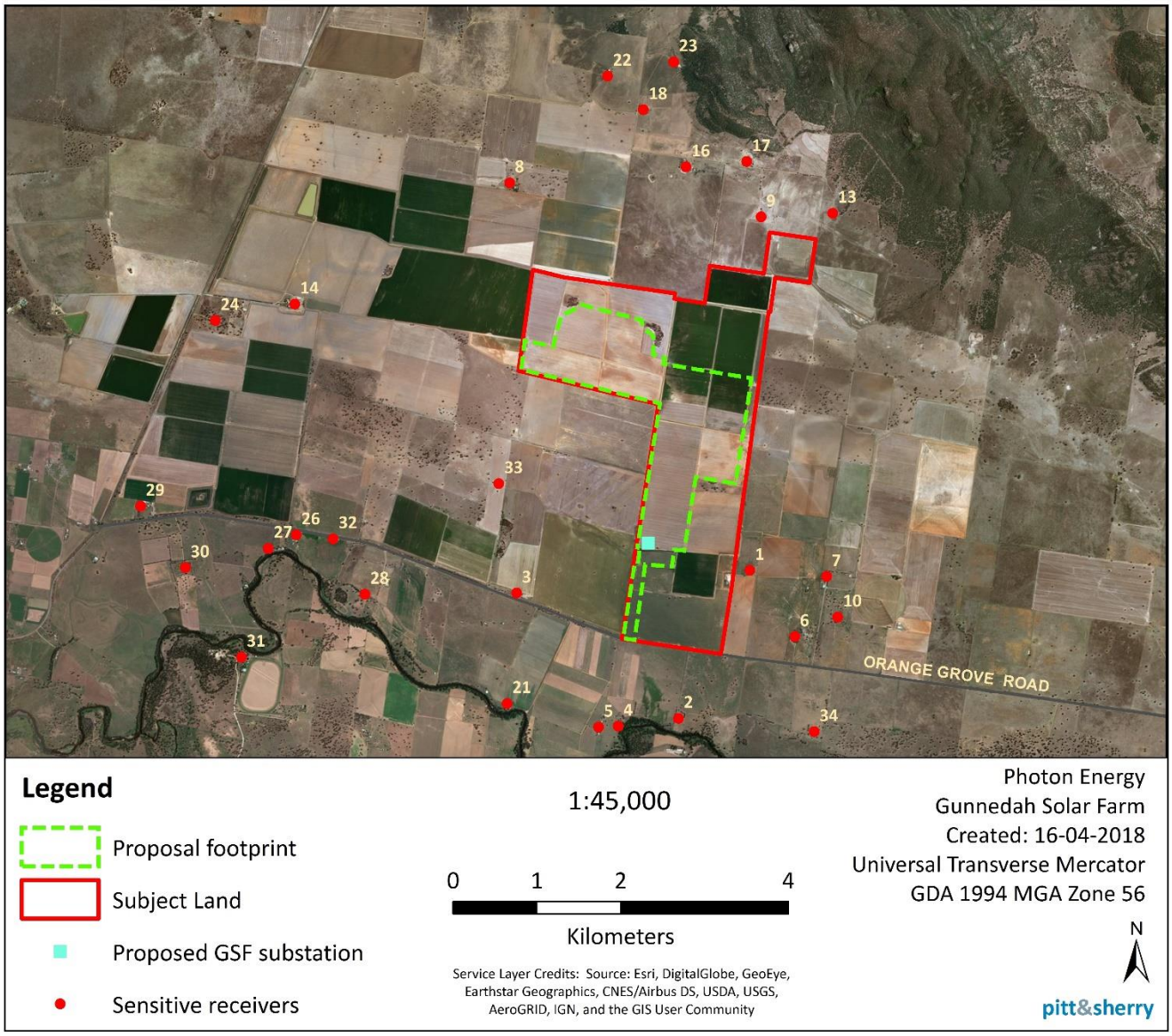

Figure 5-1 Location of sensitive receivers identified through Visual Impact Assessment

Table 5-6 Detailed summary of one on one consultation with sensitive receivers conducted 15th – 16th January

Sensitive Receiver	Concerns Raised
7.	**Flooding:** This property is approximately 1.1 kilometres from the boundary of the proposed solar site. The residents were very concerned how the flood waters would impact on their property. **Fauna species:** The residents had a fauna report prepared in 2011. This report found 2 vulnerable species, the Gould Wattled Bat (*Chalinolobus gouldi*) and the common Planigale (*Planigale maculata*). Residents concerned these species will lose their habitat. **Bushfire prevention:** Residents were concerned around the management of the asset protection buffer zones. **Decommissioning:** Residents were concerned with what happens after the 25-year period, and how the site gets rehabilitated. Residents also wanted to be informed of the negative aspects of solar, and questioned whether radiation from the panels should be a concern.
1.	**Flooding:** Resident is located next to the proposed solar farm property. Resident is concerned about flooding and water backing up causing issues to their property, house and stock. **Visual:** Resident expressed moderate concern around visual impacts, although the house looks to the east (opposite direction to the proposed site). Vegetation screening as a form of visual mitigation and dust control was discussed.
4.	**Flooding:** Property is located approximately 1km from the property boundary. They are very concerned around flooding issues and the potential impact from proposed chain wire fence. **Construction Noise**: Residents were concerned about level of noise impact during construction, in particular pile driving. **Traffic** during construction: Residents expressed concern regarding the frequency of heavy vehicles on Orange Grove Road, and how that will impact dust, road quality and the school bus run. The land management plan was also discussed.
16.	**Visual:** Residents are very concerned about the visual impact of the development on their outlook, as well as potential to devalue the property. Particular concern was the visual impact of seeing the substation. Vegetation screening as a mitigation method was discussed and considered desirable. **Bushfire:** Residents raised moderate concern around the fire risk of the panels and subsequent insurance.

Sensitive Receiver	Concerns Raised
	Construction Noise: Residents were concerned about level of noise impact during construction, in particular pile driving.
2.	**Flooding:** Property is located approximately 800m south of the property boundary. They are very concerned around flooding issues and the potential impact from proposed chain wire fence. They have a 1m levee around their house. Very concerned that the levee would not be enough should the development go ahead. **Traffic** during construction: Residents expressed concern regarding the frequency of heavy vehicles on Orange Grove Road, and how that will impact dust, road quality and the school bus run. **Construction Noise & Dust**: Residents were concerned about level of dust and noise impact during construction, in particular noise associated with pile driving.
17. 13. 9.	A group meeting including three of the impacted receivers was held, at the request of the residents. **Visual:** Residents are very concerned about the visual impact of the development on their outlook, as well as potential to devaluate the property. Vegetation mitigation was discussed however, due to the topography of the proposed development site and elevation of the houses it is unlikely vegetation screening would mitigate any potential impact. Residents were unhappy that GSF were considering moving the footprint north to minimise flood impact as this was going to have a greater visual impact on their properties. Resident commented that they did not believe the initial community meeting went well as documented in the paper. **Flooding:** Residents expressed concern about how the property boundary would impact flood pathways. Residents wanted GSF to find another site.

Table 5-7 Summary of one on one consultation with sensitive receivers conducted 12th – 14th March

Sensitive Receiver	Concerns Raised
4.	**Flooding:** More concerned about the impact flooding may have on their paddocks and fences, rather than the impact to their property. Have suggested to incorporate in flood modelling the impacts of the Mooki River flooding. **Noise:** Residents reiterated their concern about level of noise impact during construction, in particular pile driving. Noise impact assessment has shown that there will be no significant impact to noise levels during construction.

Sensitive Receiver	Concerns Raised
	Residents were supportive of the shift of the solar footprint further north, to reduce potential flood impacts.
27.	**Flooding:** Key concern was the potential impact to the flood levels of the Namoi river itself, as they are located next to the river. **Site Rehabilitation**: Residents were concerned about commitment to rehabilitation upon the decommissioning of the site. Rehabilitation requirements as set out by the EIS were explained including removal of all infrastructure. **Emergency Plans**: Residents asked about the development of emergency management plan in response to flooding, bushfire and electrical related incidents. Overall recognise the need for renewable energy developments.
9. 13. 17.	**Flooding:** Residents raised concern that flood impacts have been prioritised over the consideration of visual impacts. **Visual Impact**: All residents remain very concerned with the visual impact, despite the draft landscape plan for mitigation. Residents did not believe the photomontages presented accurately reflected the situation or impact of the proposed development. Residents strongly believe that the value of their property will decreased due to the change in outlook. Residents would like to explore compensation. Residents do not believe the landscape screening will lessen the impact of the proposed solar farm on their views. **Land Use Conflict:** Residents concerned about the impact on prime agricultural land, and felt that this land should be kept for farming. Overall these residents are not supportive of the proposal, and do not believe mitigation proposed in the draft landscape plan is adequate to address visual impact and minimise the impact to their property value.
29.	**Flooding:** Residents main concern regarded fences being pushed over during a flood, and the impact this may have on their property. They also were concerned about access to site during the flooding. Residents were supportive of the shift of the solar footprint further north, to reduce potential flood impacts.
6.	This resident is not concerned about flood impacts on their land, and did not voice any other concerns regarding the proposal.
16.	**Flooding:** Residents expressed concern that a change in flood flows may impact the regeneration of their alluvial land.

Sensitive Receiver	Concerns Raised
	Visual Impact: Residents are very concerned about the visual impact of the property, as they believe the view is a major asset of their property. They are concerned that the change in view will impact the value of their property. Residents would like to explore compensation. **Security Lighting:** Residents are concerned security lighting at night will be very obtrusive to the view from the property.
2.	**Flooding:** Residents very concerned about flooding of their property (specifically the house). Residents were supportive of the shift of the solar footprint further north, to reduce potential flood impacts.
1.	**Flooding:** Residents very concerned about flooding, and does not believe the current flood model incorporated changes in topography around the site, that may influence the flood modelling. They expressed concern with regards to the clean-up of debris and possible fencing following a flood and who would be responsible. **Air Quality:** Residents were concerned about dust control with use of the haul road around the property. **Visual:** there was discussion around the proposed visual screening. The residents said although that would be good, they were concerned about the impact the trees may have on the flooding. No visual mitigation is required.
3.	**Flooding:** Resident expressed minimal concern regarding the flood having impact on their property.
33.	Resident did not express great concern for flooding or visual impact, although wanted assurance that there was no increase in flood velocities on his land where scouring occurrence may worsen.
30.	Residents were joined by their friend, who is also Gunnedah community member. **Flooding:** Residents very concerned about the impact to flood flows and velocities. Residents noted that a flood has not occurred since new irrigation channels were constructed on the proposed site property. Concerns were raised that these channels will impact the flood flows, and should be included in flood modelling. **Socioeconomic benefits for Gunnedah:** Gunnedah community member expressed concern that a small amount of temporary and permanent jobs was not enough to ensure that the development would become accepted within the community.
34. (via Phone call)	Receiver 34 contacted pitt&sherry through the enquiries hotline (1300 881 045). Receiver 34 expressed their disappointment that they had not received information of the proposed development and requested information be sent to them. pitt&sherry provided the project update letter (20/12/2017), Project Update (factsheet), map of site location and constraints map. pitt&sherry advised that the EIS and specialists reports would be publicly available during the exhibition period. Receiver 34 was upset that they could not receive requested specialist reports earlier, and expressed concern that the exhibition period timeframe was not adequate, and should be longer. pitt&sherry offered a scheduled conversation with a pitt&sherry

Sensitive Receiver	Concerns Raised
	environmental specialist to discuss the results of the flood modelling. Receiver 34 spoke to an environmental specialist on 23/03/2018 where it was explained that the flood modelling conducted to date did not show an increased impact to their property as a result of the development. Over four received calls from Receiver 34, the following concerns were raised: **Flooding:** Expressed concern that the proposed development would impact the flow of flooding towards their property **Visual**: Expressed concern about the visual impact of the development from Orange Grove Road, as well as potential to devaluate the property. They believed that the impact of property value should be assessed within the EIS. **Bushfire:** Concern was raised regarding bushfire management and risk mitigation. Receiver 34 expressed concern that solar farm could cause major bushfires.
8, 18, 22, 23	GSF and pitt&sherry were unable to contact these residents.

5.8 Media

Four articles featuring the Gunnedah Solar Farm were published by the Namoi Valley Independent and the Northern Daily Leader during preparation of the EIS.

Community members also expressed their opinions on the proposed development through social media platforms, such as Facebook and the Gunnedah Solar Farm website (www.photonenergy.com.au/current-projects/gunnedah/).

5.9 Summary of Actions

Table 5-8 below outlines the actions taken to date as a response to the concerns raised by Gunnedah community members during consultation. As consultation is an ongoing process, actions will continue to be performed during the remainder of the approvals process.

Table 5-8 Summary of actions taken to date to address key concerns raised

Concern	Actions	Response to key issues
Flooding – and the impact of fencing on neighbouring properties	GSF commissioned detailed flood modelling to assess scenarios, including the following options for security fencing: • Drop down / sacrificial fencing; • Farm fencing; • Chain wire fencing.	• See Flood Impact Assessment in **Appendix J**. • Prior to construction, further flood modelling is required to be undertaken including:

Concern	Actions	Response to key issues
	Chain wire fencing was only type that achieved the safety and security requirements. Three options were then modelled (using catchment data) to assess and mitigate the use of the chain wire fence. This included: • Chain wire fence being 100% blocked during a 1:100-year flood • Assuming 100% blocked to 500mm and 50% blockage there after around the perimeter of the farm. Includes using 6m gates every 100m with the intention these would be opened. Two 20m channels running east west across the farm to allow for unimpeded water flow • Assuming 100% blocked to 500mm and 50% blockage there after around the perimeter of the farm. Two 20m channels running east west across the farm to allow for unimpeded water flow. After the second round of one on one's the model was revised and additional measures were used. This includes: • A Soil and Water Management Plan (SWMP) will be prepared and implemented by the Contractor as part of the CEMP • Minimising footprint of disturbance by progressive construction and remediation works • Design arrays to allow sufficient space between panels to establish and maintain ground cover beneath the panels and facilitate weed control.	• A revised hydrological model which identifies representative combinations of flooding, which are related to the annual exceedance probability of flood heights • New LiDAR data (north of Oxley Highway) to replace the current SRTM terrain data • Additional mitigation measures such as further refinements to the fence configuration to reduce changes to flood levels and flow associated with the Proposal.
Visual Impact – particularly to the north of the proposed development	Following the January one on one consultation, GSF commissioned 9 more photomontages to be completed. Photomontage locations were chosen in consultation with the sensitive receivers, to ensure accurate representation of impact. During the March one on one consultation photomontages and proposed vegetation screening landscape plans were shown to receivers. The Solar footprint was revised to ensure existing tree stands remained on site, allowing for increased visual mitigation.	See Visual Impact Assessment in **Appendix C**. Visual mitigation is being proposed by landscape screening. This is documented in the landscape plan, as a part of the Visual Impact Assessment.

Concern	Actions	Response to key issues
	Draft landscape plan was updated to include more screening towards the north-east boundary of the solar footprint as a result of recommendations made during consultation.	Consultation will be sought from neighbouring residents during the design of the detailed landscape, if the proposal is approved.
Construction Noise	Consultation with sensitive receivers prompted a review of the Noise Impact Assessment, to ensure concerns raised have been addressed. It should be noted that pile driving for geotechnical reasons was undertaken in early March 2018. The residents were sent an email to inform them of the works. There was no feedback about noise from pile driving when completing the one on ones. Several factors could have influenced this including the short term nature of the works, prevailing wind conditions and neighbours movements during that period.	The Noise Impact Assessment has addressed concerns through implementation of construction restrictions such as strict operating hours. See **Appendix H**.
Air Quality: Construction Dust	Consultation with sensitive receivers prompted a review of the Air Quality assessment, to ensure concerns raised have been addressed.	The Traffic Impact Assessment has addressed concerns through sealing between Orange Grove Road and the Site access road. A water truck will also be on site to wet down construction area, if required. This will be included as a mitigation measure in the CEMP. See **Appendix I.**
Traffic during construction: Trucks along the local roads during school bus pick up and drop off times.	Consultation with sensitive receivers prompted a review of the Traffic Impact Assessment, to ensure concerns raised have been addressed. GSF is considering putting in restrictions to vehicle operation hours between school pick up and drop off times.	The Traffic Impact Assessment has addressed concerns through ensuring vehicles are prohibited from travelling outside of standard construction hours. See **Appendix I.**

Concern	Actions	Response to key issues
		Special condition to be determined: Restrict access for delivery trucks during 0800-0900 and 1500-1600. Additionally, a detailed traffic management plan will be prepared for the proposal for endorsement prior to the commencement of works and will ensure this concern is appropriately managed through restrictions, temporary speed limits or other active management measures.
Bushfire risk: Equipment in use during construction, and/or operational electrical infrastructure causing a fire.	Consultation with sensitive receivers prompted a review of the Bushfire Risk Assessment, to ensure concerns raised have been addressed. Bushfire impact specialist have consulted with the Rural Fire Services, as well as Fire and Rescue NSW at Gunnedah to be advised on fire history, resources, mitigation measures and fire suppression.	The Bushfire Risk Assessment has addressed concerns through implementation of an asset protection zone of 15m. A buffer around the solar footprint boundary will also be required, as well as equipment on site for fire protection. See **Appendix F.**
Decommissioning & Site Rehabilitation	Consultation with receivers prompted review of the Preparation of a Land Management Plan. The remediation chapter was updated to ensure roles, responsibilities and commitments to remediation of the site were clear.	A draft Land Management Plan, has addressed concerns through clearly stating the responsibilities of GSF to remediate the land, **Appendix G.** A detailed Remediation plan will be completed as a part of the Construction Environmental Management Plan (CEMP), if the proposal receives approval.

Concern	Actions	Response to key issues
Emergency Contingency Plans	Emergency Contingency Plans for events such as bushfire and flooding will be completed as part of the Construction Environmental Management Plan (CEMP).	Prepare as part of the CEMP in consultation with the RFS.
Light interference outside of daylight hours	Use of lighting for security purposes is addressed in Section 3.3 of the EIS. Lighting will be amber coloured and movement activated.	Lighting will be limited to compulsory lighting required for the substation. Substation lighting will be turned on if an intrusion is detected or if staff are on site undertaking works outside of daylight hours.
Land Use Conflict	Consultation with receivers prompted a review of the Land-Use Conflict Risk Assessment (LUCRA), to ensure concerns raised have been addressed.	The LUCRA has been included in Section 6.3. This assessment addresses justification for use of agricultural land and rehabilitation of the site post development. As a part of the LUCRA, a draft land management plan has been prepared to ensure long term viability of the land for future agricultural use, **Appendix G**.

5.10 Changes in Design

Through the development of the project several changes were made to optimise preliminary design and minimise impacts on the local community.

These changes included:

- Flood modelling to include different fencing scenarios
- Using tracking panels to minimise glare and flood risk of infrastructure
- Increasing the number of photomontages, to demonstrate view with tracking panels to allow visualisation of the potential outcomes
- Moved the footprint north, including moving the sub-station by 200m to remove the proposed solar footprint from the high flow areas of modelled flood waters
- Minimised the amount of fencing required to reduce the potential impact on the flood zone
- Split the proposed development into several fenced blocks. This assisted with providing unobtrusive channels for water to flow through the property
- Implementing buffer zones around the stand of trees between the proposed solar footprint and Tudgey Road

- Providing visual mitigation as detailed in the draft landscape plan, **Appendix C**
- Restricting truck movements during construction, to minimise traffic during school pick up and drop off times on Blue Vale Road, Kelvin Road and Orange Grove Road
- Development of a draft land management plan and framework for a rehabilitation strategy which will be finalised if the Proposal receives approval.

5.11 Ongoing Community Consultation

GSF are committed to continual engagement with members of the community and interested stakeholders. This will be achieved through maintaining the current platforms for contact such as the enquiries hotline (1300 881 045) and Gunnedah Solar website. An updated factsheet will be distributed to all community members who registered at the community meeting, as well as placed in public forums, such as the local library, public noticeboards and community hall. This factsheet will address concerns raised through consultation and how these concerns have been addressed.

6. Environmental Impact Assessment

This chapter introduces and describes the key environmental risks and provides a comprehensive assessment of these risks related to the Proposal.

Each potential environmental impact was systematically reviewed with reference to: the current scope of the Proposal; the SEARs issued by DP&E; the findings and recommendations (for management and mitigation measures) from the specialist reports; other documentation; as well as consultation with relevant government agencies and neighbouring landowners.

The environmental risk analysis informs the scope of the EIS by ensuring all potential environmental impacts are identified and that the EIS is focused on the key risk areas. A detailed assessment of the key risks has been completed in Section 6 below. It responds to the following SEARs requirements: the EIS must include '*an assessment of the likely impacts of all stages of the development (which is commensurate with the level of impact), taking into consideration any relevant legislation, environmental planning instruments, guidelines, policies, plans and industry codes of practice*'.

The environmental risks analysis identified several key environmental issues, aligning with those identified within the SEARs. These issues were:

- Flooding
- Visual amenity
- Bushfire
- Traffic
- Erosion and sediment control
- Reduction in Biophysical Strategic Agricultural Land (BSAL).
- Biodiversity
- Heritage

6.1 Biodiversity (Flora and Fauna)

A flora survey and assessment was undertaken by pitt&sherry to investigate the potential impacts on flora of the Proposal (refer **Appendix D**). A separate fauna survey and assessment was undertaken by Biosphere Environmental Consultants (Biosphere) to investigate the potential impacts of the Proposal on fauna (refer **Appendix D**).

The reports were prepared in accordance with the following policies and guidelines:

- Framework for Biodiversity Assessment (*FBA) (OEH, 2014*)
- Biobanking assessment methodology (*BBAM) (OEH, 2014*)
- Guidelines for Threatened Species Assessment (*DECC, 2007*).

6.1.1 Assessment Methodology

Flora

An initial Desktop Assessment of relevant spatial ecological datasets was conducted to identify vegetation communities mapped for the Subject Land as well as locations of threatened flora species that have been previously recorded in the Gunnedah locality. This included a search of:

- Namoi regional vegetation mapping
- OEH Atlas of NSW Wildlife database
- Commonwealth Department of the Environment (DotE) EPBC Protected Matters database.

A flora survey of the Subject Land was undertaken on 26 October 2017 by pitt&sherry via random meander transects. This was supplemented with a Biodiversity Assessment Method (*BAM, 2017*) plot within a small remnant stand (V5) (Figure 3-2) and a single rapid data point (RDP) within the remnant stand (V2) on 18-19 January 2018.

Given that the proposal does not involve the removal of remnant native vegetation stands on the Site and given the absence of any predicted indirect impacts to retained native vegetation (via the establishment of nominated buffers), an FBA/BBAM (2014) assessment was not undertaken nor a Biodiversity Assessment Report (BAR) prepared. Instead a flora survey and assessment report has been prepared (see **Appendix D**).

Fauna

An initial Desktop Assessment was undertaken to determine what fauna are likely to occur in the vicinity. This included a search of:

- OEH Threatened Species Profiles database (Gunnedah region)
- OEH Atlas of NSW Wildlife database
- Commonwealth Department of the Environment (DotE) EPBC Protected Matters database (see below)
- Birdlife Australia database.

A fauna survey of the Subject Land was undertaken on 26 and 27 October 2017 by Biosphere. Areas of potential habitat value were identified and then traversed by foot. As most of the site consisted of cleared paddocks, there were relatively few areas remaining that could provide potential habitat for native fauna. During the course of the site investigation, any fauna observed or heard calling were noted, as was indirect evidence that may suggest the presence of a native species (e.g. scratch marks on trees, faecal droppings, chew marks, tracks and burrows).

Threatened fauna listed under the *NSW Fisheries Management Act 1994* are not assessed further as the survey determined that no habitat exists for threatened fish species on the site.

Review of previous studies

No fauna or flora studies have been conducted previously on the Site. Surveys on adjoining and neighbouring lands include:

- A fauna survey was completed on an adjoining property in 2011 (North West Ecological) and one threatened species was located, namely *Planigale maculata*, the Common Planigale
- Occasional opportunistic surveys have been undertaken with sightings of threatened flora and fauna species (as evident on NSW Bionet Wildlife database).

6.1.2 Existing Environment

The Site lies within the eastern portion of the Brigalow Belt South Bioregion (near its transition to the Nandewar Bioregion to the east), within the Liverpool Plains IBRA sub-region. The Site is situated on the outer floodplain of the Namoi River, with the topography being relatively flat, gradually grading upslope from south to the north where the adjoining properties run into the lower foot slopes and ridge country. Surface hydrology, landform and soils have been heavily modified by the paddock development and irrigation works. Locally, the site is situated between the riparian woodlands of the Namoi River and the eucalypt forests and woodlands associated with the rocky ridge country to the north known as the Kelvin Hills.

The Subject Land is largely cleared of native vegetation (refer Figure 6-1) with three small, isolated open woodland remnants stands representing the majority of vegetation on the site. The largest two clusters are in lot 1 DP 186590 and are roughly 1.51 hectares (V1) and 2.96 hectares (V2) in area respectively and the third cluster is a sparse group of trees located in lot 153 DP 754954 (V3) (refer Figure 3-2).

Figure 6-1 Existing environment showing that the land has been largely cleared

Other vegetation on-site includes: a row of native trees along the southern boundary of the Subject Land and Orange Grove Road (V4); a row of native trees along the western boundary of Lot 151 DP 754954 and Lot 2 DP801762 (V5); and other isolated trees scattered throughout the Subject Land (refer Figure 3-2).

The open woodland stands (V1, V2) support a sparse to dense predominantly exotic shrub stratum and a sparse to moderately dense predominantly exotic groundcover. Remnant stands (V1 and V2) show evidence of stress and dieback where trees begin to die from the tip of its branches due to disease or an unfavourable environment (refer Figure 6-2).

Figure 6-2 Vegetation locations V2 showing signs of stress

Flora species

Native vegetation occurs as scattered paddock trees (within land still used for cropping) and native boundary plantings. Additional native trees occur within the road reserve adjacent to the Site.

Database Searches

A search of the OEH Atlas of NSW Wildlife database found seven threatened flora species (comprising a total of 146 records/sightings for the seven threatened flora species) listed under the BC Act, previously recorded within the Gunnedah LGA. These are listed in **Appendix D**.

Two of the seven threatened flora species, both of which are native grasses, are considered as possible occurrences in native woodland remnants on the site (having at least a moderate likelihood of occurrence), these being *Dichanthium setosum* and *Homopholis belsonii*. However, no threatened flora species were recorded on the Subject Land.

A search of the EPBC Protected Matters database found that there were three wetlands of international importance, six listed threatened ecological communities and 10 listed threatened flora species recorded or potentially occurring within a 20km radius from the Subject Land. These are listed in **Appendix D**.

Flora Survey Results

The flora survey within the stands of native vegetation (V1 to V3) identified 19 native species (refer to **Appendix D**) and six exotic species including *Lycium ferocissimum* (African Boxthorn) which is a weed of national significance (WoNS).

Plant Community Types (PCT)

Native vegetation remnant stands on the subject site are considered to most closely resemble the following 'best fit' PCTs listed in the current BioNet Vegetation Classification database:

- PCTID 78 River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion
- PCTID 101 Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion **and/or** PCTID Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
- Remaining areas of vegetation on the Site (grasses and shrubs) comprise of exotic pasture cropland.

The small native vegetation stands recorded on the Subject Land likely represent a mosaic of these 'best fit' PCTs.

The Poplar Box PCT (PCTID 101) is considered to be analogous to the following EEC's listed under the BC Act.

- Fuzzy Box Woodland on alluvial Soils of the South-Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions
- Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions
- Native Vegetation on Cracking Clay Soils of Liverpool Plains EEC listings under the BC Act.

Fauna habitat

Two broad fauna habitat types were recorded within Subject Land:

- White Box, Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland
- Cleared Land with Isolated Trees.

Fauna Species

Database Searches

A search of the OEH Atlas of NSW Wildlife database found 15 threatened fauna species listed under the TSC Act and BC Act, previously recorded within the Gunnedah LGA. These are listed in **Appendix D**.

A search of the EPBC Act Protected Matters database found that there were 18 listed threatened fauna species (six bird, two fish, three reptiles and seven mammal species) and 10 listed migratory species recorded or potentially occurring within a 20km radius from the Subject Land. These are listed in **Appendix D**.

Fauna Survey Results

A total of 31 species of vertebrate fauna were recorded during the site survey and are listed in the fauna assessment (refer **Appendix D**). This included 26 species of bird (two of which are non-native), two exotic species of mammal and three species of reptile.

Despite a targeted survey effort in areas of potential habitat none of the listed threatened species were found on the Subject Land or within the Site. No migratory species listed under the EPBC Act were recorded nearby the Subject Land during the survey.

Four exotic vertebrate species (excluding livestock animals) were recorded within the Subject Land. These included the European Red Fox (*Vulpes vulpes*), Common Myna (*Arcidotheres tristis*), European Starling (*Sturnus vulgaris*) and House Mouse (*Mus musculus*).

Commonwealth Matters of National Environmental Significance (MNES)

An EPBC protected matters report was undertaken on the 23 November 2017 (20km buffer of the development site) to identify Matters of National Environmental Significance (MNES) that have the potential to occur within the development site. The assessment has been undertaken in accordance with the Commonwealth Significant Impact Assessment Guidelines (DoE 2013) which lists a suite of significant impact criteria to assist in determining whether there is likely to be a significant impact on Matters of National Environmental Significance (MNES) and thus whether a referral to the Commonwealth DoEE is required.

Results of the protected matters search are provided in Table 6-1 below.

Table 6-1 EPBC Protected Matters Search Tool Results

MNES	Number of MNES identified within a 20km buffer from the subject site
World Heritage Properties	None
National Heritage Places	None
Wetlands of International Importance	3
Great Barrier Reef Marine Park	None
Commonwealth Marine Area	None
Listed Threatened Ecological Communities	6
Listed Threatened species	• 28 Threatened species • 10 flora species • 18 fauna species (7 mammals, 6 birds, 2 fish, 1 frog, 2 reptiles).
Listed Migratory Species	10

Based on the search results, the proposal would not impact upon any world heritage properties, national heritage places, Commonwealth marine areas nor the Great Barrier Reef Marine Park given their absence in the vicinity of the subject site. The potential for these remaining MNES to occur at the site are discussed below.

Wetlands of International Importance

Three wetlands of international importance were identified by the EPBC Act Protected Matters Report:

- Banrock station, wetland complex (900 – 1,000km upstream)
- Riverland (900 – 1,000km upstream)
- The Coorong, and lakes Alexandria and Albert Wetland (1,000 – 1,200km upstream).

6.1.3 Assessment of Potential Impacts

Threatened Ecological Communities
As identified above, six threatened ecological communities may occur or are likely to occur within the 20km search area however based on the survey results three EEC are analogous to the remnant native vegetation stands identified onsite. These native vegetation stands are highly disturbed with an exotic mid-storey and groundcover and are suffering severe dieback however, they would be retained and protected as part of the proposal. As such, none of the threatened ecological communities would be impacted by the proposal.

Listed Threatened Species
Of the 10 threatened flora species listed under EPBC Act and seven threatened flora species listed under BC Act, four of these species are considered to possibly occur on the Subject Land based on the native habitats present, these being:

- *Cadellia pentastylis* (Ooline)
- *Dichanthium setosum* (Bluegrass)
- *Swainsona murrayana* (Slender Darling Pea)
- *Homopholis belsonii.*

All four species are wide ranging and would be unlikely to be exclusively reliant on-site habitats for their life cycle requirements. Regardless, the proposal would not result in a loss of potential habitat for these three-flora species as the native vegetation stands would be retained. Additionally, no threatened flora species were recorded on the Subject Land during the flora survey.

A total of 15 species of threatened fauna were considered to have potential to occur within the Subject Land or immediate surrounds however the majority of potential occurrences were limited to stopping points during migration, opportunistic habitat and secondary food trees. Additionally, no threatened fauna species were recorded on the Subject Land during the fauna survey.

Wetlands of International Importance
The nearest wetland of international importance is 900 – 1,000km upstream. None of the three wetlands identified are expected to be impacted based on their distances from the Proposal.

Migratory species
A total of 10 migratory bird species listed under the EPBC Act have been recorded within the locality or predicted to occur however none of these bird species were identified during the fauna survey.

Impact to Koalas
Schedule 2 of the *State Environmental Planning Policy No. 44 (Koala Habitat Protection*) list specific "feed trees" that are known to be used by Koalas. One of the most important factors influencing the distribution and numbers of koalas in any area is the presence and density of their food tree species. Three "feed trees" occur in the Gunnedah LGA: *Eucalyptus camaldulensis* (River Red Gum), *Eucalyptus albens* (White Box) and *Eucalyptus populnea* (Bimble Box or Poplar Box).

The site contains Schedule 2 Koala feed trees, River Red Gum and Bimble Box and therefore contains potential Koala habitat. The solar farm will create a barrier that will impede the movement of Koalas from habitat along the Namoi River to the stands of vegetation within the Subject Land (V1 and V2). However, the Site already has a barrier as it is fenced and there are no historic or current observations of koalas within the site. Furthermore, the stands of vegetation (V1 and V2) are already isolated making it extremely difficult for koalas to reach them as koalas generally will not move through more than 200m of open ground. Should koalas reach the remnant areas of vegetation they would be unable to remain there long-term due to the poor condition of the trees.

Avoidance measures
The site survey was conducted to inform the flora and fauna impact assessments and to identify site constraints to inform design.

Following the site survey, the site layout was revised to avoid impacts on the native vegetation within the proposal site (V1, V2, V3, V4 and V5).

Construction

Direct biodiversity impacts that must be managed during construction and decommissioning include:

- Clearing of native vegetation, and removal of dead wood and dead trees which in turn may cause:
  - Loss of tree food sources and reduced foraging habitat
  - Loss of nest sites
  - Loss of habitat connectivity
  - Increase edge effects
- Introduction and/ or spread of noxious weeds and pathogens
- Disturbance of fauna during construction due to light, noise and air quality impacts generated by vehicles, equipment and construction activities
- Fauna mortality or injury
- Entrapment of fauna in trenches
- Increase in predation by feral animals
- Erosion of disturbed areas leading to sedimentation and dust affecting any downgradient habitat or habitat within drainage channels (see Section 6.8)
- Decreased water quality (see Section 6.7).

Clearing of native vegetation will be limited to grasses and shrubs. The main clusters of vegetation (V1, V2 and V3), as well as isolated trees on fence lines will be retained as part of the proposal (via the establishment of buffers).

Removal of vegetation will not interfere with habitat connectivity as no trees will be removed and the existing remnant trees on the Subject Land are few in number and widely spaced. Most of the habitats within the Subject Land are already impacted by edge effects (light, noise, dust, etc.) associated with the establishment of agricultural land. The PV panels will facilitate greater vegetated ground coverage than currently exists which should suppress wind-blown dust but could facilitate weed growth in the paddock.

One WoNS has been recorded within the Subject Land (African Boxthorn) and this has the potential to migrate off site as a result of vehicular access and site disturbance. Management of weeds is detailed in the Land Management Plan (refer **Appendix G**).

Nocturnal species, species with low mobility, territorial species and some ground-dwelling species (such as lizards and snakes) are particularly susceptible to injury or death during construction and clearing. However, clearing works of the exotic pasture cropland would be minimal and the area has been deemed to have low habitat value.

It is also possible that some fauna may be disturbed or become trapped within trenches, pits or other enclosed areas. Fauna may also be impacted by increased traffic volumes however wildlife mortality on roads would be limited as a result of the Proposal, given all the existing roads are currently in operation with relatively low vehicle speed limits, and no new roads would be created.

Foxes have been recorded within the site. Any small loss of habitat caused by the proposal is unlikely to result in an increase of the impacts of foxes on native fauna. Similarly, the establishment of solar panels is unlikely to increase fox predation.

Part 7 assessment (5 Part Test)
Under Section 7.3 of the new BC Act, proponents of Part 5 activities must apply the test of significance to '*determine whether the proposed activity is likely to significantly effect on threatened species or ecological communities, or their habitats'*.

An impact assessment under Part 7 of the BC Act (referred to as the 5-part test of significance) has been undertaken for BC Act-listed Threatened species and ecological communities recorded or predicted to occur in the Subject Land that have the potential to be directly or indirectly impacted upon as a result of the proposed works (refer **Appendix D**).

The seven-part test concluded that the proposal is not expected to have a significant effect on the subject species and communities and thus the preparation of a Species Impact Statement is not deemed to be required.

Vegetation screening and landscape works for the proposal (refer **Appendix C**) will provide an opportunity to add biodiversity value to the locality.

No impacts in addition to those mentioned for construction are anticipated during the decommissioning phase.

Operation

The following impacts have been considered as having potential to occur during operation:

- Weed growth and spread
- Movement barrier and collision hazard created by perimeter fencing
- Vehicle collision risks to fauna
- Impacts of habitat connectivity
- Noise from the sub-station.

The shading associated with PV panels has the potential to create microclimate impacts however as tracking panels are to be installed on Site these impacts are not expected as all the vegetation underneath the PV arrays will be exposed at certain parts of the day.

Changes to water availability to land and vegetation underneath the PV arrays is not expected as surface and subsurface water is expected to move from adjacent rain-exposed areas to areas covered by the PV arrays. Ground disturbance as well as vehicle movement on and off Site has the potential to contribute to the spread of weeds. A draft land management including measures to manage unwanted vegetation establishing on the Subject Land is provided in **Appendix G**.

As the site has negligible habitat value, the potential to create a barrier to movement is unlikely to be significant to any local fauna over time. Some isolated collisions with fencing may occur. This is considered to be a low risk and it is not anticipated that collisions with fencing will constitute a significant impact.

Operational vehicle movements will be limited and vehicle speed limits will be set to reduce risk of collision with fauna.

Kelvin Hills and the Namoi River corridor vegetation areas are already disconnected by a 5 to 10km wide zone of extensively-cleared agricultural land. Due to the lack of native vegetation within or in proximity to the Site habitats present in Kelvin Hills and Namoi River will not become isolated by the proposed development.

Noise impacts will be localised to the Site and will not be a factor that will negatively impact on native fauna.

6.1.4 Mitigation / Management Measures

Reference	Mitigation Measures
Construction and Decommissioning Mitigation Measures	
B1	A 10-m buffer shall be established between the perimeter of the remnant vegetation stands (V1, V2, V3, V4 and V5) and the works footprint.
B2	The works (e.g. plant, material stockpiling) should not encroach into remnant vegetation and buffer areas.
B3	A Land management plan which includes weed management has been developed (refer **Appendix G**) and will be incorporated into an overall construction environmental management plan (CEMP).
B4	Trenches should be backfilled as soon as possible to minimise the chance of fauna becoming trapped. Any trench sections left open for greater than a day would be inspected daily, early in the morning and any trapped fauna removed. The use of ramps or ladders to facilitate trapped fauna escape is recommended.
B5	Speed limits should be set to 20km per hour on internal roads and tracks.
B6	Preparation of procedures within the CEMP which detail how to care for animals found at risk of harm or injured at the solar farm Site.
Operational Mitigation Measures	
B7	The OEMP will include: • The land management plan – which will have a procedure or plan for monitoring vegetation cover and composition and allow for adaptive management as well as weed monitoring and control • Vehicle speed limits on Site, to reduce risk of collision with fauna.

6.2 Heritage

6.2.1 Aboriginal Cultural Heritage

An Aboriginal Cultural Heritage Assessment was undertaken by Kelleher Nightingale Consulting (Kelleher Nightingale) to determine the archaeological significance of the site (see **Appendix E**). A summary of the key findings of this assessment are outlined below.

6.2.1.1 Assessment Methodology

The assessment employed a regional approach, taking into consideration resource availability within the area (water and stone raw materials), the landscape of the Subject Land (landforms, water resources, soils, geology etc.) and the regional archaeological patterning identified by past studies.

The report has been prepared in accordance with:

- Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW

- The Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW.

The assessment was undertaken in consultation with Red Chief Local Aboriginal Land Council (RCLALC) whose boundaries cover the Subject Land.

The following tasks were undertaken as part of the assessment:

  - A Desktop Assessment including a review of the Aboriginal Heritage Information Management System (AHIMS) for known archaeological sites
  - A review of local environmental information (topographic, geological, soil, geomorphological and vegetation descriptions) to determine the likelihood of archaeological sites and specific site types, prior and existing land uses and site disturbance that may affect site integrity
- A review of previous cultural heritage investigations to determine the extent of archaeological investigations in the area and any archaeological patterns
- The development of a predictive archaeological statement
- Identification of human and natural impacts to the Subject Land
- Consultation with the RCLALC
- A site inspection with the RCLALC
  - The Subject Land was traversed by pedestrian survey in a series of transects. Site locations were plotted using handheld GPS units, mapped and photographed, including landform context and site contents
- The development of mitigation and conservation measures in consultation with the RCLALC.

Desktop Assessment

A search of AHIMS was conducted on 1 February 2018 to identify registered (known) Aboriginal sites or declared Aboriginal places within or adjacent to the Subject Land. The AHIMS Web Service database search was conducted with the following coordinates (GDA, Zone 56):

- Eastings: 0230700 to 0253000
- Northings: 6565500 to 6582500
- Buffer: 1,000 metres

Other sources of information including heritage registers and lists were also searched for known Aboriginal heritage in the vicinity of the Subject Land. These included:

- Gunnedah Local Environment Plan 2012
- State Heritage Register and State Heritage Inventory
- Commonwealth Heritage List
- National Heritage List
- Australian Heritage Places Inventory
- Historic Heritage Information Management System (HHIMS).

Review of Previous Archaeological Work

Several archaeological surveys and test excavation programs have been carried out within the Gunnedah LGA. These surveys found surface artefact scatters and Aboriginal scarred trees within the Namoi River plains landform. The average distance of the Aboriginal sites from waterways within the Liverpool Plains is 400m.

Archaeological Potential

An assessment of archaeological potential within the Subject Land was conducted during the archaeological survey. The characterisation of archaeological potential was based on several factors known to influence both the location and preservation of archaeological sites within the Subject Land. These factors included:

- Landform context
- Gradient
- Erosion
- Distance to water
- Integrity of the ground surface / assessment of disturbance.

6.2.1.2 Existing Environment & Archaeological Context

Aboriginal Settlement

The Gunnedah area has a documented history of Aboriginal settlement. The original inhabitants of Gunnedah Shire were the Gunn-e-darr people, a sub-group of the Kamilaroi 'nation'. For most of the year the Gunn-e-darr people divided into smaller groups to hunt and gather around the Namoi and Mooki Rivers, however during the winter months they would move into the foothills of the surrounding ranges and use caves for shelter. In the mid-1700s a large flood along the Namoi and Mooki Rivers is believed to have significantly reduced the aboriginal population.

At the time of European settlement, it is estimated that there was between 150 to 300 Gunn-e-darr people inhabiting the area. The coming of European settlers brought disease and conflict resulting in the death or displacement of many of the Gunn-e-darr people.

Landscape Features

Aboriginal heritage items are often associated with particular landscape features as Aboriginal people used these features in their day-to-day lives or for cultural ceremonies. A common element that influences occurrence of sites is proximity to water. Oral history and archival investigation has also demonstrated that many of the historic, social and spiritual aspects of Aboriginal culture share a common theme with rivers, creeks and waterholes Aboriginal heritage artefacts such as Aboriginal scarred trees, and stone tools have been found in other locations along the Namoi River.

The Subject Land, is located over 500m from this landscape feature within a highly disturbed intensive agricultural environment.

Soils and Geology

Soil type would determine the state of preservation of cultural material with the higher preservation rate in deep alluvial deposits and in areas with limited previous surface and ground disturbance.

Soils within the Subject Land comprise of two soil landscapes as mapped by NSW Soil and Land Information System: Burburgate (bul) which covers most of the Subject Land and Tulcumba (tcv) which is located in the north-east corner of the Subject Land.

Both soil landscapes located within the Subject Land are very clayey and prone to frequent flooding events. Floodplains are a dynamic environment and are subject to inundation and severe erosion and as such they would not be suitable for Aboriginal occupation and are unlikely to preserve archaeological material.
Previous land use modifications within the Subject Land include land clearing for cropping agriculture, informal vehicle tracks, installation of irrigation channels, ploughing, construction of dams, water tanks and fences. All of these land use practices would have displaced any possible Aboriginal cultural material and removed modified or scarred trees.

Archaeological Potential

The assessment found that whilst the regional environment provided resources, including water, flora and fauna and raw stone materials, the Site and Subject Land appears to have limited water resources and it is likely that areas bordering the nearby Namoi River would have been more attractive to Aboriginal people.

Land clearance for agricultural purposes, including removal of trees, would have impacted on the topsoil and would have mixed the deposits, therefore possibly exposing any possible subsurface cultural material and causing a loss of archaeological context. The entire Subject Land was assessed as having low archaeological potential.

The following predictive statements were made:

- Archaeological sites are likely to consist of open artefact scatters and/or isolated finds on the elevated, well-drained landform units, and scarred trees within areas of remnant mature vegetation
- It can be expected that silcrete, quartz, quartzite, chert and volcanics will be the most commonly encountered artefact raw material
- Clearance of the majority of original vegetation lessens the likelihood of identifying culturally modified trees, but old growth trees may be present in the Subject Land and have the potential to display scars of Aboriginal origin
- Grinding grooves and shelters can be found in areas with appropriate geological formations
- Archaeological sites are more likely to be identified in areas that have been subject to less intensive disturbance
- The identification of archaeological sites is likely to be affected by differential visibility of the ground surface, but successful assessment of areas of potential archaeological deposit can be made based on landform and other environmental factors such as distance to water.

Database searches

The AHIMS search concluded that there are 52 Aboriginal sites or places recorded within the search area which covers the area beyond the Kelvin Hills to south of Black Jack Mountain with a 1km buffer. However, none were recorded within the Site. The review of other sources did not identify any items of Aboriginal heritage value listed within the Subject Land.

The distribution of recorded Aboriginal sites within the search area is shown on Figure 6-3. The frequencies of site types (site context/features) within the AHIMS database search area is listed in Table 6-2.

Table 6-2 Frequency of site types from AHIMS database search

Site Context	Site Features	Number	%
Open Site	Artefact Scatter	16	31
	Modified Tree (Carved or Scarred)	15	29
	Grinding Groove; Burial	2	4
	Grinding Groove	7	13
	Artefact Scatter; Grinding Groove	1	2
	Aboriginal Ceremony and Dreaming; Grinding Groove	1	2
	Aboriginal Resource and Gathering	1	2
	Artefact Scatter; Modified Tree (Carved or Scarred)	3	6
	Isolated Artefact	4	7
	Potential Archaeological Deposit (PAD)	1	2
	'Restricted Site'	1	2
TOTAL		**52**	**100**

Many of the registered sites on AHIMS are located in association with permanent waterways or are within areas with suitable geological formations, such as grinding grooves and Aboriginal ceremony sites. Location of scarred trees is also dependent on the preservation of native vegetation as the majority of the regional area has been previously cleared and cultivated. The closest Aboriginal site (AHIMS 20-4-0052) is a modified, scarred tree and four scattered artefacts located approximately 4.3km from the Subject Land.

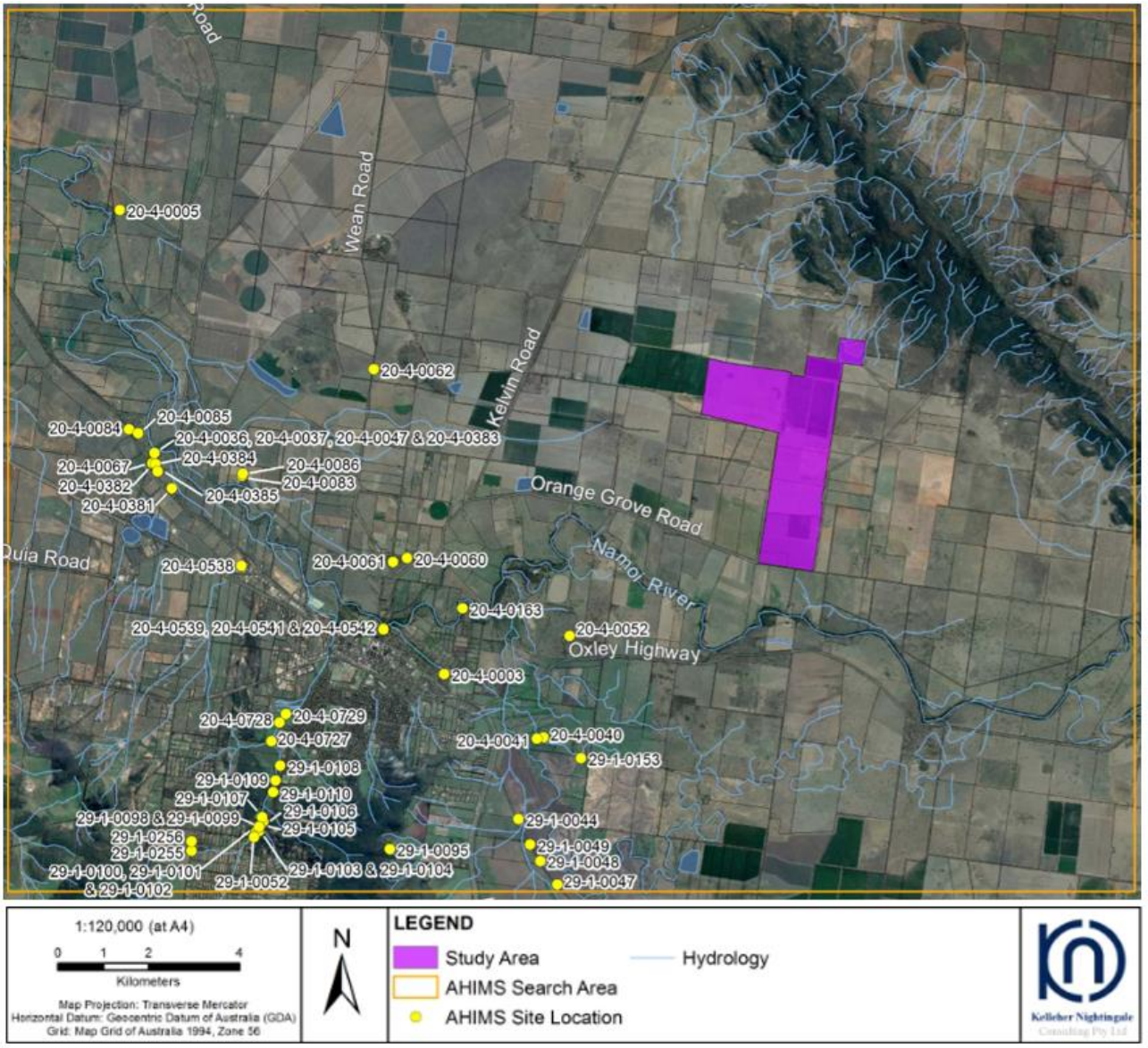

Figure 6-3 Previously recorded Aboriginal Sites

6.2.1.3 Assessment of Potential Impacts

The Site inspection, undertaken by Kelleher Nightingale and RCLALC, did not locate any Aboriginal archaeological sites or areas of Aboriginal cultural heritage potential within the Subject Land. No significant Aboriginal cultural heritage features were identified within the Subject Land by RCLALC. The entire Subject Land was assessed as exhibiting nil-low archaeological potential.

As such it was concluded that the proposed construction and operation the Proposal, would not impact on Aboriginal archaeological heritage objects or sites.

However, unexpected or unidentified Aboriginal heritage items may be uncovered during the construction of the Proposal. In the event of an unexpected find of an Aboriginal heritage item (or suspected item), the safeguards specified below would be implemented to avoid or minimise any potential impact on Aboriginal heritage items uncovered during the proposed works.

No Aboriginal heritage impacts in addition to those mentioned for construction are anticipated during the decommissioning phase. No operational impacts are expected to Aboriginal heritage as a result of the Proposal and as such no operational mitigation measures are proposed.

6.2.1.4 Mitigation / Management Measures

Reference	Mitigation Measures
Construction and Decommissioning Mitigation Measures	
AB1	An Unexpected Finds Protocol which addresses unexpected aboriginal heritage finds will be included in the CEMP to be completed by the construction contractor.
AB2	The Unexpected Finds Protocol will form part of the site induction and must be viewed by all relevant employees and contractors before working on site.
AB3	If suspected Aboriginal objects, such as stone artefacts are identified during works, works must cease within 10m of 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 or avoidance should be sought if Aboriginal objects are to be moved or harmed.
AB4	In the extremely unlikely event that human remains are found, works should immediately cease and the NSW Police are to 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.

6.2.2 Historic Heritage

6.2.2.1 Assessment Methodology

A desktop study was undertaken on 30 October 2017 and again on 7 February 2018 to identify any historic heritage (Non-indigenous) items or places in proximity to the Subject Land. The desktop study included a review of the following resources:

- Gunnedah Local Environmental Plan 2012
- Australian Heritage Database
- Australian Heritage Places Inventory
- NSW State Heritage Register
- EPBC Protected Matters Search (World Heritage Properties and National Heritage Places).

A survey of the Site was undertaken on 26 October 2017 by pitt&sherry to identify any evidence of structures or items that may have heritage significance. A summary of the investigations and key findings of this assessment are summarised in this chapter.

6.2.2.2 Existing Environment

The Proposal is located approximately 9km north-east from the Gunnedah town centre where the majority of historic heritage items in the area are located.

Historical setting
The first explorers to the area included John Oxley who moved through the Liverpool Plains area around 1818 and reported small camps of Aboriginal people along the water courses and Alan Cunningham who passed through the Gunnedah area in 1827. However, the land was not settled until the 1830s when new settlers moved into the Namoi River Valley (*Australian Heritage, 2018*).

In 1833 land in Gunnedah was settled by John Johnston who built a homestead and woolshed in the area. With settlement in the area focused on wool production, Gunnedah was initially known as 'The Woolshed' until it was renamed Gunnedah around 1860 taking its name from the local Indigenous people who called themselves the Gunn-e-darr. Smaller settlements were also established in the Carroll and Tamar Springs areas (*Australian Heritage, 2018*).

The Railway Station at Gunnedah opened in 1879 giving the town a method of transport for passengers and agricultural products to Newcastle and Sydney (*Aussie Towns, 2018*). The railway station was provided in response to the town's expanding population and the need for exportation of wheat and other agricultural products. The original station building was replaced by the current structure in 1915.

In the 1950s and 1960s the population of the Shire grew steadily in-line with the wool boom and increased cropping output as a result of increased mechanisation, availability of irrigation water and the introduction of summer crops. Both the Gunnedah Airport and the Gunnedah Abattoir were opened in 1957.

In 1877 Coal was discovered on Black Jack Hill to the south west of Gunnedah. The Gunnedah Colliery was established in 1900 and initially the coal was mined for the local domestic market and used by the railway, abattoir, brickworks and other local industries (*Aussie Town, 2018*). A number of years after the establishment of the Gunnedah Colliery, a second mine the Preston Colliery, commenced operations. New discoveries around 1980 resulted in greatly expanded coal mining operations and coal was also supplied to Tamworth, and used to power the regional power station.

Gunnedah Shire has gone through a number of '*boom and bust*' cycles in both the agriculture and mining =s ectors.

Heritage Items

Several database searches were undertaken prior to the site visit to determine the presence of any items of non-indigenous heritage in proximity of the Proposal Area. The results of the searches indicate that there are no heritage items or areas listed under the NSW Heritage Register, Commonwealth Heritage Register or Register for the National Estate within the vicinity of the Proposal Area.

The nearest heritage items listed in the Gunnedah LEP is within 3km of the Proposal Area (refer Table 6-3) however several items are located along the proposed haulage route (refer Table 6-4).

The survey of the Site undertaken on 26 October 2017 revealed no existing or relict structures or items of potential heritage significance within the Site or ancillary works areas. Historical aerial photographs of the site were unavailable.

Table 6-3 Historic items within the vicinity of the site

Register	Item Name	Item ID	Significance level	Location	Distance from the Site
World Heritage List	None identified	N/A	N/A	N/A	N/A
National Heritage List	None identified	N/A	N/A	N/A	N/A
Commonwealth Heritage List	None identified	N/A	N/A	N/A	N/A
NSW State Heritage Register	Gunnedah Railway Station Group	01160	State	15–51 Railway Avenue	9.5km south-west
Gunnedah LEP 2012 (within 6km of the site)	Frogmore Woolshed	I017	Local	6587 Oxley Highway	3km south-east
	Ruvigne	IO22	Local	385 Ruvigne Road	5.5km south-west

Table 6-4 Historic items along the haulage route

Register	Item Name	Item ID	Significance level	Location	Distance from the Site
Gunnedah LEP 2012 (within 6km of the site)	Convent of Mercy (brick building)	I010	Local	151 – 189 Bloomfield Street	8.4km south west
	Original Methodist Church (brick building)	IO07	Local	44 – 48 Abbott Street	8.5km south west

6.2.2.3 Assessment of Potential Impacts

No items of heritage significance were identified within 3km of the Proposal or identified on site; therefore, the Proposal is not expected to directly impact on any non-indigenous heritage values.

Due to the distance from the nearest heritage item, impacts from vibration, archaeological disturbance, altered historical arrangement are not expected. Similarly, due to the flat landscape and distance from the site there are no expected impacts to landscape and vistas.

Increased construction traffic along the haulage route may be perceived to impact upon the aesthetic values of the heritage items on the route or cause vibrational and dust impacts. However, these items are along a designated heavy vehicle route which currently caters for a large number of heavy vehicles including B-double combinations. Given the amount of heavy vehicle traffic that already utilise this route, the capacity of the haulage route and the temporary nature of works, potential dust and vibration generated from heavy trucks is not expected to impact on these road side heritage items.

No historic heritage impacts in addition to those mentioned for construction are anticipated during the decommissioning phase. No operational impacts to items of historic heritage value are expected as a result of the proposal and such no operational mitigation measures are proposed.

6.2.2.4 Mitigation / Management Measures

Reference	Mitigation Measures
Construction and Decommissioning Mitigation Measures	
H1	An Unexpected Finds Protocol which addresses unexpected non-indigenous heritage finds will be included in the CEMP to be completed by the construction contractor.
H2	The Unexpected Finds Protocol will form part of the site induction and must be viewed by all relevant employees and contractors before working on site.
H3	If an item (or suspected item) of heritage is discovered during construction, all work in the area of the find will cease immediately and the Unexpected Finds Protocol implemented including notifying an officer from the Heritage branch of OEH immediately (in accordance with section 146 of the *Heritage Act 1977*) and seeking advice for management of the object.

6.3 Land use impacts (including mineral resources)

This section assesses the potential impact on property and land use within the study area as a result of the proposal. The assessment presented in this section draws on desktop information, observations from the site inspection and responds to the relevant SEARs.

6.3.1 Assessment Methodology

Land use conflicts occur when one land user does, or is perceived to, infringe upon the rights, values or amenity of another. In rural areas land use conflicts commonly occur between agricultural and residential uses. However, land use conflicts can also occur between different agricultural enterprises and other industries such as mining, forestry or energy production. Due to the potential for land use conflicts between the solar farm development and the existing agricultural land use a land use conflict risk assessment (LUCRA) based on the Department of Primary Industries (DPI) '*Land Use Conflict Risk Assessment Guide' (Department of Trade and Investment, 2011*) was conducted as part of this EIS.

There are four key steps in undertaking a LUCRA and these are:

- Gather information about proposed land use change and associated activities
- Evaluate the risk level of each activity
- Identify risk reduction management strategies
- Record LUCRA results.

A Risk Ranking Matrix, (Table 2 of the LUCRA Guide) is used to rank the identified potential land use conflicts. The risk ranking matrix assesses the environmental, public health and amenity impacts according to the:

- Probability of occurrence (Table 3 of the LUCRA Guide)
- Consequence of the impact (Table 4 of the LUCRA Guide).

6.3.2 Existing Environment

Existing Land Use
The site and the surrounding land are zoned RU1 Primary production under the Gunnedah LEP 2012.

The site is privately owned and currently used for agricultural purposes specifically cropping (wheat, chickpeas and cotton). It is understood from discussions with the land owner that the Subject Land has been historically used for grazing agriculture (*Kate Groves, personal communication, 26 October 2017*). An irrigation system was installed so the land could be used for irrigated cropping agriculture and this continues to date.

The surrounding areas are dominated by parcels of cleared land with scattered trees where cattle grazing is the predominant activity. Land uses around the footprint comprise of road infrastructure (e.g. road pavement on Orange Grove Road and vacant land located within the road reserve), utility easements (comprised of overhead electricity supplies), rural residential and other privately-owned property. Land to the south, east and west of the Subject Land are used for cattle grazing and the land to the north contains rural residences.

Mineral resources
Coal deposits are known to occur in Gunnedah and there are several existing operational coal mines in the area including:

- Sunnyside coal mine, approximately 12km south-west of the site
- RocGlen coal mine, approximately 18.5km north-west of the site
- Vickery coal mine, approximately 22km north-west of the site

- Tarrawonga coal mine, approximately 35km north-west of the site
- Boggabri coal mine, approximately 38km north-west of the site
- Whitehaven coal mine, approximately 45km north-west of the site
- Watermark Coal mine, approximately 33km south-east of the site.

Additionally, Whitehaven coal handling and processing plant (CHPP) is located approximately 13km west of the site.

A search of Department Resources and Energy's MinView database found the site to have two current Mineral Titles. These are described in Table 6-5. Exploration licences entitle the holders to carry out exploration and prospecting for minerals within the specified area.

Table 6-5 Exploration licences currently in force over the proposed solar farm proposal boundary

Mineral Title/ Licence Number	Owner	Type of Title or Licence
PEL (001)	Australian Coalbed Methane Pty Limited and Santos QNT Pty Ltd	Petroleum exploration licence
EL (7241)	The Secretary, NSW Department of Planning and Environment	Coal exploration licence

The current mineral titles and exploration licence applications are illustrated in Figure 6-4. Consultation undertaken with these mineral titleholders is outlined in Section 5.

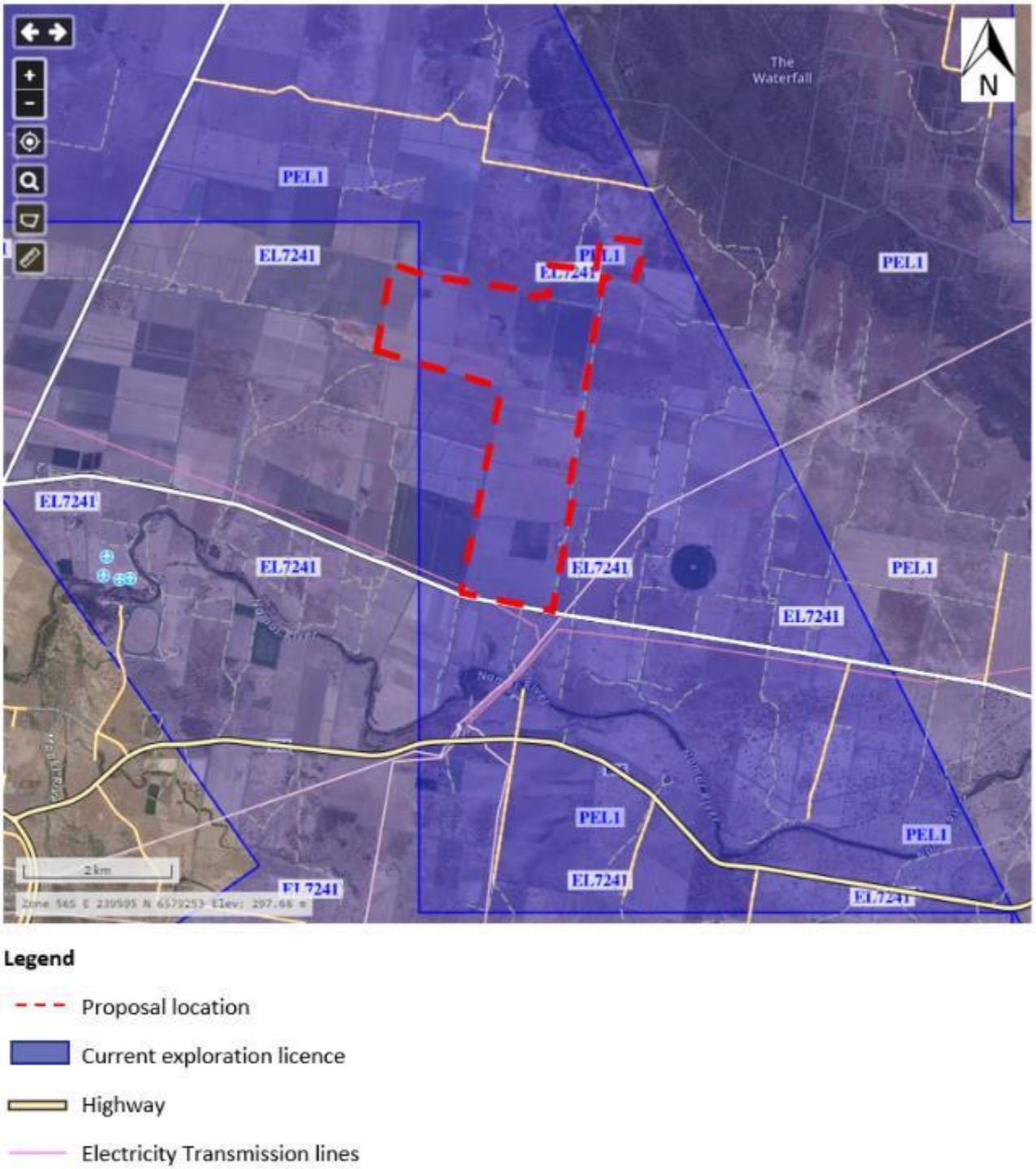

Figure 6-4 Mineral titles and Mineral title applications near the proposal site.

Biophysical Strategic Agricultural Land

The land for the Proposal has been mapped as Biophysical Strategic Agricultural Land (BSAL) by the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (New England North West Region – Map 008). BSAL land features quality soil and water resources and is assumed to be the best land capable of sustaining high levels of productivity. BSAL is naturally fertile and highly productive and can be used for intensive agriculture such as cultivation.

The solar farm is located on land mapped in capability Class 2 under the Land and Soil Capability (LSC) Mapping for NSW (*OEH, 2017*). Class 2 land is '*arable land suitable for regular cultivation for crops, but not suited to continuous cultivation.*

It has a moderate to high suitability for agriculture but edaphic (soil factors) or environmental constraints reduce the overall level of production and may limit the cropping phase to a rotation with sown pastures' (*NSW Agriculture, 2002*).

It is noted that this soil mapping for LSC and BSAL is not extensively ground-truthed and as such, the NSW OEH and the Office of Agricultural Sustainability & Food Security have created the '*Interim Protocol for site verification and mapping of biophysical strategic agricultural land'* (*NSW OEH & OAS&FS, 2013*). The Protocol specifies 12 criteria (refer Table 6-6) to determine whether the land is BSAL and the land must meet all 12 criteria to be classified as BSAL. pitt&sherry have compared this BSAL criteria to the existing environment and findings from the site visit and soil sampling undertaken (refer Table 6-6).

Table 6-6 Comparison of BSAL criteria to the Gunnedah Site (Source: Interim Protocol for site verification and mapping of biophysical strategic agricultural land (*NSW OEH & OAS &FS 2013*))

No.	Criteria	Gunnedah	Y/N
1	Is the slope less than or equal to 10%?	The slope is less than 10%	Yes
2	Is there <30% rock outcrop?	The rock outcrop is less than 30%	Yes
3	Does ≤ 20% of area have unattached rock fragments >60mm diameter?	The area for the Proposal does not contain large amount of unattached rock pieces that are 60mm or larger.	Yes
4	Does ≤ 50% of the area have gilgais (a hollow where rainwater collects; a waterhole) >500mm deep?	Less than 50% of the area have gilgais	Yes
5	Is slope <5%?	The area is on a floodplain and the slope is less than 5%	Yes
6	Are there nil rock outcrops?	There are no rock outcrops within the site	Yes
7	Does soil have moderate, moderately high or high fertility?	Landscape information from the Burburgate soil landscape indicates that plain areas are dominated by Brown Vertosols (Brown Clays), Brown Chromosols (Red-brown Earths), or Self-Mulching Red Vertosols (Red Clays). Vertosols are ranked as high fertility (5) by the Interim protocol for site verification and mapping of biophysical strategic agricultural land and chromosols are ranked as moderately high fertility (4). Soil sampling on the Site determined that the soil pH (water) of the soils was ranged from a pH of 6 to a pH of 8.3 which is within the optimum fertility range (4.8 to 8.5).	Yes

No.	Criteria	Gunnedah	Y/N
		CEC ranged from 15 to 30 which is within the moderate to high fertility range (moderate: 12 – 25, High: 25 – 40).	
8	Is effective rooting depth to a physical barrier ≥ 750mm?	To identify broad land capability and soil constraints a soil survey was undertaken on the Site. This involved excavating six test pits and completion of a test pit log sheet to record attributes of the soil layers. The majority of the test pits were terminated at 500mm however soil landscape information from the Burburgate soil landscape indicates that sands and gravels are generally deeper than 3m.	Yes
9	Is the soil drainage better than poor?	Test pit and soil sampling activities observed that the soils were well drained consisting of light clay with silt and sand.	Yes
10	Does the pH range from 5 – 8.9 if measured in water or 4.5 – 8.1 if measured in calcium chloride, within the uppermost 600 mm of the soil profile?	The average pH from the soil samples taken was 6.85 measured in water and 5.87 measured in calcium chloride. The samples were taken at the surface, 300mm and 500mm.	Yes
11	Is salinity (ECe) ≤ 4dS/m or are chlorides <800 mg/kg when gypsum is present, within the uppermost 600 mm of the soil profile?	Electrical conductivity readings averaged 0.09dS/m and none of the samples were above 4dS/m.	Yes
12	Is effective rooting depth to a chemical barrier ≥ 75mm? (Chemical barriers include: pH, electrical conductivity, chloride content, exchangeable sodium percentage and the calcium to magnesium ratio)	The majority of the test pits were terminated at 500mm however soil landscape information from the Burburgate soil landscape indicates that chemical barriers are unlikely.	Yes

Table 6-6 confirms that the Subject Land meets all 12 criteria for BSAL classification.

Current land management on the site is focussed on cropping agriculture. The site has irrigation infrastructure capable of supporting irrigated agriculture and crops requiring high water usage.

Further details regarding soils at the site and their constraints are detailed further in Section 6.8.

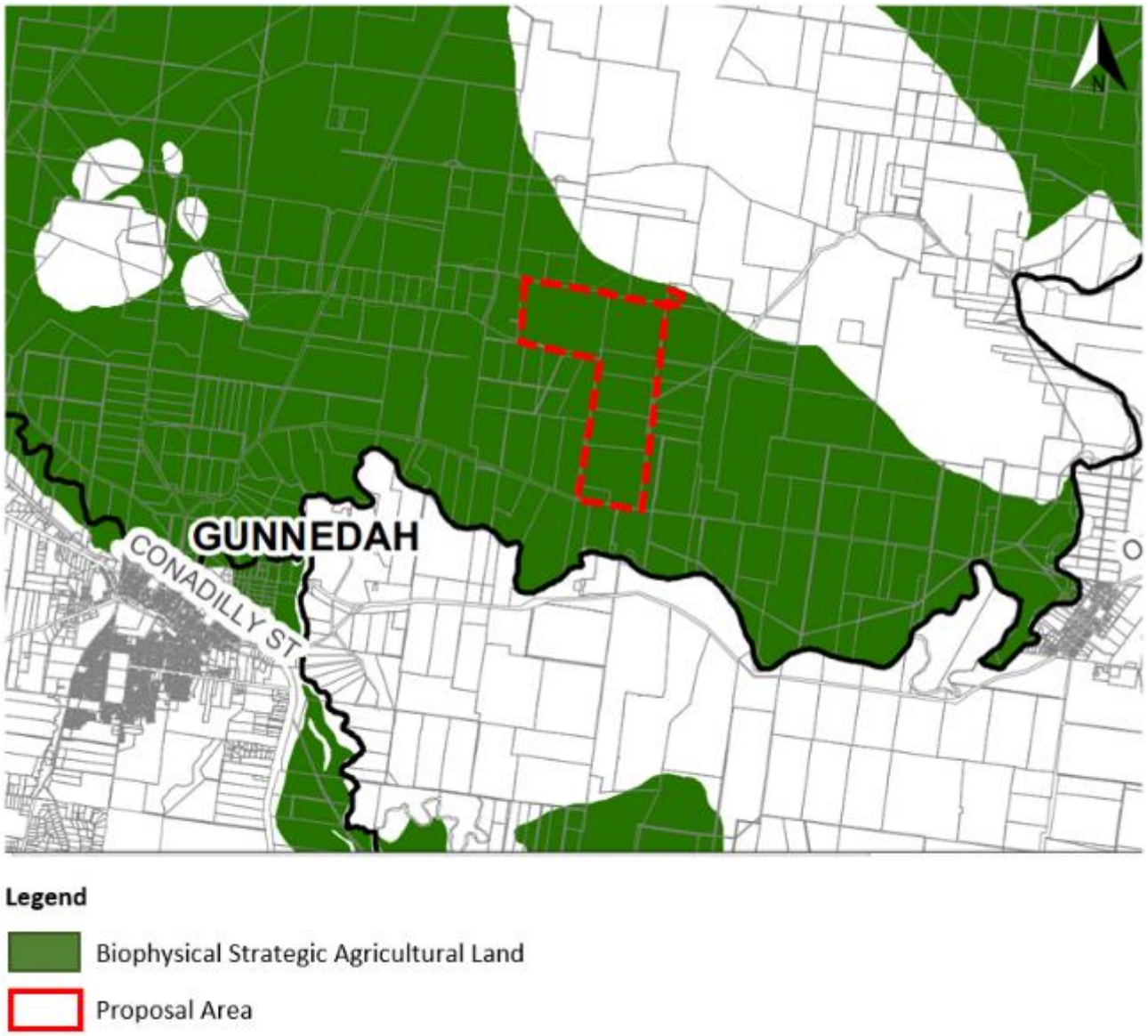

Figure 6-5 Biophysical Strategic Agricultural Land (boundary shown in red) (extracted from SEPP Mining, Petroleum Production and Extractive Industries 2007, Strategic Agricultural land map – New England North West Region 008)

6.3.3 Assessment of Potential Impacts

Nature of the proposed land use change

The proposal will result in a change from cropping agriculture to electricity generation accompanied by grazing agriculture. The major activities associated with the land use change are:

- Lease of the Site for a Solar Farm
- Site establishment and preparation for construction including minor ground cover clearing
- Installation of steel frames, PV panels, and underground cabling
- Construction of a 132kV substation and associated transmission line and transmission line upgrades
- Operation of the facility for approximately 25 years
- Grazing of sheep on site to maintain ground cover
- Routine and ad-hoc maintenance work.

The change in land use is mitigated by several factors:

- The site has operated as cropping lands for the last 20 years since the land was purchased in 1997. Prior to 1997 the land was used for grazing. As such the Proposal, will simply revert the Site to a former use albeit at a reduced capacity
- The Proposal will cover approximately 38% of the Subject Land with a percentage of the remaining area to continue to be used for cropping agriculture
- The Proposal will rest the land and allow the nitrogen content of the soil to rise naturally
- The Proposal has a reversible nature as it can be easily decommissioned and rehabilitated returning the land to its former agricultural use at the end of the operational period
- Due to the availability of water the landowner estimates they can successfully irrigate up to 180 hectares of land, which is approximately 23% of the Subject Land. This limits the agricultural use of the remaining land and as such this Proposal allows the irrigated section of land to continue to be used for cropping agriculture whilst the unirrigated land can be used for energy generation and limited grazing.

Compatibility of proposed land use and adjoining activity

Adjoining activities to the proposed solar farm are limited to cleared agricultural land and rural residences. Solar farms and agriculture can be seen as both compatible, incompatible or compatible with implementation of appropriate mitigation measures.

The following aspects of the Proposal are considered compatible with agriculture and the rural environment:

- When groundcover is established around the solar panels the land can be used for sheep grazing as well as energy production
- The panels provide a huge amount of shade, which will provide shade for animal comfort and wellbeing during warmer months
- Once operational the Proposal has limited environmental impacts and any environmental impacts are unlikely to migrate offsite and impact neighbouring land uses
- The land required for the Proposal will be wholly contained within the Subject Land and existing electricity easements. The proposal is not expected to impact or sterilise surrounding land use (including farming of BSAL land) from routine agricultural practices
- The land can be rehabilitated to ensure no future land use conflicts. The Proposal will not impact future agricultural land uses on the proposal site or adjacent lands
- Diversification of land use providing sustainable income for the landowners
- The solar farm allows the land to rest and recover from intensive agricultural practices.

The following aspects are considered incompatible with agriculture and the rural environment:

- Introduces changes (new built environment elements) to the existing landscape character and scenic values
- Loss of high value farming land (BSAL) currently used for cropping agriculture for a minimum of 25 years
- Risk of weed infestation from land clearing activities.

BSAL

The land within the site is mapped as BSAL and this has been confirmed following a site survey (refer Table 6-6). Temporary loss of the site for agricultural production would occur for the life of the proposal, approximately 25 years.

However, at present only an estimated 180 hectares of the available farmland is able to be effectively used for cropping agriculture due to water restrictions.

Currently, the development footprint (304ha) equates to less than 1% of the mapped BSAL within the Gunnedah LGA. Furthermore, the solar farm would only occupy a portion of the Subject Land approximately 38%. The remainder of the land will continue to be used for agriculture.

The area of disturbance will be minimal as no large areas of reshaping or excavation are proposed and piledriving will be used to install the pre-fabricated mounting structures. However, ground disturbance will be required for installation of electrical cabling including trenching for underground cabling and installation of inverter stations. All posts and cabling, and any stabilising infrastructure (such as the concrete footings required) would be removed upon decommissioning.

6.3.4 Land Use Conflict Risk Assessment

In accordance with examples provided by Department of Primary Industries (DPI) '*Land Use Conflict Risk Assessment Guide*' (*Department of Trade and Investment, 2011*) further potential impacts upon land use have been identified in Table 6-7 including identifying a residual risk rating (RRR) of each impact. Table 6-7 identifies the potential conflict, the mitigation measures that will be employed to manage the risk and then the RRR.

Table 6-7 Risk Evaluation, which considers the probability (P), consequence (C) of the activity and the residual risk rating (RRR). Definitions of probability and consequence are outlined in the Land Use Conflict Risk Assessment Guide' (*Department of Trade and Investment, 2011*)

Activity	Identified Potential Conflict	Mitigating factors	P	C	RRR
Use of Agricultural Land	Impacts to agricultural land are summarised below: • Disturbance to protected agricultural land uses (Good Quality Agricultural Land, Strategic Cropping Land and Priority Agricultural Land Uses) • Loss of productive agricultural land for the life of the proposal (expected to be approximately 25 years). This loss of agricultural activity would occur within the direct footprint only • Potential changes to soil properties.	• The solar farm will cover approximately 38% of the Subject Land and the remaining area will continue to be used for cropping agriculture • Managed grazing will be used to maintain the height of ground cover during operation of the Proposal. So, the land can continue to be used for agricultural purposes but represents a change from cropping agriculture to grazing agriculture albeit at a reduced capacity to grazing of the site without solar panel infrastructure • Except for limited and short-term earthworks associated with construction and operational use of internal tracks the majority of the soil surfaces would not be impacted by the development in the long term; no large areas of reshaping or excavation are proposed • The solar farm will help rest the land and allow the nitrogen content of the soil to rise naturally • The development has a reversible nature so the land can be returned to its former agricultural use at the end of the operational period • Preparation of a land management plan as part of the EIS to determine how the land will be managed during operation of the solar farm so it can go back into agricultural production upon decommissioning.	C	4	8
Use of land with mineral resources	Impacts to land with mineral resources are summarised below: • The potential exploration, assessment or extraction of minerals onsite would be impeded by the solar farm for a 25-year period.	• The proposal is expected to have a 25-year operational period and as the inground infrastructure will be relatively shallow (<4m) and all the infrastructure will be removed upon decommissioning no long-term mineral exploration impacts are expected and the land could be explored upon decommissioning • Mining titleholders have been contacted and both have confirmed that they have no immediate plans to develop the area (refer Section 5).	D	3	9

Activity	Identified Potential Conflict	Mitigating factors	P	C	RRR
Land use change	Change from cropping agriculture to electricity generation coupled with grazing agriculture.	• The site has only been used for cropping for the last 20 years. Prior to that it was used for grazing land. The proposal will revert the land to a former use whilst adding a new land use • The development is reversible and the land can be returned to its former use upon decommissioning.	C	4	8
Visual	Visual impact to sensitive receivers nearby and loss of scenic agricultural views. The proposed development has a variable level of visibility but the EIA process has identified two public viewpoints and 22 potentially affected private viewpoints. The majority of these residences have some localised vegetation screening around their properties. On-site there is a temporary residential dwelling and sheds for storing agricultural equipment. The residence is located onsite and faces Orange Grove Road. The property is surrounded by native trees with current views towards the Site. The change in the use of the land provides a moderate impact visual transition between commercial electricity generating uses and agricultural areas and includes changes to general amenity and the character of the landscape.	The mitigation measures required to alleviate visual impacts are provided in section 6.4.4.	B	3	17
Flooding	Concerns about the effect the solar panels will have on the direction and flow of the flood waters.	• The most significant influence on the flood levels associated with the Solar Farm is the fencing, and the degree of blockage caused by flood debris. A number of configurations were modelled to identify a suitable fencing configuration that would meet both the public	C	2	18

Activity	Identified Potential Conflict	Mitigating factors	P	C	RRR
		safety and security requirements whilst minimising flood impacts upon sensitive receivers and the environment • Flood modelling results and mitigation measures are detailed in **Appendix J** • Hydrology impacts and mitigation measures are detailed in Section 6.7.			
Fencing	Visual impact of fences on local amenity. Perimeter fences up to 2.5 m high will be constructed around the Proposed Development.	• Visual amenity impacts and mitigation measures are detailed in Section 6.4.	D	3	9
Impact on public roads	Increase in heavy vehicle movements on local roads due to construction traffic. Impact of construction traffic along school bus routes.	Construction traffic management mitigation measures are detailed in section 6.6.4.	C	3	13
Property	Potential decrease in land and property values.	The impacts of a solar farm on neighbouring property values has not been studied in-depth however there have been numerous studies on the impacts of wind generation on neighbouring property values in the United States (*Hoen et al., 2010; Hoen et al. 2015; Vyn and McCullough 2014*). These studies found the impact of wind energy generation on neighbouring property values to be negligible. As solar farms, do not have the same impacts as wind farms the impacts on property values caused by solar farms are anticipated to be less than the impacts of wind farms.	D	2	14
Aviation	• Perceived glare impacts	• Glare impacts are assessed in Section 6.4	D	4	5

Activity	Identified Potential Conflict	Mitigating factors	P	C	RRR
	• Impact to the flight path • Tall infrastructure may present a direct hazard to aircraft.	• The Proposal is approximately 9km east of the Gunnedah aerodrome and not runway aligned • The majority of the infrastructure is low-lying (approximately 4.0m tall). The tallest component would come from the lightning pole which is expected to be approximately 22m tall and as such would not impact the flight path or present a direct hazard to aircraft. Consultation with Gunnedah Airport and CASA in discussed in Section 5.			
Noise	Noise will impact sensitive receivers during the construction period (approximately 12 months). Construction activities will be limited to standard working hours: • Monday to Friday, 7am to 6pm • Saturday, 7am to 1pm • No construction work is to take place on Sundays or public holidays. Construction noise and associated impacts are discussed in section 6.5.	The mitigation measures required to alleviate noise impacts are provided in section 6.5.5.	C	3	13
	Noise will impact sensitive receivers during operation due to the presence of a substation onsite. Operational noise and associated impacts are discussed in section 6.5.	The mitigation measures required to alleviate noise impacts are provided in section 6.5.5.	C	3	13
Weed and Pest management	The proposal has the potential to introduce disease, weeds, vermin or destructive influences to the site Weed and pest control at the Site is the responsibility of the Proponent. The risk from	A Land Management Plan which includes weed management shall be developed and incorporated into a CEMP and OEMP to prevent further weed dispersal into retained native woodland habitats.	D	4	5

Activity	Identified Potential Conflict	Mitigating factors	P	C	RRR
	noxious weeds and pests is low but would be subject to ongoing monitoring and management.				
Use of pesticides	Pesticides may be used to control weeds at the site to ensure that the land can be returned to agricultural use upon decommissioning. The distance from neighbouring properties means the potential conflict is assessed as low.	Vegetation management practices will be implemented to minimised pesticide use such as: • The use of sheep to graze between the panel rows to manage vegetation loads • Applying pesticides in accordance with the *Pesticides Act 1999*, such that only registered pesticides are used based on label instructions that are designed to minimise impacts on surrounding land.	D	5	2

Based on the residual risk rating the activity likely to cause the greatest land use conflict is flooding followed by visual impact, the potential impact on property values and impacts caused by noise and traffic during construction. In response to this separate specialist environmental assessments have been undertaken for each and have been summarised in their respective chapters. Impacts to de-valuation of properties is incorporated into the visual assessment (refer **Appendix C**) as any impact to property value would be based on visual impacts. Mitigation measures to minimise visual impact are detailed in the landscape management plan (refer **Appendix C**).

6.3.5 Mitigation / Management Measures

Reference	Mitigation Measures
Construction and Decommissioning Mitigation Measures	
L1	Managed grazing will be used to maintain the height of ground cover during operation of the solar farm.
L2	Create and implement a remediation plan during end of operation and decommissioning.
L3	Implement the Landscape Plan (refer **Appendix C**)
L4	All pesticides will be used in accordance with the *Pesticides Act 1999*, such that only registered pesticides are used based on label instructions that are designed to minimise impacts on surrounding land
L5	All the infrastructure will be removed upon decommissioning with the possible exception of the substation, transmission lines to the substation and access road to the substation.
Operational Mitigation Measures	
L6	An OEMP will be prepared for the Proposal and will incorporate: • The land management plan including weed management • Ongoing landscaping commitments.

6.4 Visual

A Visual Impact Assessment (VIA) was undertaken by Envisage Consulting (Envisage) to investigate the potential visual impacts of the Proposal (see **Appendix C**). A summary of the key findings of this assessment are outlined below.

6.4.1 Assessment Methodology

The impact methodology used in the VIA has been based on experience with other large-scale infrastructure projects, and visual assessment guidelines used by government authorities in Australia and internationally:

- '*Environmental Impact Assessment Guidance Note – Guidelines for Landscape Character and Visual Impact Assessment*', 2013, NSW Roads and Maritime Services
- '*Visual Landscape Planning in Western Australia*', 2007, Western Australian Planning Commission
- the United Kingdom's widely used '*Guidelines for Landscape and Visual Impact Assessment*,' 2013, the Landscape Institute and Institute of Environmental Management and Assessment
- '*Best Management Practices for Reducing Visual Impacts of Renewable Energy Facilities on BLM-Administered Lands'*, 2013, United States Department of the Interior
- *'Guide to Evaluating Visual Impact Assessments for Renewable Energy Projects'*, 2014, Sullivan and Meyer, for United States Department of the Interior.

An initial step in the assessment was to identify potentially-sensitive viewing locations such as residences, and publicly accessible areas such as towns and local roads. Sensitive viewpoints were verified via aerial mapping and during the site inspection which occurred on the 26 and 27 October 2017.

Two main types of visual impacts are assessed in this report:

- Effect on the landscape character – the overall impact of a Proposal on an area's character and sense of place

- Effect on key viewpoints – the day to day visual effects of a Proposal on people's views.

The level of impact to landscape character and viewpoints is based on the combination of two criteria – 'sensitivity' and 'magnitude of change', defined by Roads and Maritime (2013) as:

- Sensitivity - The sensitivity of a landscape character zone or view and its capacity to absorb change. In the case of visual impact this also relates to the type of viewer and number of viewers
- Magnitude - The measurement of the scale, form and character of a development proposal when compared to the existing condition. In the case of visual assessment this also relates to how far the proposal is from the viewer.

The specific criteria used to determine sensitivity and magnitude of change are outlined in section 2.3 of the VIA (refer **Appendix C**).

The combination of sensitivity and magnitude provides the predicted impact rating of the effect on landscape character for a project, or visual impact for surrounding viewpoints, as shown in Table 6-8 (as adapted from Roads and Maritime, 2013).

Table 6-8 Level of Impact

Matrix of relationship between sensitivity and magnitude					
		Magnitude			
Sensitivity		**High**	**Moderate**	**Low**	**Negligible**
	High	High	Moderate-high	Moderate	Negligible
	Moderate	Moderate-high	Moderate	Low-moderate	Negligible
	Low	Moderate	Low-moderate	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

6.4.2 Existing Environment

The Proposal it is located in a rural area that is typical of the undulating, agricultural, broadacre farming areas and is situated within the North-West Slopes region of NSW, adjacent the Liverpool Plains.

The environment around the Site is dominated by cleared agricultural land which is the dominant industry in the region. The area is a significant producer of cotton, coal, beef, lamb, pork, cereal and oilseed grains. There are also several large mines in the region with the nearest the RocGlen Mine 17km to the north-west of the Site.

The town of Gunnedah and the surrounding area is focussed along the Namoi River and its wide floodplain. Local topography is generally comprised of the flat Namoi floodplain, with some gentle flanking rises and slopes. There are also several highpoints in the area such as the Bindea Hills, which rise beside Gunnedah and includes Porcupine Hill which dominates the landscape, a forested ridgeline which is part of the Kelvin Range which lies in an east-west orientation to the north of the Site, and Black Jack mountain which is located south-west of Gunnedah.

The Site comprises a series of barb-wire fenced paddocks which have been largely cleared for agricultural purposes (specifically cropping – irrigated cotton, wheat and chickpea). There are several clusters of native vegetation located in the Site which are detailed in Section 6.1.2. The Subject Land surrounding the Site currently contains a number of built structures including agricultural sheds, a temporary residential dwelling and a permanent residential dwelling which is currently under construction. Photographs of the typical landscape are shown in Figure 6-6 and Figure 6-7.

There are no natural waterways within the Site and waterways on the Subject Land surrounding the Site are limited to a large dam contained in the north-eastern corner of Lot 1 DP 1202625 which has an area of approximately 6.05 hectares. At the time of the site inspection (26 and 27 October 2017) this dam was dry. Irrigation channels are present throughout the Site to facilitate water movement for cropping from five irrigation bores and the storage dam using pumps.

There is an existing TransGrid easement which runs along Orange Grove Road at the southern boundary of the Site (refer Figure 3-5). This easement contains existing Transgrid 132kV powerlines on wooden pole structures connecting to the Gunnedah substation approximately 2.3km to the south of the Site.

A total of 24 potential viewing points was initially investigated during the site inspection (26-27 October 2017), with identification (ID) numbers allocated to identify each viewpoint. There are eight houses in elevated locations near the base of the Kelvin Hills forested range just to the north-east of the Site.

Figure 6-6 Typical rural landscape around Gunnedah – open paddocks, scattered trees, farm structures

Figure 6-7 Typical landscape character around Gunnedah – patchwork of colours and paddocks

6.4.3 Assessment of Potential Impacts

Avoidance measures

The initial visual site inspection was conducted to inform the VIA, to identify sensitive receivers and to identify site constraints to inform design. Following the site inspection, the site layout was revised to accommodate appropriate buffer distances from both residents and road users on Orange Grove Road.

Visual Intrusion

A primary concern about renewable energy is visual intrusion. Potential concerns in relation to visual intrusion include:

- Scale
- Glare
- Light refraction
- Geometric Pattern
- Risks to Aviation
- Risk to road users
- Movement
- Sky lining
- Ancillary Structures.

Each of these concerns have been addressed in **Appendix C** to determine potential visual impacts associated with these aspects. Potential impacts relevant to the solar farm are discussed below.

Scale

Industrial scale solar farms such as the Proposal can occupy very large land areas, have regular, strong geometry, and can be visible for long distances. However, when viewed from long distances, the facilities

may not be recognisable as solar facilities. Depending on the Proposals' layouts and contrast, in some cases they may appear to be like natural features, while in other cases, they may lack sufficient visual detail to be identified positively as solar facilities. Additionally, solar facilities have visual advantages in that they are generally low to the ground, have low visual contrast, and can appear as shadows from a distance.

The Proposal is of a large scale (304 hectares) however the impacts of scale are mitigated by the Proposal being low to the ground (3m above the ground), on flat ground, and that the majority of private viewpoints will view the Proposal from a distance with only seven private viewpoints within 2km.

Glare

The Solar PV modules proposed to be installed at Gunnedah are designed to absorb the light rather than reflect it. This is very different to concentrated thermal solar power which uses mirrors to reflect the sun to one point concentrating the sunlight. Furthermore, the NSW Government Discussion Paper: *Planning for Renewable Energy Generation – Solar Energy* (April 2010) states: '*The potential for glare associated with non-concentrating PV systems which do not involve mirrors or lenses are relatively limited'*.

Other infrastructure on site such as transmission poles and steel mounting frames have the potential to produce glare or glint impacts, however any impacts caused would be minor due to their small size and low surface area.

Light refraction

A 'mirage' effect — glittering or shimmering — can be sometimes observed at PV facilities. The effect is similar to the shimmering seen over a bitumen road on a hot day and occurs because the surface of the panels is hotter than the air around it. The 'mirage' effect can make the colour above the panels appear brighter and bluer. The 'mirage' effect is not bright enough to cause discomfort, and is likely to be only observed during certain times of day and from certain viewing positions. The 'mirage effect' may be observed under certain conditions at the Gunnedah Solar Farm.

Risks to Aviation

As the infrastructure is relatively low to the ground with the tallest structure (lighting pole) measuring approximately 22m the development would not pose a risk to aviation. The solar facility is a suitable distance from the Gunnedah aerodrome and private runway strip and not aligned with either runway. The PV solar panels would appear dark grey to aircraft, and does not cause a glare or reflectivity hazard.

Risk to Road Users

When driving past PV modules in rows perpendicular to the road, the colour of the panels could also change rapidly from black (when viewed from the south) to various shades from blue to white, lightening in appearance as the vehicle passes the facility. The rapid change in viewer position results in abrupt changes in angle and pattern of the panels. This visual change would only be seen if looking directly down the rows when travelling past at speed, and would be momentary.

Figure 6-8 shows the colour change in relation to viewer position. When viewed from the front, the panels appear lighter in colour – with shades of blue to white. Looking at the back, the panels appear black as they cast shadow. Tracking panels will face north and track from east to west, so they will face the north-east in the morning, to the north-west by the afternoon.

As mentioned in the section above potential glare/reflectivity generated from on-site infrastructure towards public roads is limited.

Figure 6-8 Royalla solar farm showing colour change that can occur when viewed from the front.

Movement

The solar PV panels will be mounted on a horizontal single axis tracking structure which will slowly follow the daily movement of the sun in a 120 degree turn from the north-east in the morning, to the north-west in the afternoon. As such a greater number of potential viewpoints will see the face of the PV panels although they will be exposed to this face for a shorter period of time than if the panels were fixed in that position. The movement is usually very slow and not apparent in short-duration views.

Ancillary structures

The Proposal will require a high number of ancillary structures such as inverter stations, electricity cables and the substation.

The transmission infrastructure proposed for the development would increase the density of electrical infrastructure in the area. However, the project would be generally consistent with existing transmission infrastructure in the immediate vicinity of the Proposal, and would largely occur in an existing electricity easement. Furthermore, TransGrid's electrical infrastructure has been present in the area for a significant period of time and has the capacity to absorb the visual amenity changes without marked impact to potential receptors.

There are two main types of visual impacts generated by the proposal which are:

- Impact to landscape character of the site and the surrounding area
- Visual impact to the surrounding viewpoints, both public and private.

Construction

Impact to Landscape Character

The overall landscape character is rated as having a moderate sensitivity:

- The landscape does not have particularly high scenic significance yet is an attractive, rural landscape common throughout the North-West NSW agricultural area
- The patterning of the area is dominated by geometrical patterns and a patchwork of colours ranging from the black soils, green pasture to golden crops
- The surrounding area is sparsely populated with there being a small number of permanent residential viewers on Orange Grove Road and Tudgey Road and the nearest road, Orange Grove Road, provides only local access.

During construction, there would be a number of heavy construction vehicles to deliver materials and equipment and also a higher number of light vehicles for worker transport. Additionally, the construction compound footprint would affect an area of approximately 5 hectares. Some visual impacts are expected to occur as a result of the maintenance compound, ancillary facilities, use of plant and equipment and vehicles during the construction period. These impacts will be limited to the construction period and the majority of plant will move around the site due the proposal construction occurring in one-hectare blocks with up to 10 blocks in construction at any one time. Furthermore, these areas will be stabilised once each block is complete.

Construction machinery would be present in different parts of the site however considering the prevalence of farm infrastructure and machinery this change would be relatively compatible.

The overall magnitude of change to landscape character during construction is low, based on the following:

- Relatively large extent of area affected
- The closest public views would be from Orange Grove Road, but these are not elevated and some 1km away, and Tudgey Road which is slightly elevated and almost 2km away (refer Table 6-9 for a detailed assessment of private viewpoints)
- The additional visual changes associated with the construction machinery, truck movements and a site compound would be of a short timeframe and temporary. The site compound will be returned to agricultural cropping land at the end of construction.

The moderate sensitivity ranking, combined with the low magnitude of change during construction, leads to an overall low-moderate level of impact.
Construction visual impacts to individual private and public viewpoints have not been considered as operational impacts will have a greater impact and represent a worse-case scenario.

No visual impacts in addition to those mentioned for construction are anticipated during the decommissioning phase. However, decommissioning will have a positive visual impact as it will remove the solar infrastructure and will return the existing views.

Operation

Impacts to Landscape Character
During operation, there would be permanent change to the visual landscape for road users on Orange Grove Road and Tudgey Road and surrounding private properties which are assessed below. The area of PV panels would be a very large visual feature within the surrounding landscape, however, due to the height of the PV panels and the flat terrain there are very few places where an elevated view would be possible, and therefore the change to the landscape character would not be easily perceived when viewing the landscape as a whole.

The magnitude of change to landscape character during operation is rated as moderate:

- The Site is on flat terrain and not visually prominent
- The proposed PV panels and most Site elements are low-profile and uniform across a large area

- There are no public viewpoints within 1km (the nearest is Orange Grove Road approximately 1.1km away) and no elevated viewpoints frequented by many viewers (although residents on Tudgey Road have elevated viewpoints) and therefore it would not become the dominant feature of the scene in general
- Its scale and colour would produce some contrast; however, it is not considered to be incompatible with the geometric patterning and colour of the prevalent landscape
- The substation is relatively small in scale and height and located some 1km from the nearest public viewpoint (Orange Grove Road) and more than 800m from the nearest resident.

The moderate sensitivity ranking, combined with the moderate magnitude of change post-construction, leads to an overall moderate level of impact.

Impact to Viewpoints

Public Viewpoints

The closest potential public elevated viewpoint is the Porcupine Hill lookout in the main town of Gunnedah some 8.5km away. The Proposal is not located in the part of the landscape where the main views from the lookout are orientated, and there are unlikely to be any easily discernible views of the Proposal from this viewpoint, and therefore there would be a low or negligible visual impact.

The only other public viewpoints with potential views of the Proposal are from two local roads: Orange Grove Road, some 1km to the south: and the unsealed Tudgey Road some 2km to the north. The sensitivity of Orange Grove Road is considered low as the nearest solar PV panel is approximately 1km to the north. The predicted magnitude of visual change would be at most moderate, due to: the flat terrain between the road and the substation; the separation distance; that the panels would be seen from the rear and/or side view; and the mostly low height of the substation. Therefore, the visual impact to viewpoints from Orange Grove Road has been assessed as low-moderate. As the unsealed Tudgey Road is only used by local property owners it has not been assessed in detail, as views are sufficiently covered by the assessment of impacts to private properties in the vicinity.

There would also be views of the Proposal from aircraft using Gunnedah Airport, which is situated some 8km to the south-west. It is likely that many airborne viewers would find the solar farm interesting to look at, yet others may feel it reduces the quality of the landscape character. Nevertheless, it is put forth that the overall visual impact would be low.

The assessment results of visual impact to public viewpoints finds that there would be:

- A low – moderate impact to views from Orange Grove Road
- A low – moderate impact to views from Tudgey Road
- A low or negligible impact to views from the Porcupine Hill lookout
- Low impact to aerial views from aircraft using Gunnedah Airport.

Private Viewpoints

Table 6-9 provides a detailed assessment of potential visual impacts from surrounding private viewpoints, with those viewpoints and the predicted visual impact level identified in Figure 6-9. Figure 6-10 shows the concept landscape management plan and the residual visual impacts for identified viewpoints with landscape screening. Visual screening has not been proposed for all moderately or moderate-highly impacted viewpoints due to landowner preferences, existing landscape screening within private properties and screening already proposed for viewpoints closer to the Site. Receivers which will benefit from visual screening are VP1, VP9, VP13 which will reduce the visual impact from moderate to high to moderate. Similarly, VP13, VP16 and VP17 will have a reduced visual impact from moderate to moderate or lower.

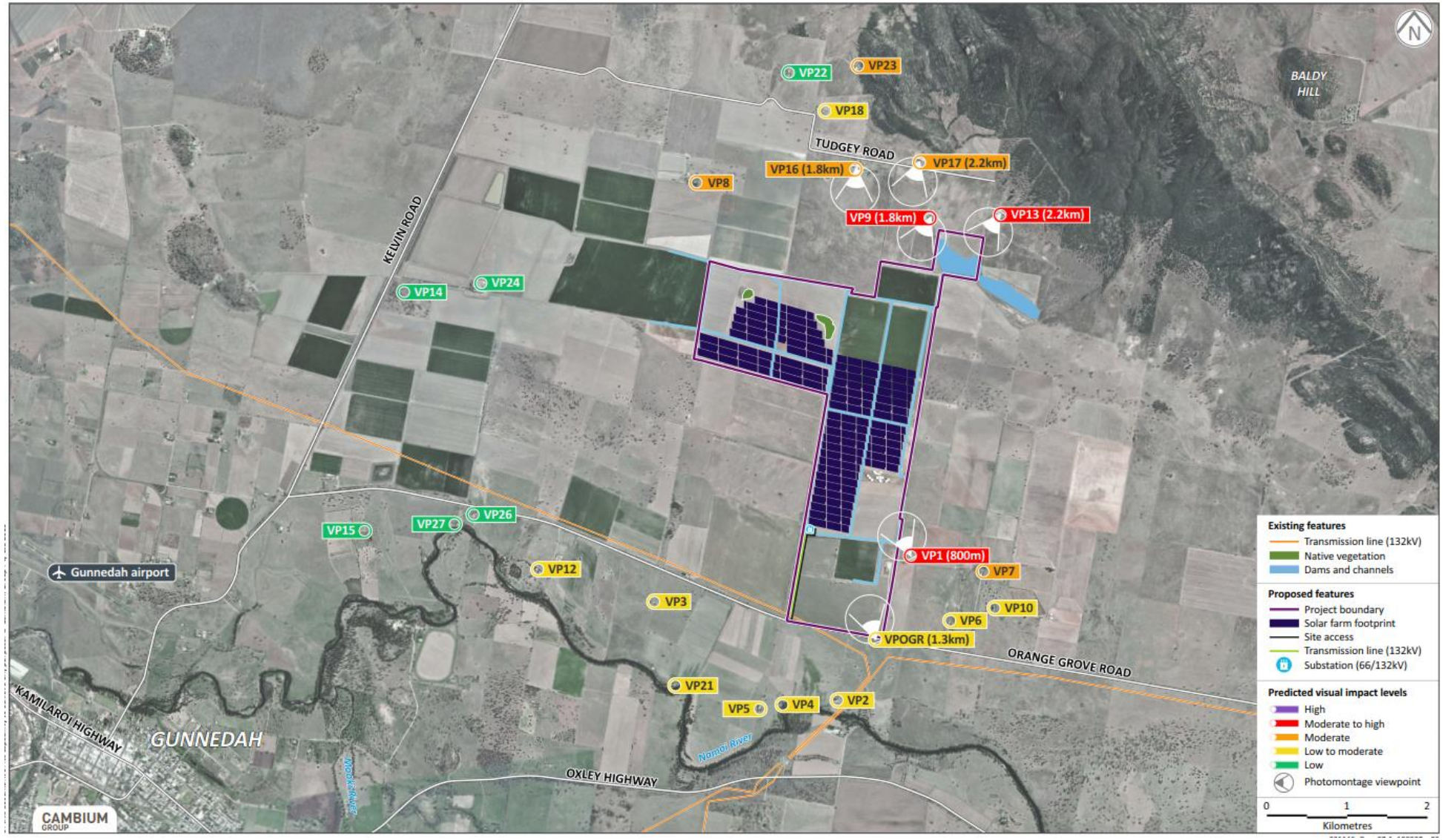

Figure 6-9 Predicted visual impacts for identified viewpoints and photomontage locations

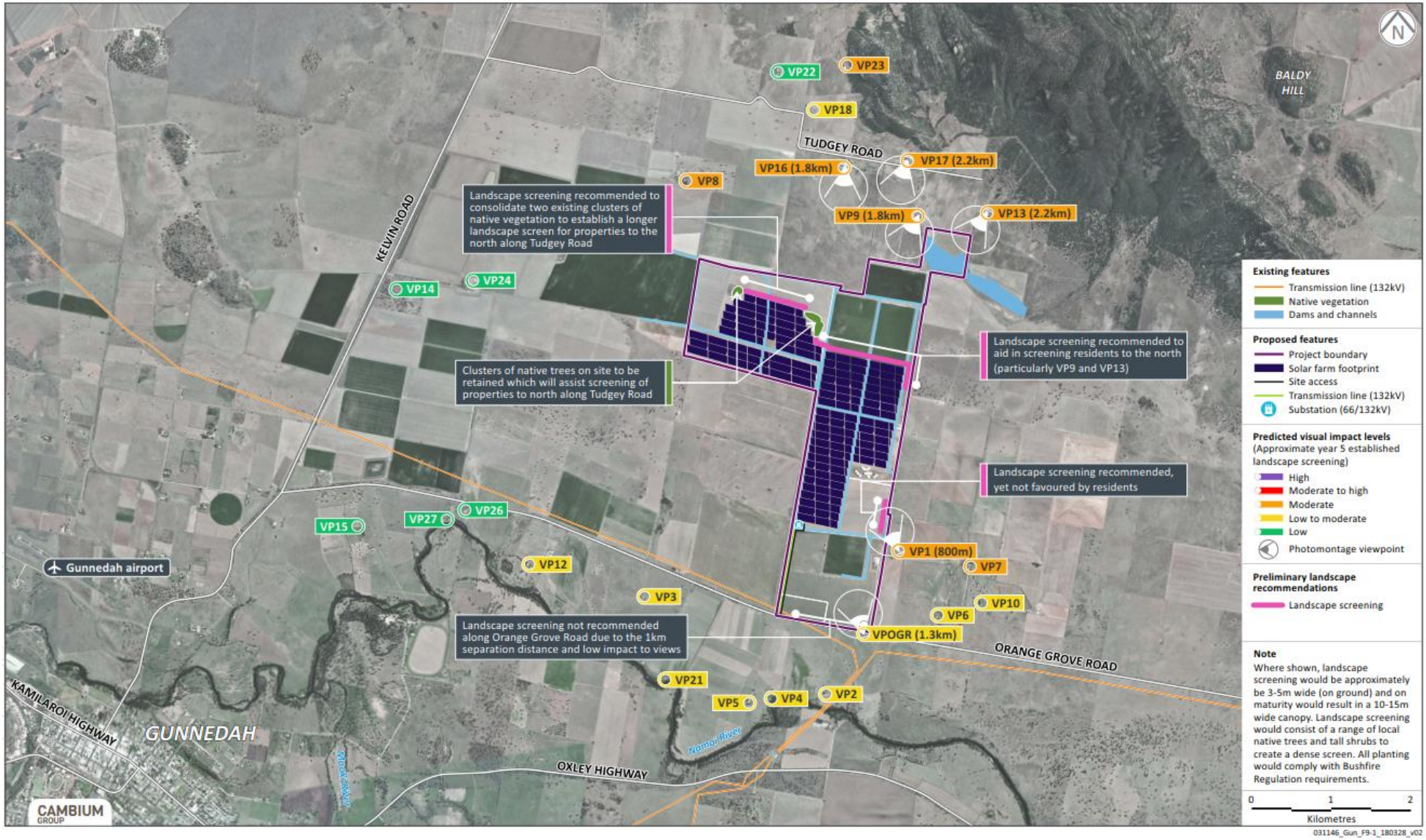

Figure 6-10 **Predicted visual impacts for identified viewpoints with landscape screening**

Table 6-9 Assessed private viewpoints (all houses) and predicted visual impact levels (Source: Envisage 2018)

Viewpoints	Analysis (on base case of no landscape screening)	Distance to nearest view of panels	Distance to substation	Position in relation to panels	Sensitivity (Criteria in VIA Appendix C)	Magnitude of Change (Criteria in VIA Appendix C)	Impact level	Visual screening proposed	Revised impact level (where relevant)
VP1* – 767 Orange Grove Road, Gunnedah	In close proximity to panels. The viewpoint is a private home with mostly unimpeded views. Slightly higher (several metres) in elevation so some views would extend over the broader solar farm. Substation more than 1km away	800m	1.25km	East, front (morning) & rear View (after noon)	High	Moderate	Moderate - High	Yes, landscape screening has been recommended however this approach is not favoured by the landowner	Moderate
VP2 – 726 Orange Grove Road, Gunnedah	In moderate proximity to panels. The view is from a private home, with closer views from front of property. Existing trees around home would likely partially screen views. Due to low elevation, coupled with rear view of panels, would mean	2km	2km	South, side view	Moderate	Low	Low-Moderate	No	N/A

Viewpoints	Analysis (on base case of no landscape screening)	Distance to nearest view of panels	Distance to substation	Position in relation to panels	Sensitivity (Criteria in VIA Appendix C)	Magnitude of Change (Criteria in VIA Appendix C)	Impact level	Visual screening proposed	Revised impact level (where relevant)
	panels difficult to discern from house. Substation 2km away.								
VP3 – 476 Orange Grove Road, Gunnedah	In moderate proximity to panels. The view is from a private home, with closer views from front of property and some intervening trees Due to low elevation, coupled with rear view of panels, it would mean panels difficult to discern from house. Substation 2km away.	2km	2km	South-west, side/rear view	Moderate	Low	Low – Moderate	No	N/A
VP4 – 640 Orange Grove Road, Gunnedah	In moderate proximity to panels. The view is from a private home, with closer views from front of property. Trees around home would partially screen views. Due to low elevation, coupled with side view of panels, it would mean	2.1km	2.1km	South, side view	Moderate	Low	Low-moderate	No	N/A

Viewpoints	Analysis (on base case of no landscape screening)	Distance to nearest view of panels	Distance to substation	Position in relation to panels	Sensitivity (Criteria in VIA Appendix C)	Magnitude of Change (Criteria in VIA Appendix C)	Impact level	Visual screening proposed	Revised impact level (where relevant)
	panels likely difficult to discern from house. Substation over 2km away.								
VP5 – 640 Orange Grove Road, Gunnedah	In moderate proximity to panels. The view is from a private home, with closer views from front of property. Trees around home would partially screen views. Due to low elevation, coupled with side view of panels, it would mean panels difficult to discern from house. Substation over 2km away.	2.2km	2.2km	South, side view	Moderate	Low	Low-moderate	No	N/A
VP6 – 851 Orange Grove Road, Gunnedah	In moderate proximity to panels. The viewpoint is a private home with mostly unimpeded views. Due to low elevation, coupled with generally a side/rear view of panels, it would mean panels	1.7km	2km	East, front (morning) & rear view(afternoon)	Moderate	Low	Low - moderate	No	N/A

Viewpoints	Analysis (on base case of no landscape screening)	Distance to nearest view of panels	Distance to substation	Position in relation to panels	Sensitivity (Criteria in VIA Appendix C)	Magnitude of Change (Criteria in VIA Appendix C)	Impact level	Visual screening proposed	Revised impact level (where relevant)
	difficult to discern from house. Substation over 2km away.								
VP7 – 875 Orange Grove Road, Gunnedah	In moderate proximity to panels. The viewpoint is a private home with mostly unimpeded views. Due to low elevation, only outer edge of panels (front in the morning) would be visible. Substation over 2km away.	1.5km	2.1km	East, front (morning) & rear view(after-noon)	Moderate	Moderate	Moderate	No, Landscape screening is not favoured by the landowner	N/A
VP8 – 254 Tudgey Road, Kelvin	In moderate proximity to panels. The viewpoint is a private home with mostly unimpeded views. Slightly higher in elevation so some views over broader solar farm with front of some panels seen in afternoon, and mostly rear of panels in morning.	1.55km	4.5km	North – front (after-noon) & rear (morning)	Moderate	Moderate	Moderate	The viewpoint has adequate existing screening within the property. Additionally, screening will be present to the north of the Proposal and the clusters of	N/A

Viewpoints	Analysis (on base case of no landscape screening)	Distance to nearest view of panels	Distance to substation	Position in relation to panels	Sensitivity (Criteria in VIA Appendix C)	Magnitude of Change (Criteria in VIA Appendix C)	Impact level	Visual screening proposed	Revised impact level (where relevant)
								native vegetation will be retained which will provide some screening.	
VP9* – 616 Tudgey Road, Kelvin	In moderate proximity to panels. The viewpoint is a private home with mostly unimpeded views (new house under construction). House location approximately 15m higher in elevation than solar farm so would therefore have elevated views and see a portion of front face of panels at different times of the day At times, could see a 'mirage' or 'shimmering' effect.	1.8km	4km	North – generally a side view, with front face of some panels seen at different times	High (due to elevation)	Moderate	Moderate - high	Yes	Moderate
VP10 – 897 Orange Grove Road, Gunnedah	In moderate proximity to panels.	2.0km	2.4km	East, front (morning) & rear view(after-noon)	Moderate	Low	Low-moderate	No	N/A

Viewpoints	Analysis (on base case of no landscape screening)	Distance to nearest view of panels	Distance to substation	Position in relation to panels	Sensitivity (Criteria in VIA Appendix C)	Magnitude of Change (Criteria in VIA Appendix C)	Impact level	Visual screening proposed	Revised impact level (where relevant)
	The viewpoint is a private home with mostly unimpeded views. Due to low elevation, only outer edge of panels (front in the morning) and substation would be visible. Substation over 2km away.								
VP13* – 691 Tudgey Road, Kelvin	In moderate proximity to panels. The viewpoint is a private home with mostly unimpeded views. House approximately 30m higher in elevation than solar farm so would therefore have elevated views and see a large portion of front of panels mostly in morning. At times, could see a 'mirage' or 'shimmering' effect mostly in the morning.	2.2km	4.5km	North – slightly front view (morning) & generally rear view (afternoon)	High	Moderate	Moderate-high	Yes	Moderate

Viewpoints	Analysis (on base case of no landscape screening)	Distance to nearest view of panels	Distance to substation	Position in relation to panels	Sensitivity (Criteria in VIA Appendix C)	Magnitude of Change (Criteria in VIA Appendix C)	Impact level	Visual screening proposed	Revised impact level (where relevant)
VP14 – 554 Kelvin Road, Gunnedah	The viewpoint is a private home with some intervening trees. Due to low elevation, only outer edge of front of panels (in afternoon) would be visible yet at some distance.	2.7km	5km	West, side view	Low	Low	Low	No	N/A
VP15 – 88 Orange Grove Road, Gunnedah	The viewpoint is a private home surrounded by some trees. Due to low elevation, only outer edge of panels (front in afternoon) and substation would be visible (yet barely discernible if at all).	5.3km	5.3km	West, side view	Low	Low	Low	No	N/A
VP16* – 526 Tudgey Road, Kelvin	In moderate proximity to panels. The viewpoint is a private home with mostly unimpeded views. House approximately 8m higher in elevation than solar farm so would therefore have slightly elevated views and see a moderate portion of front	2.1km	4.5km	North – generally a side view, slight view of front in afternoon	Moderate	Moderate	Moderate	Yes	Moderate or lower

Viewpoints	Analysis (on base case of no landscape screening)	Distance to nearest view of panels	Distance to substation	Position in relation to panels	Sensitivity (Criteria in VIA Appendix C)	Magnitude of Change (Criteria in VIA Appendix C)	Impact level	Visual screening proposed	Revised impact level (where relevant)
	of panels (mostly in afternoon). At times, could see a 'mirage' or 'shimmering' effect, yet only narrow band seen.								
VP17* – 516 Tudgey Road, Kelvin	In moderate proximity to panels. The viewpoint is a private home with mostly unimpeded views. House approximately 25m higher in elevation than solar farm so would therefore have elevated views and see a large portion of mostly side of panels all day.	2.4km	4.5km	North – generally a side view	Moderate	Moderate	Moderate	Yes	Moderate or lower
VP18 – 413 Tudgey Road, Kelvin	The viewpoint is a private home with mostly unimpeded views. House approximately 10m higher in elevation than solar farm so would therefore have elevated views and see a moderate portion of front of panels (mostly in afternoon).	2.6km	5km	North – generally a side view, slight view of front in afternoon	Moderate	Low	Low-moderate	No	N/A

Viewpoints	Analysis (on base case of no landscape screening)	Distance to nearest view of panels	Distance to substation	Position in relation to panels	Sensitivity (Criteria in VIA Appendix C)	Magnitude of Change (Criteria in VIA Appendix C)	Impact level	Visual screening proposed	Revised impact level (where relevant)
	At times, could see a 'mirage, or 'shimmering' effect. Distant views towards substation.								
VP21 – 538 Orange Grove Road, Gunnedah	The view is from a private home, with closer views from front of property. Trees around home would partially screen views. Due to low elevation, the Proposal would be difficult to discern from the house.	2.4km	2.4km	South, rear view	Moderate	Low	Low - moderate	No	N/A
VP22 – 351 Tudgey Road, Kelvin	The viewpoint is a private home with mostly unimpeded views. House approximately 15m higher in elevation than solar farm so would therefore have elevated views and see a moderate portion of front of panels (in afternoon) yet due to position only over a narrow band.	3km	5.5km	North -west, rear view (morning), slight view of front in afternoon	Low	Low	Low	No	N/A

Viewpoints	Analysis (on base case of no landscape screening)	Distance to nearest view of panels	Distance to substation	Position in relation to panels	Sensitivity (Criteria in VIA Appendix C)	Magnitude of Change (Criteria in VIA Appendix C)	Impact level	Visual screening proposed	Revised impact level (where relevant)
	At times, could see a 'mirage' or 'shimmering' effect.								
VP23 – 415 Tudgey Road, Kelvin	The viewpoint is a private home with mostly unimpeded views. House approximately 50m higher in elevation than solar farm so would therefore have elevated views and see a moderate portion of front of panels (in afternoon) yet due to position only over a narrow band, At times, may see a 'mirage' 'shimmering' effect.	3.3km	5.7km	North – generally a side view, slight view of front in afternoon	Low (due to elevation)	Moderate (due to elevation)	Moderate	No, Screening is already proposed along the northern boundaries of the site to provide visual screening for VP9, VP13, VP16 and VP17. No additional screening is required.	N/A
VP24 – 632 Kelvin Road, Gunnedah	The viewpoint is a private home surrounded by some trees, Due to low elevation, distance and trees there would be a low chance of discernible views.	3.3km	5.4km	West, rear in morning, front on afternoon	Low	Low	Low	No	N/A

Viewpoints	Analysis (on base case of no landscape screening)	Distance to nearest view of panels	Distance to substation	Position in relation to panels	Sensitivity (Criteria in VIA Appendix C)	Magnitude of Change (Criteria in VIA Appendix C)	Impact level	Visual screening proposed	Revised impact level (where relevant)
VP26 – 242 Orange Grove Road, Gunnedah	The viewpoint is a private home surrounded by some trees, Due to low elevation, only outer edge of panels and substation would be visible (yet barely discernible).	4.1km	4.1km	West, rear in morning, front in afternoon	Low	Low	Low	No	N/A
VP27 – 224 Orange Grove Road, Gunnedah	The viewpoint is a private home surrounded by some trees. Due to low elevation, only outer edge of panels and substation would be visible (yet barely discernible).	3.9km	3.9km	West, rear in morning, front in afternoon	Low	Low	Low	No	N/A
*Photomontages provided in Section 8.0 of the VIA (**Appendix C**) ** Impact levels only revised where initial impact level moderate to high or higher									

Photomontages

Photomontages have been prepared for multiple viewpoints (refer section 8 of **Appendix C**). The selected viewpoints were based on the potential level of visual impact and concerns raised by landowners. The photomontages represent a momentary point in time, and for consistency illustrate the position of the panels at approximately 9.00am, which would be a 'worst case' scenario for the most-affected residents (i.e. those to the east and north), as the panels would be partially facing in their direction.

VP1 is the closest residence to the Proposal, located approximately 800m south-east of the Proposal, and slightly higher in elevation (several metres). The rear and side views of the panels would be visible from this viewpoint. The assessed visual impact level, without landscape screening, was assessed at moderate-high. Refer to Figure 6-11and Figure 6-12.

VP9 is located 1.8km north of the Proposal and is approximately 15m higher in elevation than the Proposal and so there would be elevated views of a large portion of the front of the solar panels and a mirage effect may also occur. The assessed visual impact level, without landscape screening, was assessed at moderate-high, but the visual impact level with landscape screening has been revised down to moderate. Refer to Figure 6-13, Figure 6-14 and Figure 6-15.

VP13 is located 2.2km north-east of the proposal and is approximately 15m higher in elevation than the Proposal and so there would be elevated views of a large portion of the solar panels. As the panels turn, a portion of the front face of panels would be seen, mostly in the morning. At times a 'mirage' or 'shimmering' effect could be evident mostly in the morning. The assessed visual impact level, without landscape screening, was assessed at moderate-high but the visual impact level with landscape screening has been revised down to moderate. Refer to Figure 6-16, Figure 6-17 and Figure 6-18.

VPOGR (Orange Grove Road) is located approximately 1.3km away, from the Proposal. The visual impact to public viewpoints from Orange Grove Road was assessed as low-moderate due to: the flat terrain between the road and the substation; the separation distance; that the panels would be seen from the rear and/or side view; and the mostly low height of the substation. No landscape screening has been recommended. Refer to Figure 6-19 and Figure 6-20.

VP16 is located 1.8km north of the Proposal and is slightly elevated, being approximately 8m higher. A large portion of the panels would be seen but the depth of view would be narrow (i.e. the panels would appear as a thin band). The assessed visual impact level, without landscape screening, was assessed at moderate but the visual impact level with landscape screening has been revised down to moderate or less. Refer to Figure 6-21, Figure 6-22 and Figure 6-23.

VP17 is located 2.2km north of the Proposal and is approximately 25m higher in elevation than the Proposal. As the panels move through the day a large portion of the side of the panels would be seen all day. The assessed visual impact level, without landscape screening, was assessed at moderate, but the visual impact level with landscape screening has been revised down to moderate or less. Refer to Figure 6-24, Figure 6-25 and Figure 6-26.

Figure 6-11 Photomontage of existing views from Viewpoint 1

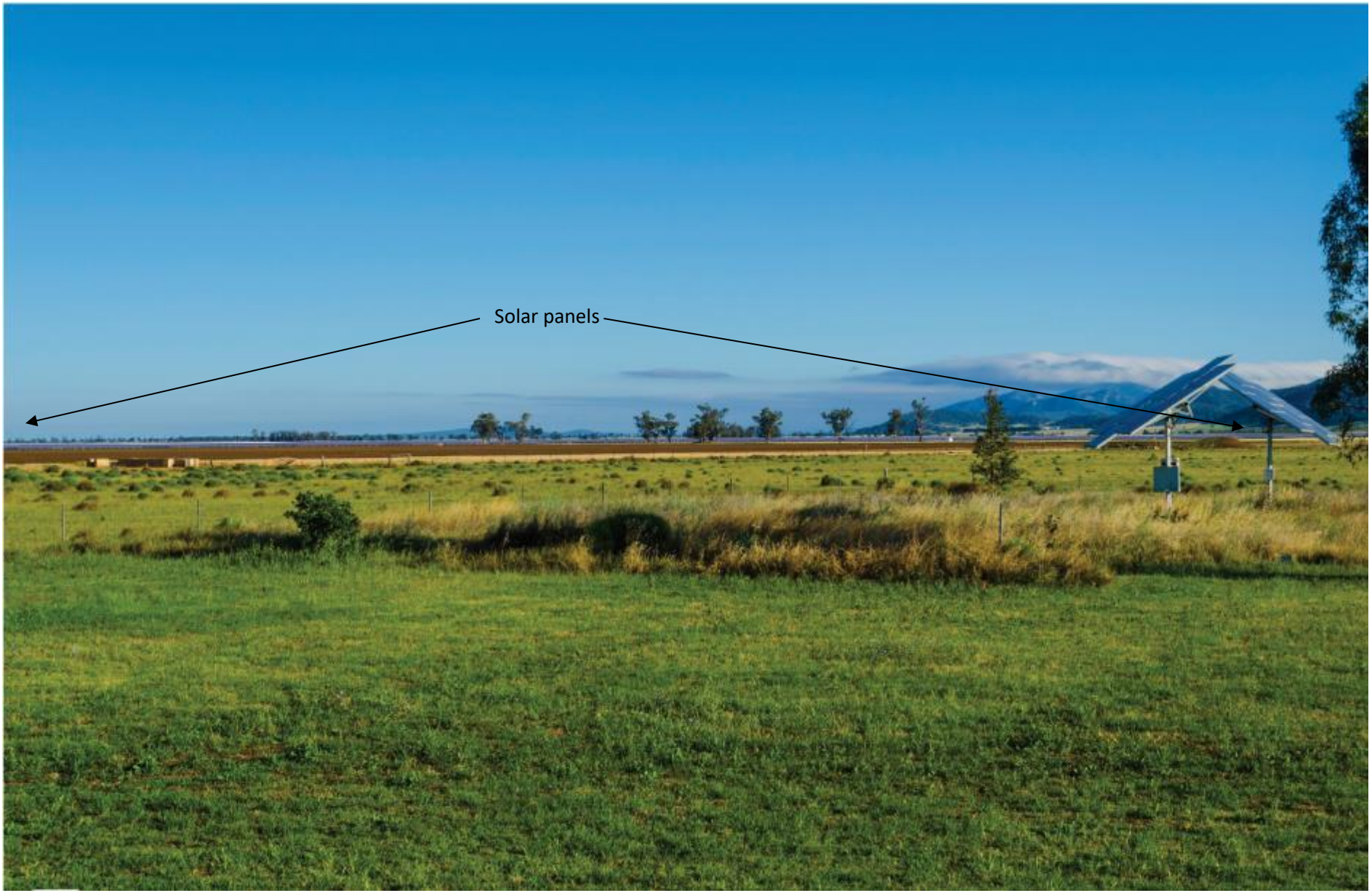

Figure 6-12 Photomontage of Viewpoint 1 with the Proposal

Figure 6-13 Photomontage of existing views from Viewpoint 9

Figure 6-14 Photomontage of Viewpoint 9 with the Proposal

Figure 6-15 Photomontage of Viewpoint 9 with the Proposal and landscape screening

Figure 6-16 Photomontage of existing views from Viewpoint 13

Figure 6-17 Photomontage of Viewpoint 13 with the Proposal

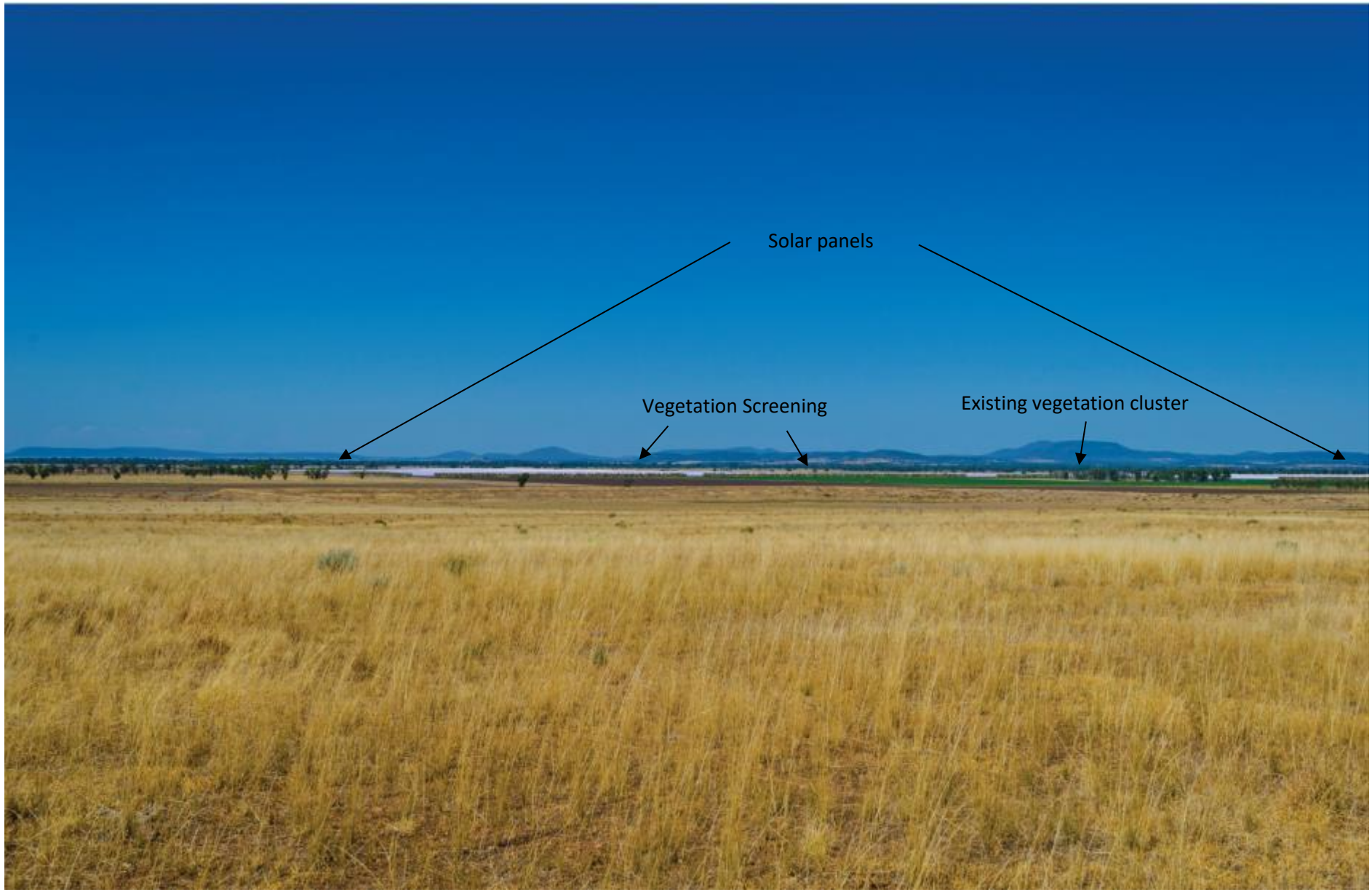

Figure 6-18 Photomontage of Viewpoint 13 with the Proposal and landscape screening

Figure 6-19 Photomontage of existing views from Viewpoint OGR

Figure 6-20 Photomontage of Viewpoint OGR with the Proposal

Figure 6-21 Photomontage of existing views from Viewpoint 16

Figure 6-22 Photomontage of Viewpoint 16 with the Proposal

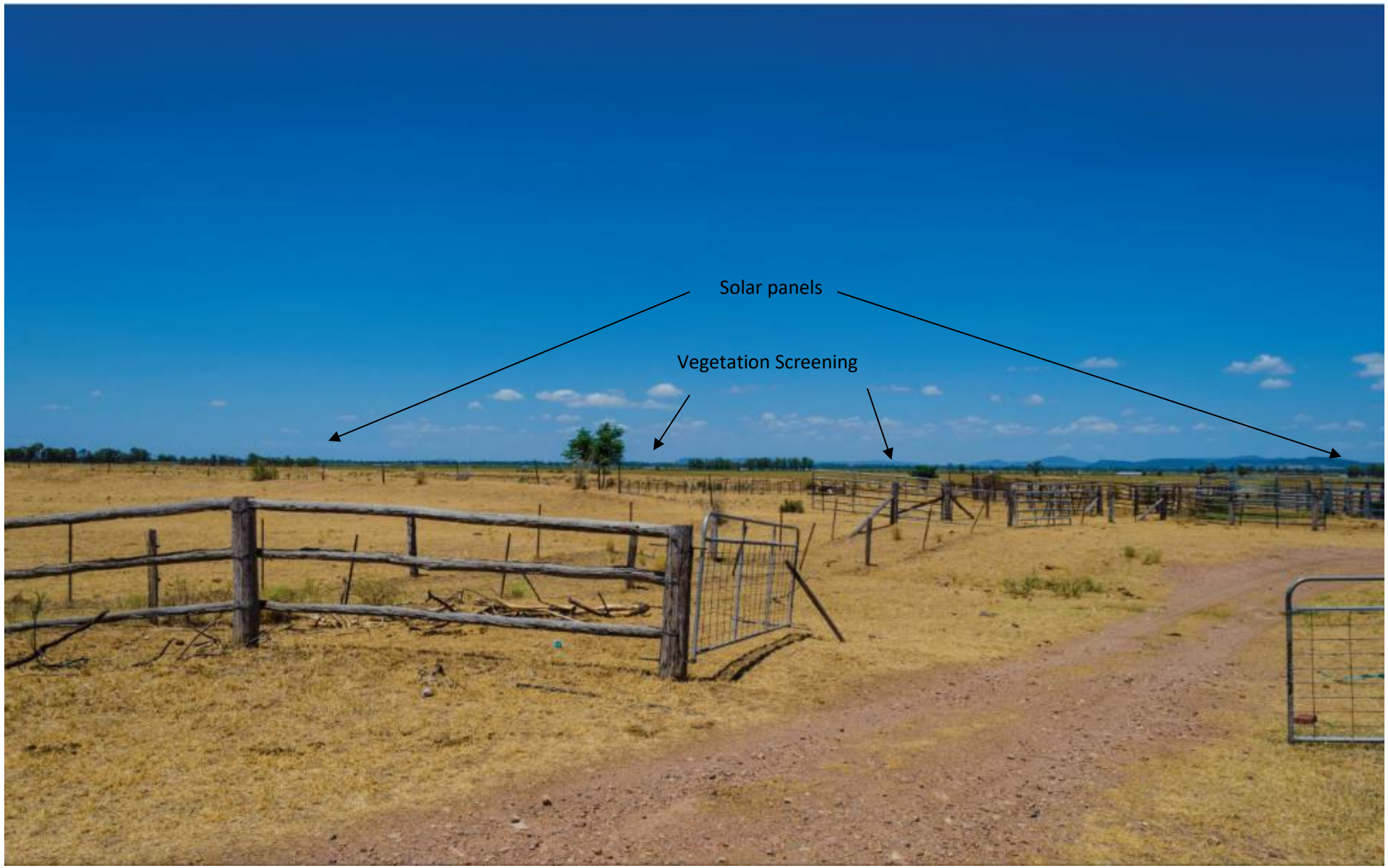

Figure 6-23 Photomontage of Viewpoint 16 with the Proposal and landscape screening

Figure 6-24 Photomontages of existing views from Viewpoint 17

Figure 6-25 Photomontage of Viewpoint 17 with the Proposal

Figure 6-26 Photomontage of Viewpoint 17 with the Proposal and landscape screening

A summary of the levels of impact for each private viewpoint is given in Table 6-10.

Table 6-10 Summary of identified potentially affected private viewpoints

Impact level	Number	Residential/private viewpoints identified as potentially impacted
High impact	0	No viewpoints with a high impact
Moderate – high impact	3	VP1, VP9, VP13,
Moderate impact	5	VP7, VP8, VP16, V17, VP23
Moderate – low impact	8	VP2, VP3, VP4, VP5, VP6, VP10, VP18, VP21,
Low impact	6	VP14, VP15, VP22, VP24, VP26, VP27

6.4.4 Mitigation / Management Measures

Reference	Mitigation Measures
Construction and Decommissioning Mitigation Measures	
V1	*Minimise impact through use of siting and design features* • Group ancillary facility structures where possible to minimise sprawl • Stabilise new access tracks formed within the Site required for operations, but do not seal with bitumen or other dark coating.
V2	*Minimise and repair ground disturbance* • Minimise grading across the Site and undertake the minimum levelling necessary to install panel supports • Rehabilitate exposed ground surfaces as soon as possible.
V3	Implement Concept Landscape Plan (refer **Appendix C**), which includes visual screening.
V4	Retain all existing trees
V5	Retain as much existing ground cover (pasture grasses) beneath solar panels as possible.
V6	Progressively stabilise disturbed area with pasture grasses.
Operational Mitigation Measures	
V7	*Minimise impact through use of siting and design features* • Signage required at the Site should be of sufficient size to be readable at driver height within short range (0-20m) and contain only information sufficient for basic facility and company identification, for safety, navigation, and delivery purposes. Large scale signage will not be installed.
V8	*Avoid Night Sky Impacts* • Lighting will be limited to compulsory lighting required for the substation. Substation lighting will be turned on if an intrusion is detected or if staff are on site undertaking works outside of daylight hours • Amber colour lights will be used rather than bluish-white lighting.
V9	An OEMP will be prepared for the Proposal and will incorporate: • A complaints management process.
V10	Monitor performance of screen planting areas six-monthly for first three years then annually. Replant as necessary if plants die, and supplement planting with alternative species of plants are not adapting to the Site.

6.5 Noise

A Noise Impact Assessment (NIA) was undertaken by Muller Acoustic Consulting Pty Ltd (MAC) to investigate the potential acoustic impacts of the Proposal (see **Appendix H**). A summary of the key findings of this assessment are outlined below.

The report was prepared in accordance with the following policies and guidelines:

- NSW DECCW *Interim Construction Noise Guideline 2009* (ICNG)
- NSW EPA *Industrial Noise Policy 2000* (INP)
- NSW EPA *Road Noise Policy 2011* (RNP).

6.5.1 Assessment Methodology

A quantitative noise assessment has been undertaken in accordance with the ICNG. The quantitative assessment method involves predicting noise levels and comparing them with the levels in the ICNG which have been reproduced in Table 6-16.

The initial step in the assessment was to identify sensitive receivers which were verified via aerial mapping and during the site inspection which occurred on the 26 and 27 October 2017.

To quantify existing background noise levels, long-term unattended and short-term operator attended noise measurements were performed at representative receptors located near the project between Thursday 26 October 2017 to Saturday 4 November 2017. Background noise levels are given in Section 6.5.2.

Noise modelling was used to determine the impact of project noise emissions to neighbouring receivers for typical construction activities and operations.

Noise emission data and assumptions used in this assessment are summarised in Table 6-11.

Table 6-11 Construction Equipment Sound Power Levels (Lw) dBA re 10^{-12} W

Noise Source/Item	Utilisation %	Quantity	Lw/Item	Total Lw
TRENCHING & EARTHWORKS				
Backhoe	100	1	104	104
Light vehicle	50	2	76	76
Total – Trenching & Earthworks				**104**
PILING				
Piling Rig (Hydraulic)	100	1	113	113
Tele-handler	80	1	106	105
Light Vehicle	50	1	76	73
Total – Piling				**114**
ASSEMBLY				
Mobile Crane/ HIAB	100	1	104	104
Tele-handler	100	1	106	106
Light vehicle	50	2	76	76

Noise Source/Item	Utilisation %	Quantity	Lw/Item	Total Lw
Hand tools/power tools	25	1	102	96
Welder	25	1	105	99
Total – Assembly				**109**
TRANSPORT (On site)				
Heavy vehicle	100	1	104	104
Tele-handler	100	1	106	106
Total – Transport				**110**

Operational noise predictions were modelled for a typical worst case operational scenario over a 15-minute assessment period based on the operational assumptions and sound power levels in Table 6-12.

Table 6-12 Operational Equipment Sound Power Levels dBA re 10^{-12} W

Noise Source / Item	Activity	Quantity	Lw/Item	Total Lw
PV Panel Tracking Motor[1]	All tracking motors in operation 1 minute per 15-minute period	6,730	78	104
Transmission Kiosk – each consisting of the following				
• Inverter	Constant	34	75	90
• Transformer	Constant	34	70	85
• Capacitor Battery	Constant	34	75	90
Transmission Kiosk – Total	Constant	34	79	99
Substation	Constant	1	90	90
Light vehicle	2 vehicles arrive and depart from site (5 minutes duration)	2	76	79
Note 1: Tracking motor is situated underneath the PV panel, -5dB attenuation applied to account for shielding provided by the panel. Note 2: Modifying factor penalty of +5dB added for low frequency and tonality. Note 3: -5dB applied to account for power station/ kiosk vented enclosure.				

6.5.2 Existing Environment

Surrounding area

From observations whilst on site, the noise environment at existing residential receptors is best described as 'rural' in accordance with the INP, being an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic noise and generally characterised by low background noise levels.

Potentially affected sensitive receivers

A total of 25 sensitive receivers were identified as having the potential to be affected by noise. The identified receivers are presented in Figure 6-27 and **Appendix H**.

Figure 6-27 Sensitive receiver locations (Figure 1 of MAC Noise Assessment, 2018)

Background noise levels

Criteria for the assessment of construction and operational noise are usually derived from the existing noise environment of an area. To quantify existing noise levels, long-term unattended and short-term operator attended noise measurements were performed at representative receptors located near the project, these locations are presented in Table 6-13 and Figure 6-27.

Table 6-13 Noise Monitoring Locations

ID	Unattended Noise Monitoring Locations	Site Description	Coordinates (MGA 56)	
			Eastings	Northings
L1	Project Site	765 Orange Grove Road	6572270	247117
L2	Kelvin Road	Corner of Kelvin and Orange Grove Road	6572950	239671

The results of the unattended noise measurements for both background monitoring locations, including derived RBLs are summarised in Table 6-14.

Table 6-14 Unattended Noise Monitoring

Unattended Noise Monitoring Location	Time Period	Measured background Level RBL LA_{90}, dBA	Measured Ambient Noise Level LAeq, dBA
L1 Project Site	Day	26	55
	Evening	30	51
	Night	28	46
L2 Kelvin Road	Day	30	59
	Evening	27	57
	Night	26	55
Note: Monday to Saturday: Day 7am to 6pm; Evening 6pm to 10pm; Night 10pm to 7am. On Sundays and Public Holidays, Day 8am to 6pm; Evening 6pm to 10pm; Night 10pm to 8am			

In accordance with the INP, where background noise levels are less than 30dB(A), the minimum applicable background noise level is recommended to be set at 30dB(A). Therefore, this minimum background noise level has been adopted for all receiver locations nominated during the night time assessment period.

The route via Kelvin Road and O'Keefe Avenue crossing the Namoi River on Cohen's Bridge would be used for light vehicles access and worker transport (shuttle buses). Receptors at 515 Orange Grove Road (OG10) and 351 Kelvin Road (K1) are the closest receptors on any of the access routes and are both 40 m from the road edge. Therefore, an offset distance of 40m has been adopted as the nearest offset to heavy vehicle movements along the public road network.

As there is potential for construction road traffic noise impacts, road traffic noise was assessed at noise monitoring location L2 – Kelvin Road. Existing road traffic noise levels along Kelvin Road are summarised in Table 6-15.

Table 6-15 Existing Road Traffic Noise Levels

Noise Monitoring Location	Time Period[1]	Existing Road Traffic Noise
L2 – Kelvin Road	Day	59 dB LAeq, 15 hr
	Night	55 dB LAeq, 9hr
Note 1: Day 7am to 10pm; Night 10pm to 7am.		

6.5.3 Criteria

Construction Noise Criteria

In NSW, noise impacts arising from construction activities are managed in accordance with the ICNG. According to the guideline, a quantitative assessment of noise impacts is warranted when works are likely to impact an individual or sensitive land use for more than three weeks in total. Table 6-16 below (reproduced from Table 2 of the ICNG) sets out the noise management levels for residences and how they are to be applied. Residential receivers are considered '*noise affected*' where construction noise levels are greater than the noise management levels identified in Table 6-16.

Table 6-16 Noise management levels at residential receivers

Time of Day	Management Level LAeq (15 minutes) *	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected 52 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (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: • Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) • If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected Evening 47 dB(A) Night 42 dB(A)	A strong justification should 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 5dB (A) above the noise affected level, the proponent should negotiate with the community.

Time of Day	Management Level LAeq (15 minutes) *	How to Apply
		For guidance on negotiating agreements see section 7.2.2 of the ICNG.
* 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.		

Construction Noise Management Levels (NMLs) for construction activities at all residential receivers are 45dB LAeq,15min (RBL +10dB). Although construction activities are only planned for standard hours, the relevant NML standard construction hours and out of hours' periods are summarised in Table 6-17.

Table 6-17 Noise Management Levels

Location	Assessment Period	RBL, dBA	NML dB LAeq, 15 min
Residential Receptors	Day (Standard hours)	35	45 (RBL + 10 dBA)
	Evening (OOH Period 1)	30	35 (RBL + 10 dBA)
	Night (OOH Period 2)	30	35 (RBL + 10 dBA)

Operational Noise Criteria

The INP sets out noise criteria to control the noise emission from industrial noise sources. Mechanical and operational noise from the development shall be addressed following the guideline in the INP.

The calculation is based on the results of the ambient and background noise unattended monitoring, addressing two components:

- Controlling intrusive noise into nearby residences (Intrusiveness Criteria)
- Maintaining noise level amenity for particular land uses (Amenity Criteria).

The intrusiveness criterion can be summarised as LAeq, 15 minute ≤ RBL background noise level plus 5 dB(A) (refer Table 6-18).

The amenity criterion and project amenity noise levels (PANL) defines the acceptable noise levels that will protect against noise impacts such as speech interference, community annoyance and to some extent sleep disturbance, these are outlined in Table 6-18.

The Project Noise Trigger Levels (PNTLs) is the lower of either the Intrusiveness Noise Level or the PANL (refer Table 6-18).

Table 6-18 Intrusiveness, amenity and project noise trigger levels

Receiver	Time Period	Background Noise Level RBL dB LA_{90}	Adopted RBL	Intrusiveness Noise Level dB LAeq, 15 min	Recommended Amenity Noise Level dB LAeq, period	PANL dB LAeq, 15 min[2]	PNTL dB LAeq, 15 min
Residential (Rural area)	Day (7am to 6pm)	26	35	40	50	53	40
	Evening	30	30	35	45	48	35

	(6pm to 10pm)						
	Night (10pm to 7am)	28	30	35	40	43	35
Note 1: Monday to Saturday: Day 7am to 6pm; Evening 6pm to 10pm; Night 10pm to 7am. On Sundays and Public Holidays, Day 8am to 6pm; Evening 6pm to 10pm; Night 10pm to 8am. Note 2: Includes a +3dB adjustment to the amenity period level to convert to a fifteen-minute assessment period as per Section 2.2 of the NPI.							

Road Traffic Noise Criteria

Road traffic noise is assessed in accordance with the NSW Road Noise Policy (RNP) (DECC 2011). The criterion (Table 3 – Road Traffic Noise Assessment Criteria for Residential Land Uses) divides land use developments into different categories and lists the respective criteria for each case. The category that is relevant to the proposed use of the site is Freeway/arterial/sub-arterial as shown below in Table 6-19.

Table 6-19 NSW Road Noise Policy – Traffic Noise Assessment Criteria

Road Category	Type of project / land use	Assessment Criteria	
		Day (7am – 10pm)	Night (10pm – 7am)
Freeway/arterial/sub-arterial road	Existing residences affected by noise from existing freeway/arterial/sub-arterial roads generated by land use developments.	60dBA LAeq, 15hr external	55dBA LAeq, 9hr external
Note: For road noise assessments, the day period is from 7am to 10pm (i.e. there is no evening assessment period as there is with operational noise). Night is from 10pm to 7am.			

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2dB, which is generally accepted as the threshold of perceptibility to a change in noise level.

In addition to meeting the assessment criteria, any significant increase in total traffic noise at receivers must be considered. Receivers experiencing increases in total traffic noise levels above those presented in Table 6-20 due to the addition of vehicles on Kelvin Road should be considered for mitigation. This relative increase criteria is not applicable to local roads.

Table 6-20 Relative Increase Criteria for Residential Land Use

Road Category	Type of project / land use	Assessment Criteria	
		Day (7am – 10pm)	Night (10pm – 7am)
Freeway/arterial/sub-arterial road	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road.	Existing traffic LAeq,15hr +12dB (external)	Existing traffic LAeq,9hr +12dB (external)

6.5.4 Assessment of Potential Impacts

Construction

Construction activities would result in a temporary increase in localised noise levels, particularly for sensitive receivers located close to the proposal site or along the haulage route. Construction would be carried out within standard construction hours (i.e. Monday to Friday 7 am to 6 pm; Saturday 8 am to 1 pm; No work on Sundays or public holidays) with no out of hours' work proposed.

The key noise generating activities that will occur are listed below:

- Earthworks involving trenching for cabling
- Piling of panel supports
- Assembly of the panels.

It is envisaged that all three-key noise generating activities could occur simultaneously at up to 10 locations across the Site, along with substation construction, vehicle movements on the site and deliveries of materials to site.

Table 6-21 presents the maximum noise levels from each construction scenario that are likely to be experienced at the nearby affected receiver locations during the construction works. The results show that the works comply with the NMLs at all residential receptors for the day period.

Table 6-21 Predicted Construction Noise Levels

Receiver ID	Description	Highest Predicted Construction Noise Level dB LAeq,15min	NML Standard Hours dB LAeq,15min	Compliant Y/N
K1	351 Kelvin Road	44	45	Yes
K2	210 Kelvin Road	36	45	Yes
K3	632 Kelvin Road	24	45	Yes
K4	554 Kelvin Road	26	45	Yes
OG1	767 Orange Grove Road	43	45	Yes
OG2	875 Orange Grove Road	32	45	Yes
OG3	897 Orange Grove Road	42	45	Yes
OG4	851 Orange Grove Road	29	45	Yes
OG5	898 Orange Grove Road	38	45	Yes
OG6	726 Orange Grove Road	34	45	Yes
OG7	640 Orange Grove Road	27	45	Yes
OG8	640 Orange Grove Road	29	45	Yes
OG9	476 Orange Grove Road	38	45	Yes
OG10	515 Orange Grove Road	36	45	Yes
OG11	306 Orange Grove Road	36	45	Yes
OG12	242 Orange Grove Road	34	45	Yes
OG13	224 Orange Grove Road	34	45	Yes

Receiver ID	Description	Highest Predicted Construction Noise Level dB LAeq,15min	NML Standard Hours dB LAeq,15min	Compliant Y/N
OG14	118 Orange Grove Road	33	45	Yes
OG15	88 Orange Grove Road	44	45	Yes
OG16	43 Orange Grove Road	36	45	Yes
S1	133 Shanley Lane	24	45	Yes
T1	Tudgey Road (Lot 2 DP1202625)	26	45	Yes
T2	254 Tudgey Road	43	45	Yes
T3	526 Tudgey Road	36	45	Yes
T4	615 Tudgey Road	34	45	Yes

Operation

The operational noise predictions have been modelled for a worst-case scenario over a 15 minute period including noise generated from tracking motors, inverter stations, the substation and light vehicles required for operation. Light vehicles and machinery are already used onsite and within the surrounding area so noise levels associated with the operation of the solar farm should have similar or less than current noise levels.

Noise levels were predicted at each assessed receptor assuming receiver heights of 1.5m above ground level. Table 6-22 summarises the predicted operational noise levels which are demonstrated to comply with the PNTLs at all residential receptors. A detailed maximum noise level assessment is not required as predicted noise levels for night time operations do not exceed the maximum noise level screening criterion of 40dB LAeq,15min and/or 52dB LAmax.

Table 6-22 Predicted Operational Noise Levels

Receiver ID	Description	Predicted Operational Noise Level dB LAeq,15min	Limited Night time PNTL dB LAeq,15min	Complaint Y/N
K1	351 Kelvin Road	<15	35	Yes
K2	210 Kelvin Road	<15	35	Yes
K3	632 Kelvin Road	<15	35	Yes
K4	554 Kelvin Road	<15	35	Yes
OG1	767 Orange Grove Road	23	35	Yes
OG2	875 Orange Grove Road	18	35	Yes
OG3	897 Orange Grove Road	<15	35	Yes
OG4	851 Orange Grove Road	<15	35	Yes
OG5	898 Orange Grove Road	<15	35	Yes
OG6	726 Orange Grove Road	<15	35	Yes

Receiver ID	Description	Predicted Operational Noise Level dB LAeq,15min	Limited Night time PNTL dB LAeq,15min	Complaint Y/N
OG7	640 Orange Grove Road	<15	35	Yes
OG8	640 Orange Grove Road	<15	35	Yes
OG9	476 Orange Grove Road	19	35	Yes
OG10	515 Orange Grove Road	16	35	Yes
OG11	306 Orange Grove Road	17	35	Yes
OG12	242 Orange Grove Road	<15	35	Yes
OG13	224 Orange Grove Road	<15	35	Yes
OG14	118 Orange Grove Road	<15	35	Yes
OG15	88 Orange Grove Road	<15	35	Yes
OG16	43 Orange Grove Road	<15	35	Yes
S1	133 Shanley Lane	18	35	Yes
T1	Tudgey Road (Lot 2 DP1202625)	16	35	Yes
T2	254 Tudgey Road	17	35	Yes
T3	526 Tudgey Road	16	35	Yes
T4	615 Tudgey Road	16	35	Yes

Road Traffic

During construction, traffic generated by the project would include employee/subcontractor vehicles and delivery vehicles. During the peak construction period, the traffic volume over a typical day for standard construction hours would not exceed 50 heavy vehicles, mostly B-double trucks and 50 light vehicles per day (including shuttle buses for employee transport). Road traffic noise calculations are based on these worst case numbers and parameters adopted for average and peak flows presented in Table 6-23.

Table 6-23 Predicted Construction Road Traffic Noise Levels

Vehicle Type	Vehicle/day	Average /hour	Maximum/hour	Movements/hour	Speed km/ h
B-double or Semi-trailer	40	3.6	7	14	80
Shuttle bus	5	<1	5	10	80
Light vehicle	45	4.1	20	40	100
Note 1: Standard construction hours 7am to 6pm Note 2: Assumes that all Shuttle buses and 50% of light vehicles travel to and from site during AM peak and PM peak.					

Predicted LAeq,1hr noise levels from project related construction traffic at an offset distance of 40m from the road edge is presented in Table 6-24. Results demonstrate that project construction traffic noise levels would comply with the relevant RNP criteria.

Table 6-24 Predicted Construction Road Traffic Noise Levels

Receiver ID	Description	Predicted Noise Level dB LAeq, 15hr	RTN Criteria dB LAeq, 1hr	Comply
K1	351 Kelvin Road	50.9	60	Yes
OG10	515 Orange Grove Road	50.9	60	Yes

Sleep disturbance

Section 4.3 of the ICNG (*DECC, 2009*) states that a sleep disturbance assessment is required where construction activities are planned to occur for more than two consecutive nights. Given that construction activities are only expected to occur during standard construction hours, sleep disturbance has not been considered in this assessment.

No noise impacts in addition to those mentioned for construction are anticipated during the decommissioning phase.

6.5.5 Mitigation / Management Measures

Reference	Mitigation Measures
Construction and Decommissioning Mitigation Measures	
N1	Prepare a construction noise management protocol for the Site to manage noise emissions.
N2	Implement a formal complaint handling procedure to manage any potential concerns from the community. This will include: • Details of a readily accessible contact person • A well-documented process that includes an escalation procedure so that (if required) there is a path to follow should the complainant not be satisfied • Details regarding setting up a complaint register. Each complaint would need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences, where the noise in question is in excess of allowable limits.
N3	Works are to be carried out during standard work hours (i.e., 7am to 6pm Monday to Friday; 8am to 1pm Saturdays). Any construction outside of these normal working hours would only be undertaken in the event of an emergency or with prior approval from relevant authorities. For non-emergency works outside standard hours, residents and other sensitive land use occupants should be informed of the works between 5 and 14 days before commencement.
N4	Toolbox and induction of personnel prior to start of shift to discuss noise control measures that may be implemented to reduce noise emissions to the community, construction hours and nearest sensitive receivers.
N5	All plant should be shut down when not in use. Plant to be parked/started at farthest point from relevant assessment locations
N6	Avoid the operation of noisy equipment near noise sensitive areas and where possible, loading and unloading would be conducted away from sensitive areas.
N7	Noise levels will be considered when procuring equipment.

Reference	Mitigation Measures
N8	All plant is to utilise a broadband reverse alarm in lieu of the traditional hi frequency type reverse alarm.
N9	Ongoing community consultation for residences within close proximity of the works. The information would include details of: • The proposed works and when these will occur • The duration and nature of the works • Details of what to do should they have a noise complaint • Updates on the progress of works.
N10	Where possible use localised mobile screens or construction hoarding around plant to act as barriers between construction works and receivers, particularly where equipment is near the site boundary and/or a residential receiver including areas in constant or regular use (e.g. unloading and laydown areas)
Operational Mitigation Measures	
N11	Complete a one-off noise validation monitoring assessment to quantify emissions from site and to confirm emissions meet relevant criteria.
N12	Prepare an operational noise protocol that can be implemented to address any community concerns regarding project noise emissions for future operations of the project.

6.6 Traffic, Transport and Road Safety

A Traffic Impact Assessment (TIA) was undertaken by Seca Solution to investigate the potential traffic impacts of the Proposal (see **Appendix I**). A summary of the key findings of this assessment are outlined below.

6.6.1 Assessment Methodology

The assessment included:

- A site visit to assess the existing condition of the local road network
- Traffic surveys taken during the AM and PM period at a key intersection on Thursday 26 October 2017
- Review of the local road network, with regard to road safety, intersection controls, any access constraints and any concerns over access to the regional road network
- Identifying access concerns or road upgrades potentially required
- Review the impact of the temporary increase in heavy vehicle flows along the local and regional roads for the various stages of the development.

6.6.2 Existing Environment

The site is located with road frontage to Orange Grove Road only. The existing road environment related to the proposal is described below and shown in Table 6-25.

Table 6-25 Existing road environment

Road	Local/ State Road	Width/ Movements	Condition	Speed Limit	Connection
Orange Grove Road	Local	6m wide Two-way traffic movements as required	Majority Sealed The section to the Site access road is sealed	100km/h	Orange Grove Road connects with Kelvin Road to the west of the site via a simple give way controlled intersection with Kelvin Road being the priority road.
Kelvin Road	Local	7m wide Two-way traffic movements	Sealed road	100km/h	Kelvin Road merges into O'Keefe Avenue.
Old Blue Vale Road	Local	4m wide Allows for 2-way traffic movements although it is noted that the sealed width allows for a single vehicle only	Sealed road, however width allows for a single vehicle only	No speed limit posted	Old Blue Vale Road connects with Kelvin Road at its eastern end and Blue Vale Road at its western end via a simple give way controlled intersection with Blue Vale Road and Kelvin Road being the priority roads.
Blue Vale Road	Local	7m wide Two-way traffic movements	Sealed road	100km/h	Blue Vale Road connects with the Kamilaroi Highway via a left turn acceleration lane.
Kamilaroi Highway[1]	State	7m wide Two-way traffic movements	Sealed road	100km/h	The Kamilaroi Highway connects to Blue Vale Road via a sheltered right turn lane for vehicles turning right into Blue Vale Road off the Kamilaroi Highway.
Oxley Highway	State	7m wide Two-way traffic movements	Sealed road	100km/h	The Oxley Highway connects to the Kamilaroi Highway via a single lane roundabout.

[1] The Kamilaroi Highway runs through the centre of Gunnedah, however a sign on the eastern and western approaches to the centre of Gunnedah direct heavy vehicles away from the centre of town. This alternate heavy vehicle route provides a wide sealed pavement of approximately 12 m and runs along Warrabungle Street / Bloomfield Street / Boundary Road.

Existing Traffic Volumes

Traffic volumes in the immediate vicinity of the Site are very low, reflective of the rural environment.

Orange Grove Road provides access to several rural land holdings however does not provide a direct access for through traffic movements. Traffic surveys taken during the AM and PM period found that the traffic flows on this road are less than 100 vehicles per day two-way.

Kelvin Road similarly carries low traffic flows with less than 500 vehicles per day two-way.

Old Blue Vale Road also carries very low traffic flows as it provides access to a low number of dwellings along its length and does not provide any through traffic movements. It is considered that the daily traffic flows along this road would be less than 100 vehicles per day.

Blue Vale Road is well used by trucks associated with the Whitehaven mining operations, with heavy vehicles observed travelling in both directions hauling coal south and empty trucks heading north. Traffic flows on this road are impacted upon by these trucks however daily traffic flows are less than 500 vehicles per day two-way.

The Kamilaroi Highway carries higher traffic flows. No traffic data is available for this road; however, the Roads and Maritime Traffic Volume Viewer indicates that the daily traffic flows on the Oxley Highway to the east of Gunnedah are in the order of 3,500 vehicles per day with 16% heavy vehicle content. It is considered that the flows and heavy vehicle content on the Kamilaroi Highway would be similar.

Observations on site during a typical morning peak period shows that the current road network near the Site and around Gunnedah operates with minimal delays and congestion. The route proposed to be used for the Proposal currently carries low traffic volumes and operates with no delays.

6.6.3 Assessment of Potential Impacts

Proposed haulage and traffic routes

Traffic movements associated with the construction, operation and decommissioning of the Proposal include transport of materials to/from the site and transport of workers to/from the site.

The majority of material deliveries during the construction phase are expected to originate from Newcastle Port or Port Botany (via State Motorways and Highways and utilising heavy vehicle routes where necessary) with some local sourcing of general supplies, plant and equipment. Regardless of origin all transport of materials to the site will be via Blue Vale Road (accessed from the Kamilaroi Highway) then Old Blue Vale Road, Kelvin Road and Orange Grove Road.

The Kamilaroi Highway and other highways have suitable capacity to cater for construction and operational traffic as these roads currently carry high traffic volumes. Any additional construction or operational vehicle traffic can be accommodated as both are key freight routes in NSW and designated as 'oversize, over mass load carrying vehicles network approved roads' by Roads and Maritime. Furthermore, any additional traffic would be within the range of daily variation in traffic on these routes. It is considered that the additional truck movements associated with the construction activities for the Proposal will have a minimal and acceptable impact upon road safety along these roads.

All local roads along the proposed haulage route are approved B double routes with wide road pavement to cater for kerb side parking and the safe 2-way movement of trucks along the road. These roads also have sufficient capacity to accommodate the proposed construction traffic movements due to the existing low traffic volumes as identified above.

The intersections along this route are well laid out and provide good visibility in all directions to allow for the safe turning movements of vehicles. It is considered that the heavy vehicle route (as shown in Figure 6-28) can safely accommodate the additional traffic movements associated with the Proposal. The heavy vehicle route within Gunnedah will be included within the Driver's Code of Conduct and will form part of the inception meeting for all staff and drivers prior to construction on Site.

Figure 6-28 **Designated Heavy Vehicle route to Proposal site (*Source: Google maps via SECA TIA 2018*)**

Figure 6-29 Light vehicle access in and out of the subject site (Source: Google maps via SECA TIA 2018)

For light vehicles associated with workers, the proposed access route will be via Chandos Street and O'Keefe Avenue to allow for direct access between the Site and the centre of Gunnedah (refer Figure 6-29). This is a safe and acceptable route for light vehicles which can safely and conveniently cross the Namoi River on the existing bridge.

The decommissioning haulage route will be determined towards the end of the operational period of the Proposal as the road infrastructure may change. The indicative decommissioning haulage routes are the same as the construction haulage routes.

Site Access

Access to the site will be facilitated by the current unnamed, unsealed access road off Orange Grove Road (south-west corner of Lot 151 DP754954). To facilitate safe turning movements in and out of the Site, the existing full width seal on Orange Grove Road will be extended from the current end point to the Site access road.

The unnamed, unsealed access road will also be sealed to allow for safe construction, operational and decommissioning traffic movements and to reduce potential for dust and erosion impacts (refer Section 6.11 and Section 6.8).

Construction

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

- Increased collision risks (other vehicles, pedestrians, stock and wildlife)
- Damage to road infrastructure
- Associated noise and dust which may adversely affect nearby receivers
- Disruption to existing services (school buses, cyclists, pedestrians).

Increased Vehicle Numbers

Staffing requirements will vary over the 12-month construction period. Approximately 150 people are expected during peak periods with a lower level outside peak construction periods. It is anticipated that approximately 50% of these jobs will be sourced within 100km of the site, subject to the labour force being available.

GSF propose to use the same methodology to maximise local staff participation in the Proposal as they have for other sites in Australia which includes holding a community information session and creating an Expressions of Interest (EOI) for interested local suppliers and contractors.

Staff will be encouraged to car pool as appropriate with other staff transferred to and from the site via shuttle buses to reduce vehicle demands. Due to the size of the site footprint, these same vehicles will also be used on site to move staff across the site.

With a peak of 150 staff, a vehicle occupancy rate of four people per vehicle has been assumed based upon carpooling and the use of a shuttle bus e.g. Toyota Coaster. This would give 40 vehicle movements inbound and outbound for staff movements.

Alternatives such as walking and cycling to site were considered. Cycling to the site could be an option for the proposal as the site is within 20 minutes of the Gunnedah town centre. Cyclists can ride on the road due to low traffic flows and can park bikes on site as required. However, walking is not considered appropriate due to the relatively remote location of the site, no footpaths available in the locality and excessive travel time which is estimated to be over 2 hours.

The level of heavy vehicles accessing the site will vary throughout the Proposal timeframe. At the beginning of the Proposal there will be a requirement for some earthwork moving equipment to construct the access tracks and some minor earthworks across the site as required. This may require a scrapper or bull dozer which will be transported to site on a low loader. This machinery will remain on site for the duration of the earthworks portion of the construction work. Once the earthworks have been completed, the balance of the construction work will commence. All plant will be located on site and will therefore be only required to access the site once for the construction works.

A summary of the anticipated vehicle movements during the construction period is provided in Table 6-26 below. Delivery vehicles make up a large percentage of vehicle movements. Deliveries would be spaced out over the construction period to prevent congestion and reduce the need to store panels onsite. Deliveries will also be spaced out over the course of the day to prevent concentration of heavy vehicle movements.

Table 6-26 Vehicle movements expected as a result of the proposal

Phase	Purpose	Vehicle Type/ Trailer Type	No. of one-way vehicle movements
Site Set-Up and Demobilisation	Portacabin delivery and removal	Low loader	10
	Skip delivery and removal	Low loader	20
	Generator delivery and removal	Semi-trailer	2
	General deliveries	Semi-trailer	20
	Crane mobilization and demobilization	Crane	4
	Water tank delivery and removal		2
Roads and hardstands	Delivery of imported capping for road laydowns and crane hardstands	Truck and dog	375
	Plant delivery and removal: excavators, compactors drill rig	Low loader	20
	Concrete deliveries for maintenance container hardstands	Concrete agitator	60
Generating Equipment	Tool container delivery and removal	Low loader	2
	Module deliveries	Semi-trailer or B-double	1,300
	Mounting structure and pile deliveries	Semi-trailer or B - double	1,000
	Inverter Station deliveries	Low loader	26
	DC cabling trays and combiner boxes	Semi-trailer or B-double	200
AC Cable Installation	AC Cable delivery	Semi-trailer or B - double	180
	Backfill material delivery	Dump Truck	1,500
Plant Delivery and removal	Telescopic handler and excavator	Low loader	28
Overhead Line	Conductor delivery	Semi-trailer	20
	Pole deliveries	RAV	5

Phase	Purpose	Vehicle Type/ Trailer Type	No. of one-way vehicle movements
	Pole dressing delivery	Semi-trailer	1
Other	Employee vehicle movements	Light vehicle / shuttle bus	40
	Monitoring equipment fibre SCADA servers etc	Truck	2
	Waste Collection	Truck	200
	Consumables (Oil and Fuel)	Truck	20
	Miscellaneous deliveries	Light vehicle	20
		TOTAL	**5,057**

The average daily vehicle movements are anticipated to be 50 light and 10 heavy vehicles two-way (50/10 inbound, 50/10 outbound) per day.

The construction of the solar farm is expected to commence in early 2019 and be completed within a 12-month timeframe. However, any road upgrades required would be completed prior to commencement of construction. Local traffic impacts would be confined to standard hours of construction (7am to 6pm Monday to Friday and 8am to 1pm on Saturdays, with no construction work on a Sunday or public holiday). No construction work, upgrading or decommissioning activities will be undertaken outside of these hours with the exception of:

- The delivery of material as requested by the NSW Police Force to other authorities for safety reasons
- Emergency work to avoid the loss of life, property and / or material harm to the environment.

Increase in traffic may be noticeable and could present an adverse effect on local tourism, if coinciding with local festivals (such as AgQuip).

Parking arrangements
All parking will be contained on site within a temporary construction parking and temporary facilities area adjacent to the site office and construction laydown area.

All staff vehicles will be able to park within the site adjacent to the site office with no external parking demands. The construction parking area will allow for up to 50 vehicles to park within this compound area as part of the construction it is proposed to maximise the local workers content (sourced within 100km of the Site) however it is anticipated that external labour will be required in addition to local labour. The workforce needed for the Proposal will travel to Site through a combination of private vehicles or via shuttle buses for non-local staff from Gunnedah, and potentially from Tamworth or Narrabri. Shuttle bus arrangements from Gunnedah and Tamworth s will reduce the vehicle numbers and parking requirements.

Increased Collision Risk
There will be an increase in the number of heavy vehicle movements associated with the construction work which will impact the local road network along the haulage route. The major road safety impact is associated with traffic entering and exiting the Site off Orange Grove Road as well as the impact of these movements upon the operation of intersections along the haulage route.

The vehicle numbers associated with the construction work are relatively low and it is considered that the movement of vehicles in and out of the site for construction works can safely occur with minimal delays to pedestrians and in a safe manner.

Truck movements would be minimised, where practicable, between 08:00 – 09:00 and 15:00 – 16:00 during school days to avoid school bus pick up and drop off times.

Given the journey length between the Origin (Port) and the Destination (Site), vehicles approaching the Site will be spread out ensuring the impact is not occurring all together. With unloading of vehicles taking 30 minutes or more, trucks exiting the site will also be spread out.

Intersection sight distances

The intersection sight distances from four key intersections along the primary haulage route are shown in Table 6-27.

Table 6-27 Intersection sight distances

Intersection	Speed Limit	Austroads Guidelines (sight visibility requirement)	Sight distance measured onsite	Upgrade works required
Kelvin Road and Orange Grove Road	100km/km/h	285m	400m in both directions	No upgrade to this intersection is required.
Old Blue Vale Road and Kelvin Road	100km/km/h	285m	320m in both directions	No upgrade works are required based on sight distance requirements however upgrades of the intersection have been suggested (see below). Maintenance work has also been recommended to remove the large amount of loose gravel material which has accumulated over the intersection.
Blue Vale Road and Old Blue Vale Road	100km/km/h	285m	350m in both directions	No upgrade works are required based on sight distance requirements however upgrades of the intersection have been suggested (see below).
Kamilaroi Highway and Blue Vale Road	100km/h but 70km/h around the intersection	151m	250m in both directions	No upgrade to this intersection is required.

Damage to Road Infrastructure
The increase in traffic and heavy vehicle movements could impact the condition of roads on the haulage network. Along the New England Highway and Kamilaroi Highway the impact is expected to negligible due to the existing capacity of the road network. Similarly, local roads already be subject to heavy vehicle movements from mining operations and agricultural activities. However, any damage as a consequence of the Proposal would be rectified.

With regards to any emergency repairs required, the contractor on Site would contact the relevant authorities and will ensure the road is safe. Repairs will be made in accordance with the relevant authority standard and using approved council contractors.

Disruption to Farming
There are a number of farms in the general locality of the Site as well as in the wider Gunnedah area however, coordination of construction traffic with seasonal agricultural haulage is not necessary considering the level of additional vehicle movements associated with construction and the existing capacity of the road network.

Disruption to Existing Services
There is no requirement to divert traffic as part of this construction work however, the existing heavy vehicle detour for Gunnedah shall be utilised. As no diversion is required there is expected to be minimal impact on emergency vehicles, heavy vehicles, cyclists and pedestrians. Public transport near the Subject Land is limited to a coach link with infrequent operation. These services may experience some minor delays due to additional construction traffic.

There are no pedestrian paths around the Subject Land, and pedestrian movements are not expected due to the distance of the Site to Gunnedah. As such no impacts for pedestrians are expected as a result of the Proposal.

There is no school within the general locality of the Subject Land however a 2.5km section of the haulage route along Kelvin Road forms part of the local school bus run. As part of the employee and site induction for all heavy vehicle drivers this school bus route will be highlighted so that drivers are aware of a potential school bus over this section. The Proposal will also seek to minimise truck movements between 08:00 – 09:00 and 15:00 – 16:00 during school days to avoid school bus pick up and drop off times.

It is noted that the light vehicles associated with the staff movements will typically occur in the morning prior to this school bus inbound movement and staff leaving the site at the end of the day will be after the return of this school bus run and as such are not expected to have any interaction. Once on the regional and state road network all school zones will be delineated in accordance with RMS Guidelines with reduced speed limits in accordance with normal NSW road rules. All drivers associated with the Proposal construction work will adhere to the road rules as applicable.

Associated noise and dust impacts from traffic are assessed in section 6.5 and section 6.11.

No traffic impacts in addition to those mentioned for construction are anticipated during the decommissioning phase however this will have to be reviewed during preparation of the TMP for decommissioning as circumstances are likely to change between construction and decommissioning.

Operation

Post construction, the traffic numbers generated by the Proposal are very low, with a maximum on-site workforce of 10 people. There will not be any need for regular heavy vehicle access to the site once the solar farm is operational.

10 Year Horizon
The major impact of the Proposal is during the construction phase which will be over approximately 12-months. The impact of this construction phase has been assessed based on current traffic flows.

For the 10-year horizon the traffic will be that associated with the on-going maintenance / operation of the facility. Up to three staff will conduct maintenance and ad-hoc repair work on the site once the facility is operational. The impact of these staff will be very low on the local road network.

6.6.4 Mitigation / Management Measures

Proposed Road Improvements and Maintenance

Old Blue Vale Road
Increased truck movements could impact upon the operation of Old Blue Vale Road as the road is a single sealed travel lane which requires opposing drivers to place the kerb side wheels of their vehicle on the dirt to the side of the seal to allow passing. As the increased demands, will be limited to the construction period it is considered that this road can continue to operate as a single sealed lane with the following mitigation measures:

- Increase the extent of two-lane seal width (7m) for a distance of 100m at the western end of the road to allow for two-way traffic movements to occur close to the intersection
- A similar upgrade should be applied at the eastern end of Old Blue Vale Road to allow for two opposing heavy vehicles to pass close to Kelvin Road
- Remove loose gravel material which has accumulated over the Old Blue Vale Road and Kelvin Road intersection
- Agree a maintenance schedule with Gunnedah Shire Council for the construction period to allow for increased wear along the edges of the sealed pavement due to the increased passage of heavy vehicles and the demand for placing two wheels in the dirt to the side of the sealed central pavement lane.

Orange Grove Road
A minimum 30m seal is required Orange Grove Road, to the Site access road. This will ensure site access can be safely provided and allow for safe turning movements in and out of the site.

Reference	Mitigation Measures
Construction and Decommissioning Mitigation Measures	
T1	Road improvements in accordance with the TIA and any ancillary road works should be completed prior to the construction of the proposal.
T2	A Traffic management plan (TMP) for construction shall be developed in accordance with Roads and Maritime Guidelines and the Australian Standard AS1742.3. The plan would include: • The designated routes of construction traffic to the site • A map of the primary access routes highlighting critical locations • Drivers Code of Conduct • Carpooling/shuttle bus arrangements to minimise vehicle numbers during construction • Scheduling of deliveries • Community consultation requirements • Any restrictions on traffic movements (such as residential areas, school pick-up and drop-off times) • Traffic controls (speed limits, signage, etc.)

Reference	Mitigation Measures
	• A complaint handling procedure • An induction process for vehicle operators.
T3	All Proposal personnel will be provided training on the requirements of the TMP through site inductions, toolbox talks or specific training
T4	The heavy vehicle route will be included within the Driver's Code of Conduct and will form part of the project inception meeting for the project for all staff and drivers
T5	Traffic control will be provided in accordance with the approved construction TMP to manage traffic movements (vehicular, cycle and pedestrian) during construction and maintain the flow of traffic within the site and on surrounding public roads
T6	Traffic management controls will be communicated to appropriate stakeholders which will include the local community in the site vicinity via a letter box drop
T7	Directional signage will be installed to direct construction traffic, and warn other motorists of construction traffic. This signage is positioned in accordance with the approved Traffic Control Plans.
T8	All employees, subcontractors and suppliers will comply with the speed limits within the worksite, which are as follows: • 40km/h on formed roads • 20km/h during foggy/dusty conditions with headlights on • 10km/h when passing pedestrians.
T9	Develop a protocol will be provided for both undertaking dilapidation surveys and making any necessary repairs following construction. The dilapidation surveys will assess the existing condition of Old Blue Vale Road prior to construction and identify any damage once construction is complete. Should any damage be identified the road will be repaired in line with Council standards.
T10	A dilapidation survey will be completed along Old Blue Vale Road prior to upgrades on this road and after the works are complete. A dilapidation survey protocol is provided in **Appendix I**.
T11	A Traffic management plan (TMP) for decommissioning will be developed as part of the decommissioning management plan. This will include a decommissioning haulage route. The indicative decommissioning route provided in this EIS will be reviewed prior to the start of decommissioning.

6.7 Surface Water, Hydrology and Groundwater

This chapter summarises the site hydrological conditions and provides an assessment of potential impacts on surface water and groundwater. Surface water drainage conditions are described and an assessment provided of potential impacts on surface water drainage patterns. Given the site's location on the floodplain, flooding is considered a key risk and is addressed in this Section. The flood potential of the site is described based on available flood information which is used to develop a flood model to understand and assess the likely flood interactions and impacts of the Proposal. Groundwater conditions are described based on desktop searches, existing published data (where available) and site observations, and potential groundwater interactions and impacts are assessed. Potential impacts of the Proposal are assessed for the construction and operation of the Proposal, and mitigation measures developed to address specific risks.

This chapter addresses the requirements of the SEARs, in particular the following matters:

- Surface water and groundwater conditions
- Identification of riparian land and groundwater dependent ecosystems
- Flood behavior and impacts
- Water requirements and supply arrangements for the Proposal
- Existing licensed groundwater users
- Potential hydrological impacts during construction and operation
- Management and mitigation measures to minimize potential hydrological impacts

A Flood Impact Assessment (FIA) was also undertaken by pitt&sherry to investigate the potential flooding impacts of the Proposal (see **Appendix J**). A summary of the key findings of this assessment are also outlined below.

6.7.1 Assessment Methodology

Surface Water

Surface water drainage patterns were identified using published resources such as the Department of Lands 1:25,000 topographic map series and recent aerial photography available from Google Earth. Site survey information and observations provided additional information on constructed drainage systems that exist on the site.

Given the site is relatively distant from the nearest natural watercourse, this being the Namoi River approximately 900m south of the property, a qualitative water quality assessment was undertaken that includes identification of appropriate water quality protection measures.

Groundwater

Information on existing groundwater resources was compiled from published information including the Department of Primary Industries (Office of Water) water monitoring network and online maps of groundwater vulnerability. A qualitative groundwater assessment is presented.

Flood Assessment

Flooding is considered a key risk given the Proposal lies on the Namoi River floodplain and is known to be affected by flooding. **pitt&sherry** undertook a flood impact assessment (**Appendix J**) of the proposed Solar Farm. A flood model was developed to understand the nature of flooding at the site; estimate flood levels for a range of design events; and to estimate the impacts the Solar Farm would have on flood levels.

A review of previous flood studies was undertaken including:

- Stewart Surveys, which estimated a 1% AEP flood level at RL 269.95 at the site for Lot 2 DP 801762
- NSW SES FloodSafe brochure, which refers to estimated flood levels at the Gunnedah Gauge (Cohen's Bridge) for the 1998, 1955 and the 1% AEP flood level (available on-line)
- Gunnedah and Carroll Floodplain Management Plan 1999, SMEC Study, updated 2014, which approximates the 1955 flood to the 1% AEP flood event. (available on-line)
- Carroll to Boggabri Floodplain Management Plan 2006, Webb McKeown & Associates on behalf of Department of Natural Resources (available on-line), which relies on earlier modelling by SMEC and infers conclusions for the purposes of planning.

Information from these studies as well as available data from local river gauges was combined with topographic data and current site conditions to identify inputs for hydraulic modelling, to estimate the peak flood level using HEC-RAS Version 5.0.3 in 2D mode.

Modelling Approach

The flood model has been constructed from available rainfall and terrain data and has been verified by comparing flood levels with historic records and other flood studies, especially river gauge records and the Gunnedah and Carroll Floodplain Management Plan 1999 (SMEC Study, updated 2014). Flows are described as flood hydrographs, which are based on historic data for the 1984 flood.

The terrain data used were acquired from the Shuttle Radar Topography Mission (SRTM), which comprises a digital elevation model (DEM) with a grid size of about 30m. Though a finer grid size would be preferable, especially in describing small features such as minor irrigation channels and farm drains, these terrain data were considered the most appropriate because they cover the entire flood plain.

The roughness of the flood plain was described as a single roughness value that covers the state of crops, vegetation and general farm fences. As a conservative approach, a uniform Manning's roughness coefficient was applied to the modelled events representative of smooth crop roughness i.e. roughness of the floodplain representative of conditions directly after cropping (Manning's n = 0.03). While this approach produces lower depths and higher velocities than the roughness associated with crops during growth and before cropping it also results in higher predicted impacts and thus is considered a conservatively approach to the modelling of impacts from the solar farm.

To meet the security and public safety constraints associated with the Proposal a chain wire security fence is required. The modelling approach assumes that the feature of the solar farm with the greatest potential to influence flood behaviour is the perimeter security fence. Individual solar panels were not represented as discrete structures, or changes in the floodplain roughness as they don't represent the same lateral barrier across the flow of the flood event. They are unlikely to influence flood behaviour, as the solar panels are elevated above flood waters on supporting posts that would have little influence on the passage of a flood.

The impact of the fence is associated with its potential to be blocked by debris conveyed in floodwaters, causing it to be relatively impervious and consequently act like a solid barrier and redirect flood flows. To model this impact, the fences around the proposed Solar Farm were described as discrete features that included representations of the nature and degree of blockage that would occur from flood debris.

Modelling Scenarios
A number of fencing configurations were modelled to identify a suitable configuration that would meet both the public safety and security requirements whilst minimising flood impacts upon sensitive receivers and the environment. The three scenarios assessed were:

- Fence Configuration 1 – 100% blocked. This scenario assumes:
  - Security fence around the entire perimeter of the solar farm
  - 100% fence blockage during a flood.
  - This is considered a potential worst-case scenario
- Fence Configuration 2 – partially blocked fence with gates and laneways. This scenario assumes:
  - Fences around Solar Farm paddocks
  - Fence 100% blocked up to 0.5m above ground
  - Fence 50% blocked above 0.5m above ground
  - Laneways between solar panel paddocks
  - 6m Gates at 100m intervals.
- Fence Configuration 3 – partially blocked fence with laneways. This scenario assumes:
  - Fence 100% blocked up to 0.5m above ground
  - Fence 50% blocked above 0.5m above ground
  - Laneways between solar panel paddocks
  - No gates.

These fencing scenarios plus a baseline representative of the existing conditions were modelled.

Maps of flood level, flood level change (afflux) and flow velocity were prepared for each Scenario for the following flood events:

- 10% AEP
- 5% AEP
- 1% AEP
- Probable Maximum Flood (PMF).

The results of the modelling were used to identify the preferred fencing configuration for the Proposal that mitigated flood impacts while meeting safety and security requirements.

6.7.2 Existing Environment

Surface Water drainage

The Proposal is located within the Namoi River Catchment and floodplain of the Namoi River.

The Namoi River Catchment is one of the Murray-Darling Basin's major sub-catchments. The main tributaries of the Namoi River are the Manilla and Peel rivers. The town of Tamworth on the Peel River, is the largest town within the catchment and the Keepit Dam, situated some 40km to the north-east, is the major irrigation storage for the Namoi catchment, with a capacity of 426,000 megalitres.

The catchment area is approximately 42,000km^2 from the Great Dividing Range near Tamworth, to the Barwon River near Walgett.

It is over 350km long, stretching from Bendemeer in the east to Walgett on the western boundary. The river has developed an extensive floodplain, with around a quarter of the basin prone to flooding. The catchment of the Namoi River at the site is 9,961km².

The Namoi River is the only waterway is close proximity to the Site, located approximately 900m south of the subject Site and around 2 km south of the proposed solar farm. The Namoi River is surrounded by scattered stands of native vegetation. Nearby water courses include tributaries of the Namoi River including the Mooki River, Carroll Creek, Rangria Creek and Kibah Creek.

There are no natural waterways within the Site however the Site does contain an extensive network of constructed irrigation channels principally installed to enable flood irrigation of cotton and other crops. These irrigation drains facilitate water movement from irrigation bores and from a large storage dam located within the Subject Land contained in the north-eastern corner of Lot 1 DP 1202625 which has an area of approximately 6.05 hectares (refer to Figure 1-3).

To varying degrees the surrounding farms across the floodplain have also been developed with banks and drains for irrigation and flood protection works. These features influence the nature of surface water drainage across the floodplain and would influence flood behaviour.

Groundwater

The Proposal is located within the Upper Namoi groundwater management area (Zone 4) which comprises the alluvial sediments associated with the Namoi River, running roughly south east to north west from Keepit Dam to Gin's Leap (*Office of Water, 2012*).

Shallow aquifers that are highly connected to the river system are common in the Upper Namoi and as a result levels are highly dependent on surface water flows. A search of the Department of Primary Industries (Office of Water) water monitoring network found two groundwater bores near the Site. These identified groundwater depths of 6.7 to 7.6m in the area.

The Site is not designated as groundwater vulnerable under the Gunnedah LEP.

Groundwater Dependent Ecosystems

A search of the BoM Groundwater Dependent Ecosystems Atlas identified that parts of the site are identified as containing groundwater dependent ecosystems (GDE) (refer Figure 6-30). The dataset expresses the potential for groundwater interaction/use of native vegetation ecosystems across Australia.

The GDE mapping does not accurately reflect the current site conditions as it maps numerous areas of GDE on the Site that have been cleared and no longer contain native vegetation. Nonetheless, those parts of the Site that have been mapped as containing remnant native woodland according to recent vegetation surveys, do align with the mapped GDEs. On this basis, it is assumed that the remnant woodland is GDE and reliant in part on groundwater for its survival. All of the remnant woodland (and GDE) on the Site is outside the proposed solar farm footprint and would not be impacted by the development.

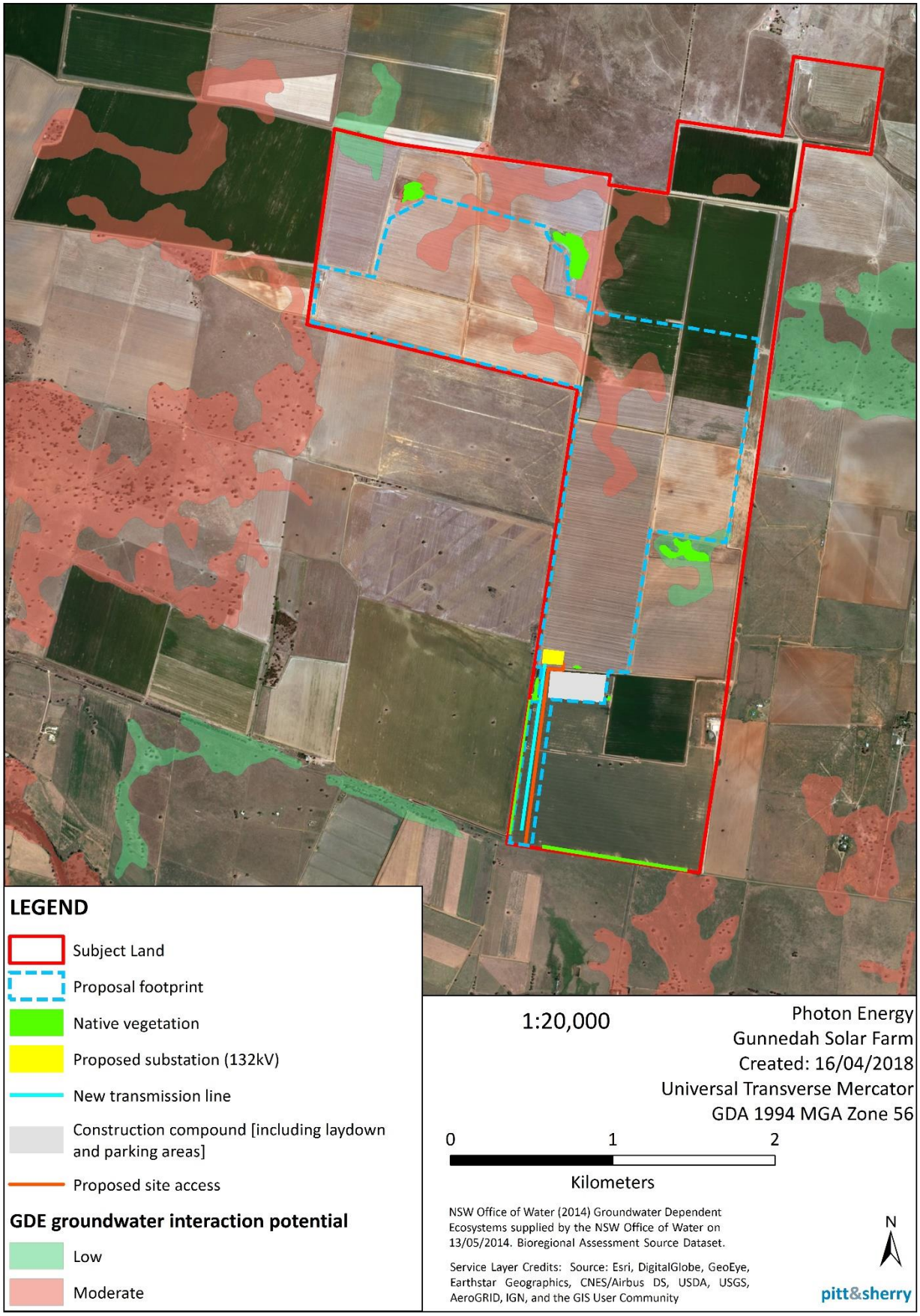

Figure 6-30 Groundwater Dependent Ecosystem

Flooding

The site has been identified as flood prone land within the Gunnedah LEP 2012 but is not identified as wetland or riparian land. The Site is located within an area that is prone to flooding in events less than 5% AEP and functions principally as flood storage.

The baseline scenario modelled within the Flood Impact Assessment identifies that the majority of the site is impacted by flood waters during a 1% AEP event as evident in Figure 6-31.

Water use and Access Licenses

Agricultural activities undertaken on the Site are currently supported by an irrigated water supply. This water use will continue for the remaining areas of the Subject Land not subject to the Proposal. Photon would secure an access agreement with the landowner to supply water for construction and operation of the Solar Farm.

Table 6-28 summarises the existing water access licenses and water use approvals at the property.

Table 6-28 Water Licenses and Approvals

Approval	Type	Use Purpose
Water Supply Works and Water Use 90CA806821 WAL Number – 30665 (472ML)	Extraction Works Gw – Bore Lot 1 DP 1202625 (2 works) Lot 264 754954	Irrigation Lot 59, DP 754928 Lot 153, DP 754954 Lot 264, DP 754954 Lot 1, DP 1084560 Lot 1, DP 1202625 Lot 2, DP 1202625
Basic Rights 90WA830649	Extraction Works Gw – Well Lot 153 DP754954	
Basic Rights 90WA830771	Extraction Works Gw – Bore Lot 153 DP754954	
Water Supply Works and Water Use 90CA806819 WAL Number – 30665 (472ML)	Extraction Works Gw – Bore	Irrigation Lot 2 DP801762 Lot 151 DP754954
Flood Work Approval 90FW833873	Earthworks or embankment Lot 59, DP 754928 Lot 1, DP 1084560 Lot 1, DP 1202625 Lot 2, DP 1202625	
Basic Rights 90WA809774	Extraction Works Gw – Bore Lot 1 DP 1202625	
Basic Rights 90WA830648	Extraction Works Gw – Bore Lot 1 DP 1202625	
Basic Rights 90WA830770	Extraction Works Gw – Bore Lot 1 DP 1202625	

Approval	Type	Use Purpose
Water Supply Works and Water Use 90CA806813 WAL Number – 30665 (472ML)	Extraction Works Gw – Bore Lot 1 DP 186590 (3)	Irrigation Lot 1 DP186590

6.7.3 Assessment of Potential Impacts

Avoidance measures

Feedback obtained from local residents and Council during stakeholder engagement highlighted concerns regarding potential flood impacts on their properties as a result of the solar farm. Photon has considered the community feedback, reviewed the available flood information and undertaken modelling of various solar farm configurations, and proactively sought to minimise potential flood impacts through a process of design review and modification.

Following the site inspection and preliminary hydrological assessment (including flood modelling), the site layout was revised to reduce hydrological impacts including. These design changes included:

- Establishing a 5m buffer either side of all irrigation channels across the site. This is to protect the integrity of these drainage structures and allow space for implementation of erosion and sediment controls when required
- Revision of the site layout to maximise utilisation of those areas of the Site on higher ground that are least impacted by flooding. In particular, the southern extent of the solar farm was moved north and away from a known area of flood flows which occurs through the southern part of the Site
- Placing the substation and inverter containers on elevated fill pads to ensure their flood immunity in a minimum 1% AEP flood event
- Placing PV panels on elevated support posts, raising them to a height that is above the 1% AEP flood level. This configuration would allow flood waters to pass beneath the PV panels without damaging the panels or obstructing flows
- Adoption of a tracking system for the PV panels to allow positioning of panels to a horizontal position during flood events to minimise impacts upon and from the panels.

Flooding

The Proposal, and more specifically the presence of security fencing, will affect flood levels in the floodplain by creating a barrier within the flow of flood water across the flood plain. This is due to the anticipated accumulation of flood debris mats (vegetation and litter collected by flood waters) on the fences that will partially obstruct or hinder flows. The blockages will cause flows to back up on the upstream sides of the fences and to drop on the downstream sides of the fences.

The distribution of areas of increased flood levels and decreased flood levels changes with the direction of flow across the flood plain, which changes according to the AEP of the event, and the timing within the event.

The modelling and flood impact assessment assessed three fencing configurations to identify the preferred fencing configuration for the Proposal that mitigated flood impacts while meeting safety and security requirements. These fencing configurations are described in Section 6.7.1.

Fence Configuration 1 – 100% blocked
This configuration assumes that vegetation will block 100% of the flood water and that it will act like a solid wall on water flows for the entire height of the fence. This scenario will result in a change in the 1% AEP flood

level of up to 550mm immediately adjacent to the fence of the eastern side of the Site, between 100mm to 300mm at various locations along the Site boundary and up to 64mm at the most affected sensitive receiver (receiver 3) (refer to Table 6-29). However due to the solid boundary flood levels are reduced in areas to the north and to the west of the fence but increase to the east, southeast and southwest (refer to Figure 6-31 and Figure 6-32).

Fence Configuration 2 – Partially blocked fence with gates and laneways
This configuration assumes that the blockages caused by vegetation will be 100% from ground level to 0.5m and 50% above that. This option divides the Proposal into four sections, each section is fenced separately and laneways run between the laneways. The laneways were added to allow flood waters to move from east to west. Gates have also been included at regular intervals along the fence (approximately every 100m) to assess the benefit of opening gates to allow flood waters to move more easily through the boundary fence.

This scenario will result in a change in the 1% AEP flood level of up to 100mm immediately adjacent to the fence on the eastern side. The change in flood level is reduced to about 50mm at the site boundary and up to 13mm at the most affected sensitive receiver (receiver 3) (refer Table 6-29). Flood levels are reduced (compared to the existing scenario) to the north and west of the fence and increase to the east, southeast and southwest (refer to Figure 6-31 and Figure 6-33).

Configuration 2 creates a reduction in increased flood levels by creating pathways for water through the site.

Fence Configuration 3 – Partially blocked fence with laneways
The blockages under Configuration 3 have been estimated to represent a less severe scenario than Fence Configuration 1. It is unlikely that the fences will be 100% blocked by debris mats to their full height. This configuration assumes that the blockages caused by vegetation will be 100% from ground level to 0.5m and 50% above that. This option divides the Proposal into four sections, each section is fenced separately and laneways run between the laneways. The laneways were added to allow flood waters to move from east to west.

This scenario will result in a change in the 1% AEP flood level of up to 340mm directly immediately adjacent to the fence and 110mm at the upstream property boundary and up to 18mm at the most affected sensitive receiver (receiver 3). Flood levels are reduced (compared to the existing scenario) to the north and west of the fence and increase to the east, southeast and southwest (refer to Figure 6-31, Figure 6-34 and Table 6-29).

Configuration 3 creates a reduction in increased flood levels compared to configuration 1 by creating pathways for water through the site. However, the reduction in increased flood levels is less than configuration 2 as configuration 3 does not include gates and as such there are less pathways for water movement.

The full results of flood modelling for all three scenarios plus the base case (without development) are outlined in the Flood Impact Assessment (**Appendix J**). Based on the modelling results, Configuration 3 was selected as the preferred configuration which limits the flood impacts and also manages the safety and security requirements for the development. Configuration 3 includes four individually fenced areas of solar infrastructure to establish laneways that permit some passage of flood flows.

Table 6-29 Flood model results at sensitive receivers – 1% annual exceedance probability (AEP) event

Receiver	Peak Flood level (m AHD)				Change (m)			Comments
	Existing	Conf. 1	Conf. 2	Conf. 3	Conf. 1	Conf. 2	Conf. 3	
1	-			-			-	
2	0.541	0.541	0.541	0.541	0.000	0.000	0.000	
3	0.315	0.379	0.328	0.333	0.064	0.013	0.018	Small change to moderate flow depths
4	0.555	0.555	0.555	0.555	0.000	0.000	0.000	
5	-			-			-	
6	-			-			-	
7	-			-			-	
8	-			-			-	
9	-			-			-	
10	-			-			-	
11	-			-			-	
13	-			-			-	
14	0.489	0.434	0.475	0.464	-0.055	-0.014	-0.026	Small change to moderate flow depth
16	-			-			-	
17	-			-			-	
18	-			-			-	
19	0.017	0.017	0.017	0.017	0.000	0.000	0.000	
21	0.700	0.706	0.700	0.700	0.006	0.000	0.000	
22	-			-			-	
23	-			-			-	
24	-			-			-	
26	0.060	0.08	0.065	0.068	0.020	0.005	0.007	Small change to moderate flow depth
27	-			-			-	
28	0.593	0.628	0.602	0.606	0.035	0.009	0.013	Small change to moderate flow depth
29	-			-			-	
30	-			-			-	
31	-			-			-	

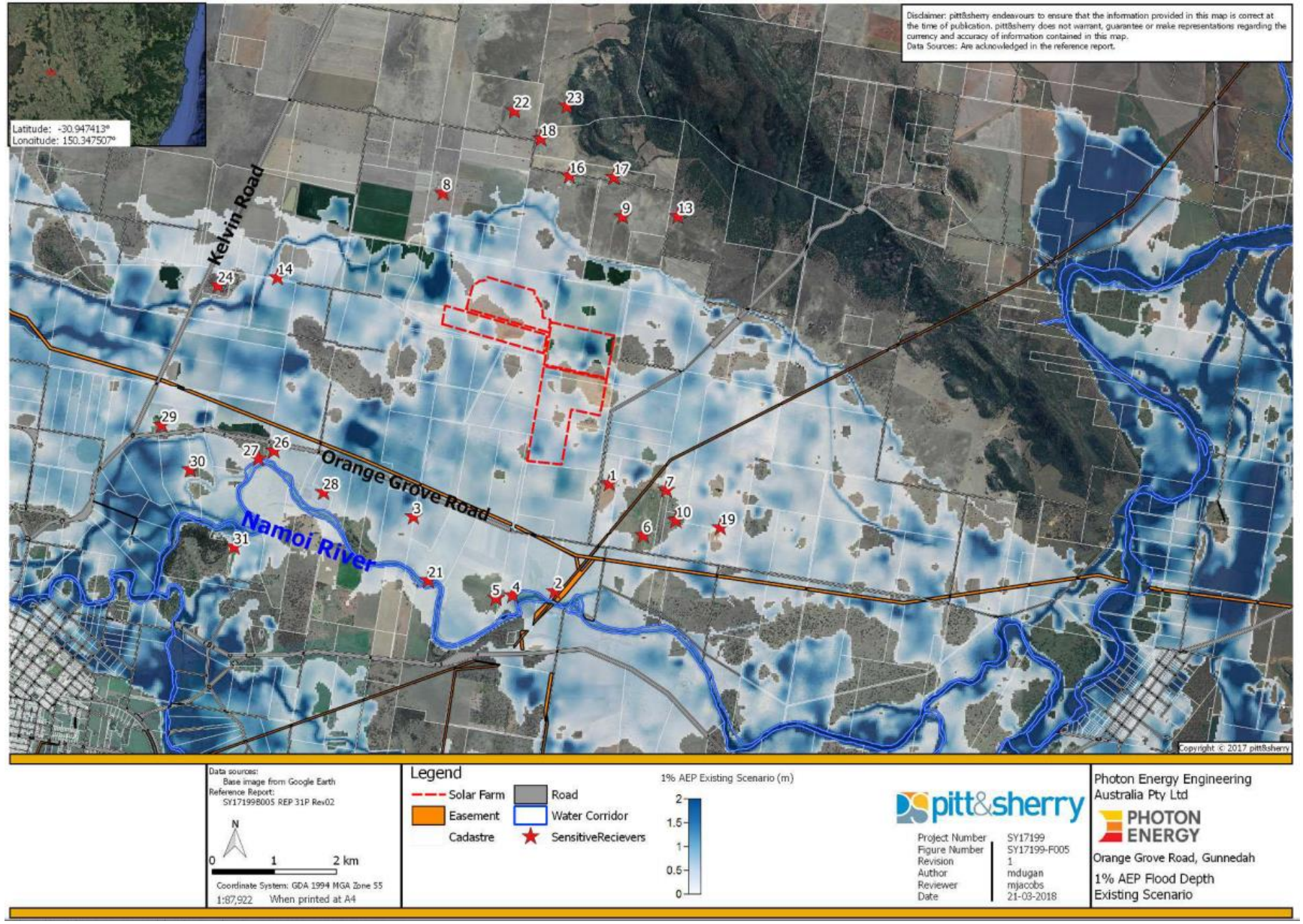

Figure 6-31 1% AEP Flood Depth Existing Scenario

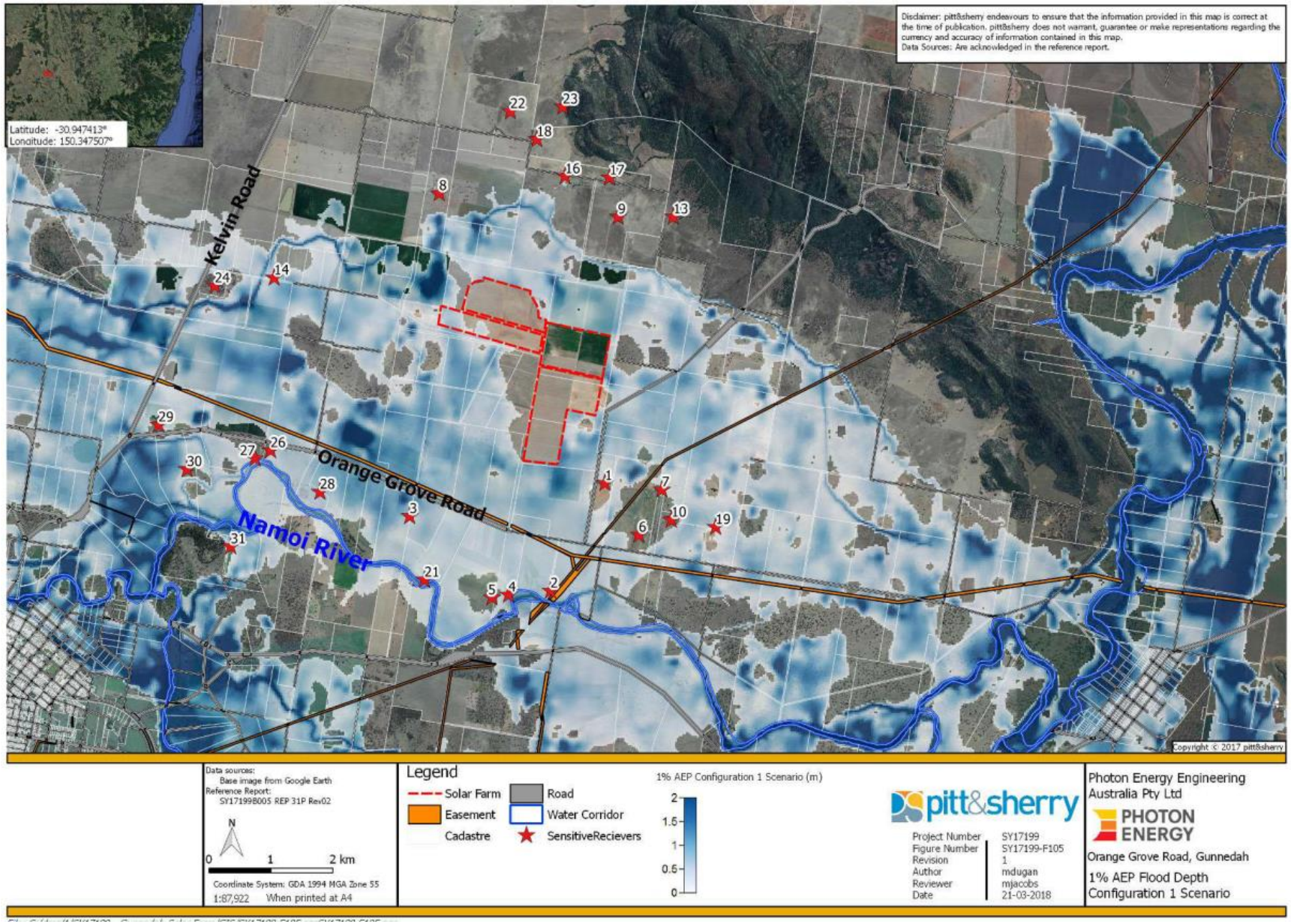

Figure 6-32 1% AEP Flood Depth Configuration 1

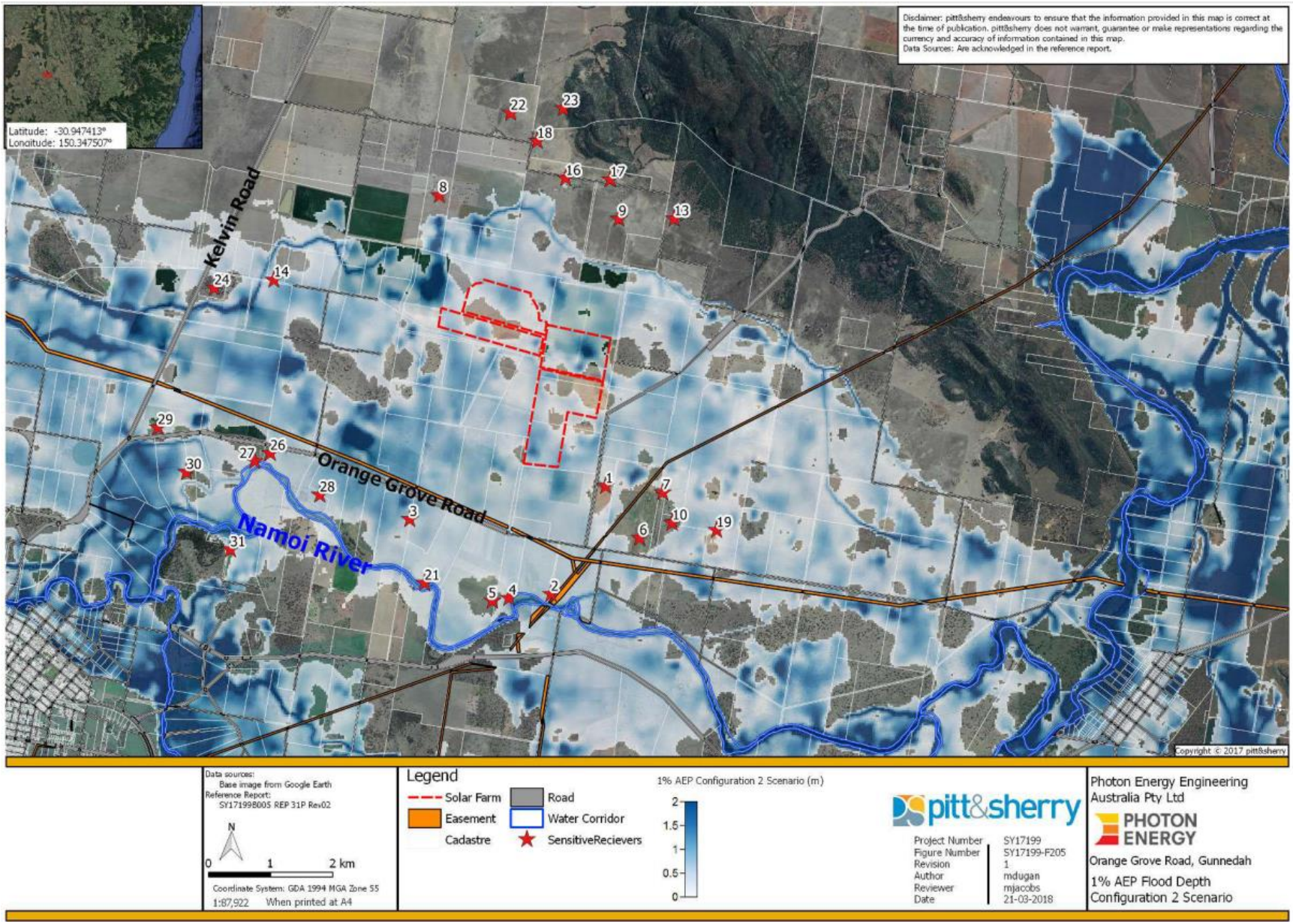

Figure 6-33 1% AEP Flood Depth Configuration 2

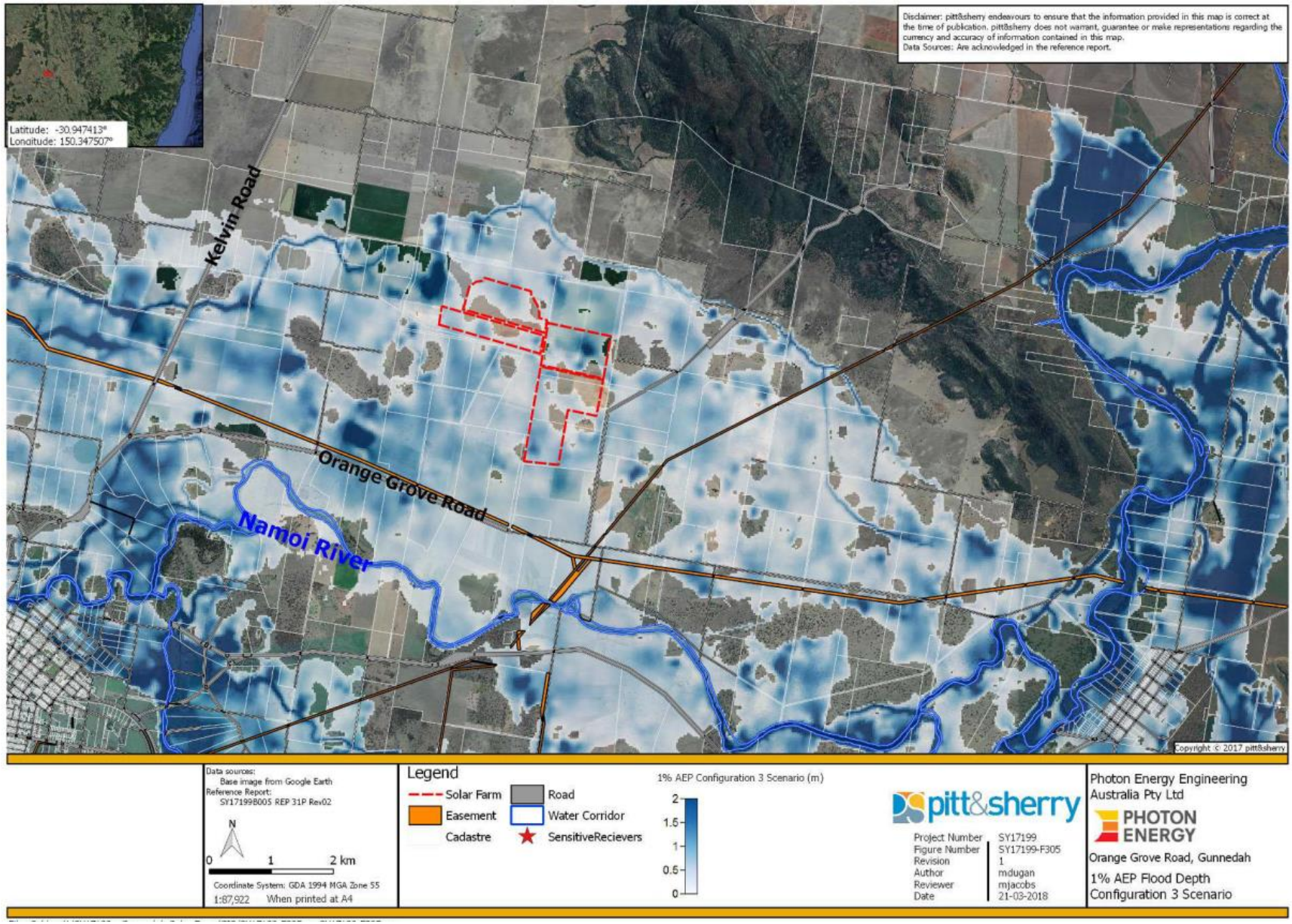

Figure 6-34 1% AEP Flood Depth Configuration 3

Velocity

Velocity maps for 1%AEP and PMF flows for Fence Configuration 3 are shown in **Appendix J**. (Figure SY17199-F306 and SY17199-F308 respectively). These show that the maximum velocities in the flood plain are about 1.4 m/s for the 1%AEP and about 2.1 m/s for the PMF, and that they occur in the same location as the existing case (current conditions scenario). This is typical of flood plain behaviour, in which flow travels relatively slowly across the flood plain and pools in local depressions and flow paths.

Higher velocities are shown where floodwaters flow over the gaps in the partially blocked fence. The velocities in the laneway are about 1.0 to 1.5 m/s in the centre of the laneway, and they increase to about 3.3m/s where they overtop and cross over the fence. The laneways do little to focus the flow into 'jets' along the laneways.

Soil erosion is expected where flood velocities exceed 0.4 to 0.8 m/s, depending on the state of the covering vegetation, whether it be crop, bare soil or natural grass. However, these velocities are already exceeded in the existing situation for the 1%AEP and PMF flood events. It is concluded, therefore, that soil erosion will already occur for major floods under existing conditions. The erosion hazard may be reduced compared with present, as it is proposed to establish permanent pasture throughout the solar farm which will provide greater vegetation cover and protection against erosion compared with the current cropping conditions.

The fences for the proposed solar farm are expected to change the direction of flow locally, but will not greatly change the magnitude of the velocities over the flood plain. Higher velocities will occur at the gaps in the debris accumulated on the fence, which may exacerbate erosion in the immediate vicinity of the gap, but this is a comparable situation to the blockage of ordinary stock fences in neighbouring paddocks.

Offsite Impacts

Flood behaviour was considered at the sensitive receivers surrounding the Solar Farm by comparing predicted flood levels under the baseline (existing) situation with flood levels under Fence Configuration 3. The locations of sensitive receivers are indicated in the flood maps and tables identifying the flood levels and changes to flood levels at sensitive receivers are included in **Appendix J**. Overall, the Proposal will result in small changes to overall flood depths at sensitive receivers. These changes are conservatively estimated to be less than about 18mm. The introduction of a partial obstruction in the flood plain diverts some of this flow. The main effects are changes to the direction of flow and increased depths, rather than changes to velocity.

Flood Impacts

Based on the small changes in modelled flood behaviour as a result of the development, it is considered that the development:

- Would not adversely affect beneficial inundation. The modelling predicts no appreciable change to inundation area
- Would not cause changes to erosion, siltation and riparian vegetation. As the site is not located close to the Namoi River, it is considered that the proposed development will not appreciably change erosion, siltation, riparian vegetation or the stability of river banks
- Would not affect existing flood Emergency Management and access procedures in place for the region
- Would not increase the risk to life from flood
- Would not have appreciable adverse social or economic costs to the community. The economic costs relate to the changes to flooding, which are mapped in Appendix A of the Flood impact assessment **Appendix J**. There are many social and economic benefits associated with the construction and operation of the proposed Solar Farm, however a more comprehensive economic assessment in the context of flooding is beyond the scope of the current study.

It is concluded that the proposed development is compatible with the hydraulic function of flood storage. Though the proposed security fences create a hindrance to flow as it is distributed through the site, there is

no appreciable reduction in flood storage as there would be with, for instance, the placement of a significant volume of fill in the area. It is expected that floodwaters will continue to seep or flow through the fences to occupy the same volume of flood storage as is currently available.

Water Quality

Construction

Construction activities with the potential to impact upon surface water flows include those with the potential to disturb soils and lead to sediment runoff. During construction, the soils will be subject to disturbance associated with site preparation, access and construction activities. However, due to the distance from the Namoi River, absence of any natural watercourses near the Site and the staged construction program leading to progressive stabilisation of disturbed soils, any potential erosion and water quality impacts to nearby waterways from the Proposal are considered low. These are capable of being managed through implementation of conventional erosion and sediment controls.

Operation

Apart from flooding, once the solar farm is in operation the potential impacts on hydrology and water quality are minor. Day to day activities would revolve around routine monitoring of the solar farm performance, undertaking required maintenance activities and managing the ongoing agricultural activities, none of which involve significant land disturbance, use of hazardous chemicals or other activities that could impact water quality.

Water use

Construction

Construction of the proposal will require limited potable water for staff amenities. Potable water would be trucked to the Site on an as needs basis and stored within temporary water tanks at the staff amenities area.

During construction, there is a need for non-potable water mainly for dust suppression. The volume of non-potable water required during construction may reach up to approximately 50,000 L/day, during hot windy weather conditions that lead to maximum dust suppression demand. Conversely, during cool or wet conditions the water demand would be minimal. Based on an estimated average daily water demand of 25,000 L/day throughout the construction period, this equates to an annual water use of less than 10 ML.

Photon have had approval from the land owner to use the water from bores on his property and will have a water use agreement in place for the volumes required. Water for dust suppression during construction would be sourced from collected stormwater and existing bores. The water demand is well within the capacity of the existing water supply network and access licenses. Should additional water be required this can be carted to site.

Operation

During operation, water would be required for stock watering and vegetation management. Water for these purposes is proposed to be supplied from the existing water access licenses under agreement with the landowner. Water may also be required for panel cleaning on an ad hoc basis. The water demands of the solar farm operation are small and likely to be less than the current demands from irrigated cropping.

Groundwater and Groundwater Dependent Ecosystems

Impacts to groundwater during construction are considered unlikely due to the depth of groundwater anticipated across the site. The closest groundwater monitoring bores indicated a standing water level exceeding 6m. Excavation on site will not exceed 4m associated with pile driving for the mounting structures and open trenching will not be deeper than about 1.2 m. As such, works on site are not anticipated to intercept or impact upon groundwater.

During operation, there is no planned increase on groundwater abstraction and hence no change to groundwater conditions are expected because of the proposal. Consequently, the proposed solar farm would not impact on groundwater dependent ecosystems directly or indirectly.

Further improvements to flood modelling

It is acknowledged that the accuracy and quality of the flood modelling results depends chiefly on the quality of the terrain data. The current model uses the SRTM-H digital elevation model (DEM), which comprises a grid of about 30m with a vertical accuracy of about ±9.8m. This terrain data does not fully describe fine details such as irrigation drains and bunds, many which have been constructed recently and may be too small to be captured in the SRTM survey. Though there are better terrain data to the south of the Oxley Highway, they do not extend to the northern edges of the flood plain, and do not cover the site of the proposed Solar Farm. The current terrain data is considered sufficient for modelling and understanding the relative change in flooding patterns and impacts due to the Proposal.

Prior to construction, further flood modelling will be undertaken to provide more accurate results for flood levels, depths and velocities at a higher resolution. Further modelling was suggested in response to community concerns about the local effects on floods of farm channels, levees and the smaller flow paths, and of apparent irregularities in the terrain model.

A greater level of accuracy will be achieved by:

- Completing a LiDAR survey (laser scanning from an airplane) of the Namoi Floodplain to the north of the Oxley Highway
- Ground-truthing of the LiDAR could also be used to survey floor levels of houses and buildings
- Refining the model to include a broader set of hydrological inputs such as splitting inflows between the Namoi and Mooki rivers

6.7.4 Mitigation / Management Measures

Reference	Mitigation Measures
Construction and Decommissioning Mitigation Measures	
SW1	A Soil and Water Management Plan (SWMP) will be prepared and implemented by the Contractor as part of the CEMP.
SW2	Minimise the footprint of disturbance by implementing progressive construction and remediation works
SW3	Design solar panel arrays to allow sufficient space between panels to establish and maintain ground cover beneath the panels and facilitate weed control
SW4	Ensure all refuelling activities are undertaken in a bunded area at least 40m from any waterways.

Reference	Mitigation Measures
SW5	Prior to construction, further flood modelling is undertaken including: • A revised hydrological model which identifies representative combinations of flooding from the Namoi and Mooki Rivers • New LiDAR data (north of Oxley Highway) to replace the current SRTM terrain data • Identification of additional mitigation measures such as further refinements to the fence configuration, if required, to reduce changes to flood levels and flow associated with the Proposal • Preparation of an addendum flood impact assessment report to describe the revised modelling outcomes and any subsequent flood mitigation requirements.
SW6	Additional mitigation measures will be considered during detailed design.
Operational Mitigation Measures	
SW7	Construct fencing in accordance with Final Flood Impact Assessment to be prepared prior to construction.
SW8	Implement the Land Management Plan to ensure at least 80% groundcover is restored and maintained (Refer **Appendix G**)

6.8 Soils, Geology and Contamination

An assessment of soils, geology and contamination has been undertaken for the Proposal. Information on the existing environment was obtained through a combination of desktop searches, site observations and a soil survey. Potential impacts of the Proposal have been identified and assessed for the construction and operation of the Proposal, and mitigation measures developed to address specific risks.

This chapter addresses the requirements of the SEARs, in particular the following matters:

- Geology and landform
- Existing soil conditions
- Potential soil contamination
- Soil and landscape suitability, and limitations to development
- Potential soil impacts during construction and operation
- Management and mitigation measures to minimize potential impacts on soils.

6.8.1 Existing Environment

Landform

Gunnedah is located on the Liverpool Plains in the Namoi River valley at an elevation of 264 m above sea level. The topography of the area is dominated by the flat plains that form the river valley and these occasionally give way to gentle slopes and rises which can reach low altitudes of 400 to 500 m above sea level. There are several highpoints in the region including the town of Gunnedah which is located on an elevated area, Black Jack Mountain which is situated to the south of Gunnedah town and the Kelvin Range to the north.

The subject site is located between the Namoi River to the south and a forested ridgeline which is part of the Kelvin Range which lies in an east-west orientation to the north of the Site. The Namoi River is located to the south of the site with all drainage running in a southerly direction with the majority of flows being via sheet drainage. Clearly defined natural drainage depressions and watercourses are sparse in this area and when present these concentrate flows to the Namoi River.

No natural watercourses exist on the site. Numerous watercourses upslope drain the slopes of the Black Jack Mountain range though become indistinct as they reach the floodplain. The site is located on the Namoi River floodplain and is characterised by long gentle slopes with the local relief being in the order of 3- 5m, and slopes varying in length from several hundred to over 600m. Figure 6-35 display the local landform and drainage patterns.

Over the last 10 -20 years, the subject property has been developed substantially for irrigated cropping with a series of constructed water ways and channels allowing distribution of bore water to all parts of the property. The majority of paddocks have been land planed and levelled to allow flood irrigation to take place. This has also seen the installation of head and toe drains, and gutters to allow use and re-use of irrigation water. The construction of these works has seen each paddock effectively contained within its own drainage system which then links with the major irrigation drains and channels.

The site has predominantly been cleared of native vegetation with some scattered mature eucalypts remaining and the groundcover has been highly disturbed through previous grazing and current cultivation. Much of the property was under crop with wheat and chick peas and several paddocks were being sown to other crops on the day of the site inspection. In the areas between paddocks and where cropping has not occurred the groundcover consists of introduced and common weed species.

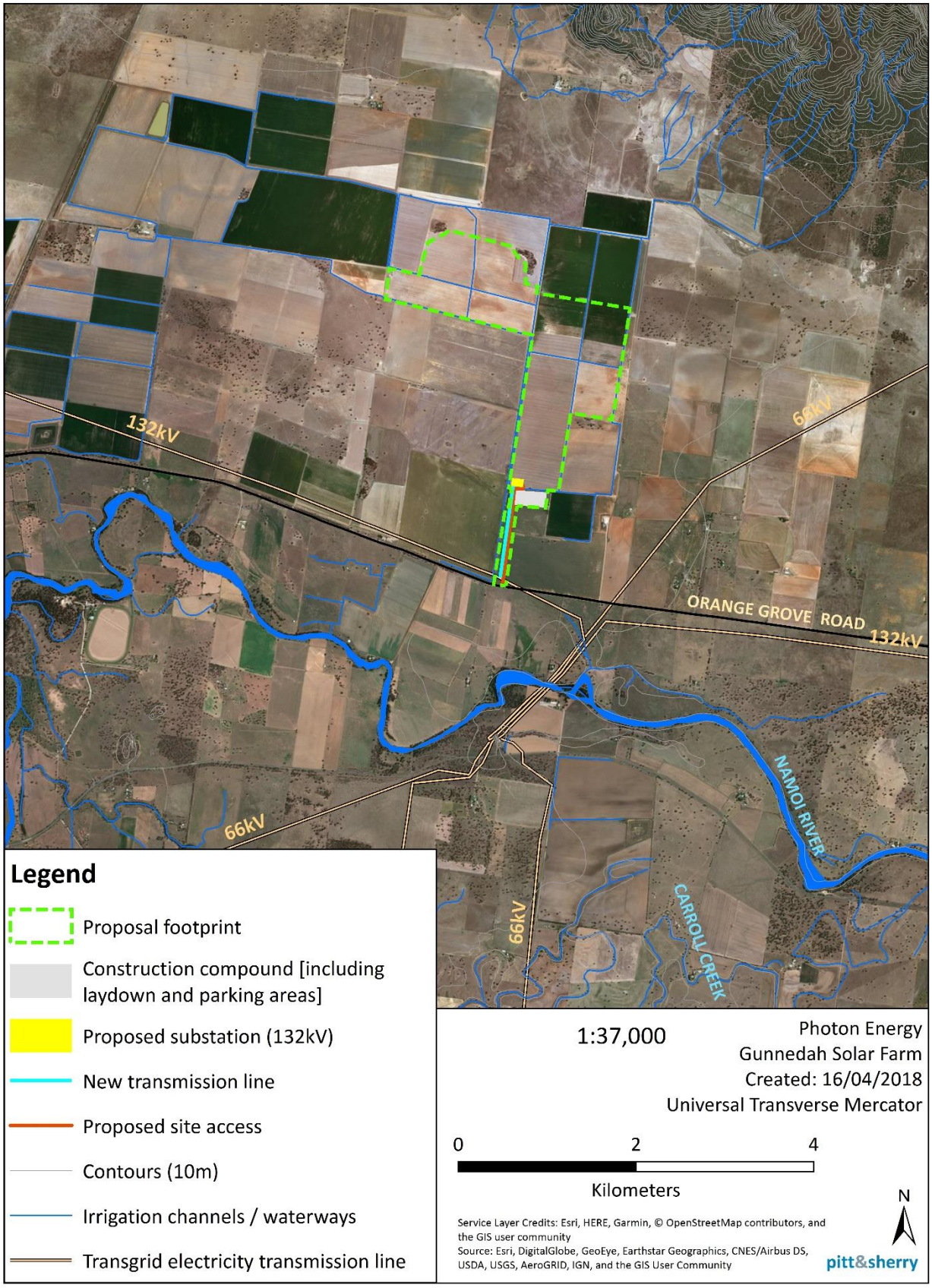

Figure 6-35 Location of the Subject Land in relation to the Namoi River

Geology

The Manilla 1:250000 Geological Map was reviewed to provide an initial determination of the underlying geology of the subject area. This indicates that the geology of the Site is categorized as Quaternary Alluvium (Qa) and is shown on Figure 6-36.

The New England Fold Belt is the youngest structural feature in NSW and is separated from the Lachlan Fold Belt by the Sydney-Bowen Basin that is filled with Mesozoic sediments. The rocks in this sequence are Devonian sedimentary and volcanic rocks, with the youngest being Triassic sandstones and shales which were deposited by the rivers on the edge of the Gunnedah Basin approximately 250 million years ago. During this period the New England area was also being uplifted by granite intrusions.

In terms of geomorphology, the western slopes can be viewed as a dissected ramp that links the uplifted highlands with the western plains. Western rivers pass across this ramp without depositing large volumes of sediment while the Darling Riverine Plains alluvial fans begin at the base of this ramp.

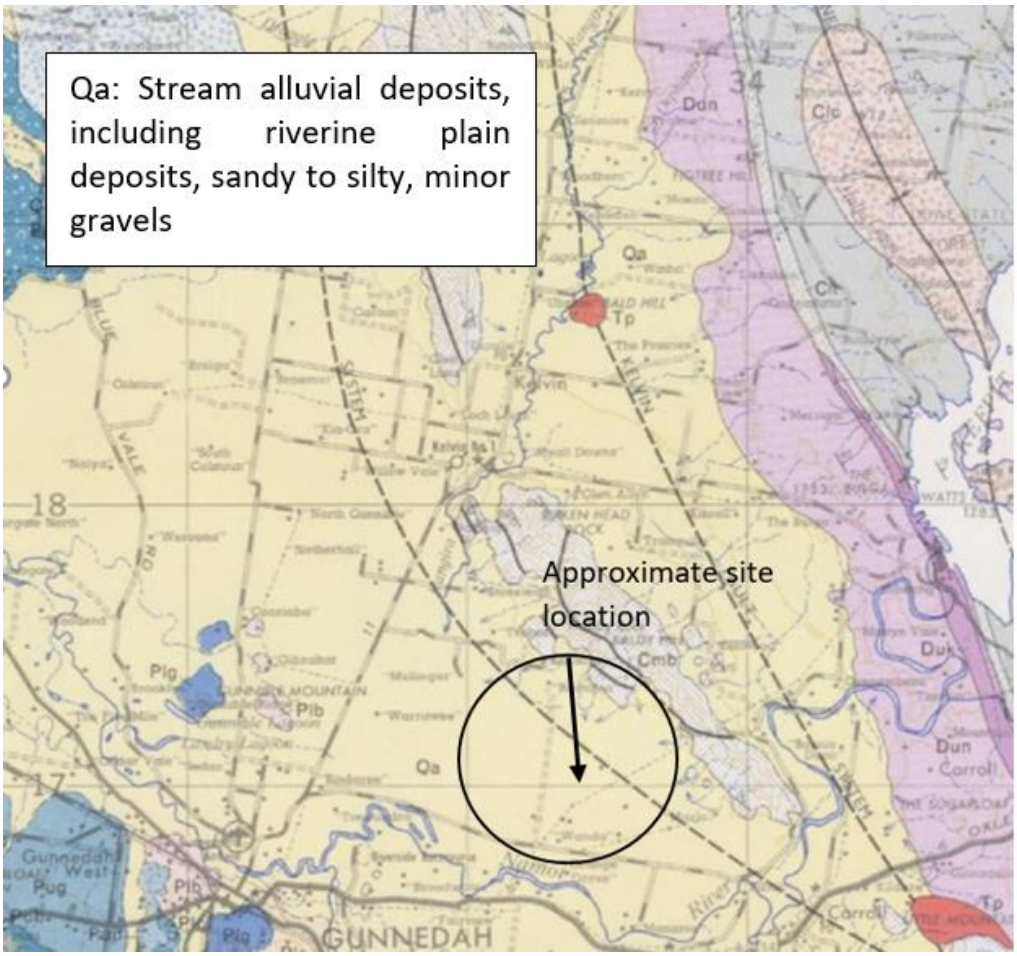

Figure 6-36 Geology of the area (Qa) (Extract from Manilla 1:250000 Geological Map)

Soil Landscape

The majority of the site has been mapped as the Burburgate soil landscape in the SLAM Soil Landscape Report for Liverpool Plains v 1.0.0. The soils of this landscape can sometimes be complex due to their distribution being influenced by alluvial processes that are common on flat landscapes associated with inland river catchments.

As detailed in the Soil Landscape description, "*Nondescript plain areas are dominated by giant, poorly drained Vertic Eutrophic Brown Chromosols (Red-brown Earths) or giant, moderately well-drained Endocalcareous*

Self-Mulching Brown Vertosols (Brown Clays) or giant, imperfectly drained Self-Mulching Red Vertosols (Red Clays). (SLAM Soil Landscape Report for Liverpool Plains v 1.0.0)

The northern most section of the subject property which is outside the solar farm footprint is situated within the Tulcumba Soil Landscape and includes the gently inclined foot slopes of the Kelvin Range. This soil landscape lies to the north of the Site and is different in landscape and topography to that of the subject land.

Table 6-30 details the qualities and limitations for soils found in the Burburgate Soil Landscape.

Table 6-30 Soil qualities and limitations

Qualities	Limitations
Complex soils	Foundation hazard
Fertile	Localised Dieback
Productive arable land	Widespread recharge zone
Land and Soil Capability 2 (3)	Localised high run on
	Widespread flood hazard

Potential Acid Sulfate Soils (PASS) and Acid Sulfate Soils (ASS)

Potential Acid Sulfate Soils (PASS) and Acid Sulfate Soils (ASS) are generally associated with natural soils and sediments containing iron sulfides under anaerobic conditions – usually below the watertable. These types of soils are more common along the NSW coast but can also occur in some inland areas. Inland acid sulfate soils are mainly associated with inland waterways, wetlands and drainage channels. As is the case with the coastal soils, inland acid sulfate soils develop in waterlogged, saline and anaerobic conditions.

The NSW Government have undertaken risk assessment mapping of areas that could potentially be affected by Acid Sulfate Soils. This mapping has been quite extensive along the NSW coast with very limited risk mapping being completed for inland areas.

The NSW government web site, http://www.environment.nsw.gov.au/eSpade2WebApp was consulted on 10th January 2018 to gather relevant data on soils in this area and determine the level of risk from issues such as ASS.

A review of the current mapping indicates that the subject Site is not currently mapped as being a risk area for ASS. Based on the site geomorphology, drainage and observed soils, it is highly unlikely that ASS/PASS would exist or pose a problem at or near this Site. The activities proposed on the Site will have a minimal impact in relation to disturbance of ASS or PASS. The, majority of works will occur in the upper 800mm of soil and there is minimal risk of disturbing or exposing PASS to oxidation.

Potential contamination

A search of the NSW contaminated land register was conducted on 10th January 2018. This register contains four sites in the Gunnedah Shire Council LGA. These are all within the town ship of Gunnedah and all are former Service Station sites (Refer Table 6-31).

Table 6-31 Registered contaminated sites within Gunnedah LGA (Source: NSW EPA)

Suburb	Address	Site Name	Distance from the site
Gunnedah	Intersection of Henry Street and Conadilly Street	Adjacent to Service Station	Approx. 14.7km
Gunnedah	Corner Conadilly Street & Henry Street	BP Service Station	Approx. 14.7km
Gunnedah	61 Railway Avenue	Former Caltex Depot	Approx. 14km
Gunnedah	341 Conadilly Street	Mobil Service Station	Approx. 14.5km

Land uses which generally lead to an area being deemed contaminated land include heavy industry and intensive agriculture. The subject land has previously been used for broad acre cultivation and prior to this grazing for livestock. Both these uses present a low risk of contamination from fuels, herbicides, pesticides and other farm chemicals.

6.8.2 Soil Survey and Analysis

Soil Survey

To identify broad land capability and soil constraints a soil survey was undertaken on the Site. A desktop analysis was conducted to determine approximate sites for the soil survey to be undertaken. This analysis considered the site in terms of topography, drainage, access and possible variation of soil types to ensure the samples were representative of the site.

The soil survey included:

- Excavation of six test pits using a shovel and crowbar to expose the soil profile to a depth of approximately 500mm
- Completion of a test pit log sheet to record attributes of each soil layer in the field, including layer depth, field texture, colour, structure and other relevant data. A photo was taken of each soil profile. These are included as Figure 6-38 and the soil log sheets are included as **Appendix K**
- Collecting a representative sample (approx. 1kg) of each soil layer. Samples were placed in sealed plastic bags and labelled appropriately
- Analysing soils to assess soil fertility and a range of general constraints to land development.

Figure 6-37 shows the approximate location of the test pits in relation to the solar farm boundary. At the time of assessment, the landholder was sowing crops in several paddocks and had already completed sowing in other paddocks. This restricted the access to some sections of the property and in these areas, soils were sampled on the edge of these areas to minimise damage and disturbance to recently sown crops.

Soil Description

As previously described the topography of the site is relatively flat and has been used previously for grazing of livestock and more recently cultivation for both dryland and irrigated crops including wheat, cotton and chick peas. The soils observed are typical alluvial plains associated with inland rivers such as the Namoi River and as with many soils used for cultivation and growing of crops, soil fertility can be depleted over a period of years.

The following general observations were made:

- The site soils can be characterized as deep alluvial brown clays, typically comprising clay loam topsoil's over clay loam to medium clay subsoils
- Soils are whole-coloured without obvious mottling and appear to be well drained in the upper soil profile
- Soils on site display a small amount of shrink / swell in response to moisture, and this is evident in the floor of the irrigation channels that service the property

- The site presents a low to moderate hazard for rill and gully erosion. This is due to the scarcity of flowlines and drainage channels and absence of concentrated flow conditions. The flat topography and location on the alluvial plain suggest the site may be most at risk of sheet erosion during and after rainfall and irrigation events and in times of flood. Sheet erosion may be exacerbated by surface sealing, which leads to reduced infiltration and increased runoff. Localised steep areas (e.g. drain batters) are at increased risk of rill erosion. Wind erosion may be experienced when soils are left bare or fallow between cultivation cycles.

Table 6-32 provides a brief summary of the soil materials sampled.

Table 6-32 Soil Sample Descriptions

Sample Name	Sample Depth	Description
1A	0 – 100 mm	Clay loam, dark brown
1B	100 – 500 mm +	Clay loam, dark brown
2A	0 -100 mm	Clay loam, brown
2B	100 – 500 mm +	Clay loam, dark brown
3A	0 -300 mm	Clay loam, light brown
3B	300 – 550 mm	Sandy clay loam, grey brown
3C	550mm+	Sandy clay loam
4A	0 – 300mm	Clay loam, brown
4B	300mm +	Light clay, brown
5A	0 – 150 mm	Clay Dark, brown
5B	150 – 500 mm +	Clay Dark, brown
6A	0 – 100 mm	Clay loam, dark brown
6B	100- 500 mm +	Clay loam, dark brown

Soil analysis

A number of representative soil samples were sent to the NSW Department of Primary Industries laboratories in Wollongbar and Scone for analysis of a range of physical, chemical and fertility indicators.

Table 6-33 lists the schedule of analysis and a brief summary of the results is provided in Table 6-34 and the following sections. Certificates of analysis containing the complete laboratory results are contained in **Appendix K**.

Table 6-33 Laboratory analysis schedule

Sample ID	Depth (mm)	Erosion hazard K factor (incl particle size analysis)	pH (water) pH (CaCl2) Electrical conductivity (EC)	Cation Exchange Capacity (CEC) Available P Available S Organic C Total N
1A	100	X	X	X
1B	500	X	X	X
2A	100		X	X
2B	500		X	
3A	100	X	X	X
3B	300		X	
3C	500		X	
4A	200		X	
4B	500	X	X	
5A	200		X	X
5B	500		X	X
6A	100		X	X
6B	500		X	
Note – "X" denotes the sample was analysed				

Table 6-34 Summary of laboratory results.

Factor	Units	Maximum	Sample No.	Minimum	Sample No.
pH (Water)	pH units	8.3	4B	6	1A
pH ($CaCl_2$)	pH units	6.9	5A/B	5.2	1A
Electrical Conductivity	dS/m	0.17	4B	0.037	3C
Sulfur (KCl_{40})	mg/kg	2.8	3A	9.1	1B
Bray Phosphorus	mg/kg	460	1B	9.9	5A
Organic Carbon	%	1.5	1B	0.74	3A/ 5A
Total Nitrogen	%	0.18	1B	0.081	5B
Aluminium	cmol(+)/kg	<0.1	all	<0.1	all
Calcium	cmol(+)/kg	19	5A	9	2A
Potassium	cmol(+)/kg	1.6	1A	0.74	2A
Magnesium	cmol(+)/kg	10	5B	3.9	6A
Sodium	cmol(+)/kg	0.71	5B	0.048	3A

Factor	Units	Maximum	Sample No.	Minimum	Sample No.
CEC (effective)	cmol(+)/kg	30	5A/B	15	3A
Calcium/ Magnesium		2.7	6A	1.8	2A/5B
Percent Aluminium Saturation	% of ECEC	N/A		N/A	
Exchangeable Calcium	% of ECEC	67	6A	60	2A
Exchangeable Potassium	% of ECEC	7.6	6A	3.6	5B
Exchangeable Magnesium	% of ECEC	34	2A	25	6A
Exchangeable Sodium Percentage	% of ECEC	2.3	5b	0.33	3A

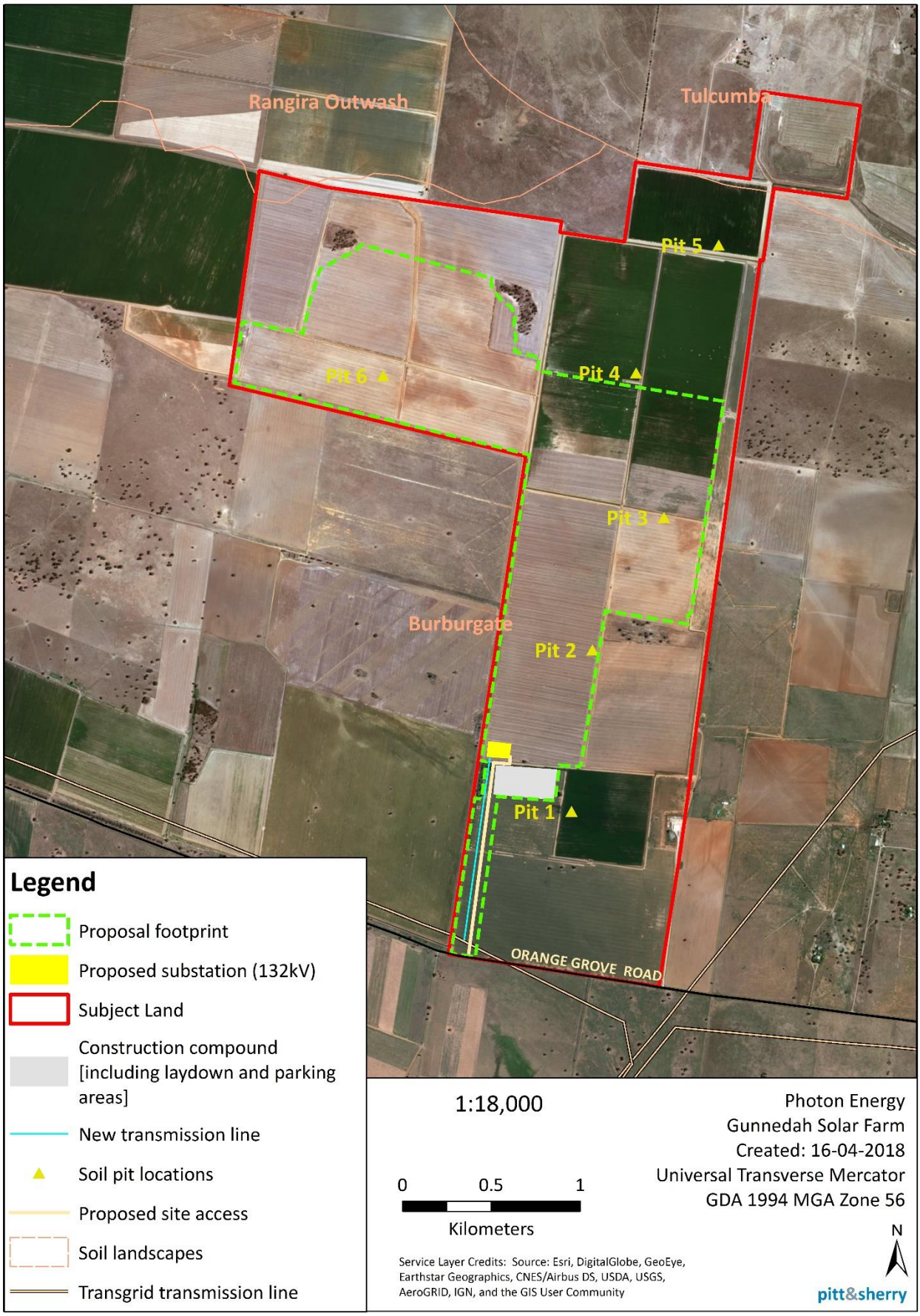

Figure 6-37 Soil test pit locations

Soil Acidity

Acidity or soil pH is a measure of the concentration of hydrogen ions in the soil solution and the lower the pH of soil, the greater the acidity. It is recommended that pH (water) should be maintained at above 5.5 in the topsoil and 4.8 in the subsurface as well maintained soil pH will maintain the soil resource and increase crop and pasture choices, while also avoiding production losses associated with high and low pH's. Laboratory analysis of the soils sampled indicates a pH (water) range of 6 (slightly acid) to 8.3 (moderately alkaline).

Alternately pH in a Calcium Chloride solution can also be used an indication of pH. As a rough guide the CaCl2 reading will be 0.8 units lower than the water pH. Values < 5.5 indicate that the soils are becoming acid. These samples show that site 1, 2 and 3 are approaching this level and amelioration with lime would be recommended to prevent them becoming more acid. This is especially the case considering the cation exchange capacity (CEC) levels are above 15. Also, acid soils restrict the availability of major nutrients such as phosphorus and nitrogen to the plants.

Site 5 which is moderately alkaline would not be an issue to plant growth and nutrient availability.

Soil Salinity

Electrical conductivity (EC) is a measure used to determine the salinity levels in soils. The ECse range for non-saline soils to extremely saline soils are listed in Table 6-35

Table 6-35 Salinity Rating

Rating	Electrical Conductivity of a saturated soil Extract (ECe)
Non-saline (very low to Low)	<2
Slightly saline (Medium)	2 -4
Moderately saline (High)	4 – 8
Highly saline (Very High)	8-12
Extremely saline (Extreme)	>12

There are no indicators of salinity present on the subject land including no:

- Visible signs of scalds
- Poor crop growth in low-lying areas where water cannot drain freely due to poor layout and drainage
- Waterlogging-tolerant plant species become dominant
- Salt appearing adjacent to irrigation bays on non-irrigated land, and
- Salt accumulation on check/contour banks.

Table 6-36 Site Electrical Conductivities (1:5 solution)

Sample	Electrical Conductivities dS/M	ECse
1A	0.12	1.032
1B	0.16	1.376
2A	0.062	0.533
2B	0.063	0.542
3A	0.063	0.542

Sample	Electrical Conductivities dS/M	ECse
3B	0.054	0.513
3C	0.037	0.352
4A	0.094	0.808
4B	0.17	1.615
5A	0.12	0.9
5B	0.1	0.75
6A	0.11	0.946
6B	0.057	0.490

The laboratory analysis shows a range of 0.037 to 0.17 dS/m in a 1:5 water solution (refer Table 6-36). When adjusted for the loam to clay loam textures for ECse, these soils are all non – saline soils.

Furthermore, there are no indicators of salinity present on the subject land, including no:

- Visible signs of scalds
- Poor crop growth in low-lying areas where water cannot drain freely due to poor layout and drainage
- Waterlogging and prevalence of salt tolerant plant species
- Salt appearing adjacent to irrigation bays on non-irrigated land
- Salt accumulation on check/contour banks.

Sodicity

Sodicity is related to the amount of sodium (Na) held in a soil within the cation exchange complex. Sodium is a cation (positive ion) that is held loosely on clay particles in soil and is one of many types of cations that are bound to clay particles. Other cations include calcium, magnesium, potassium and hydrogen. Problems occur in soils where there is an imbalance of sodium relative to other cations and this can occur with relatively low levels of sodium. If the exchangeable sodium percentage (ESP) is more than about 5% of all cations bound to clay particles, the soil is said to be sodic and above 10% is strongly sodic (Hazelton & Murphy, 2007).

The general problem with sodic soils is that high levels of sodium cause the soil to be dispersible and unstable when moisture is applied making them highly susceptible to erosion, particularly water erosion. Dispersion causes structural decline and surface crusting, leading to increased runoff susceptibility and reduced water infiltration. Problems can become severe when sodic subsoils become exposed after erosion of topsoil's.

Similarly, soils with high levels of magnesium levels in the cation exchange, referred to as magnesic soils, can exhibit problems similar to sodic soils. For soil to exhibit sodic symptoms due to high magnesium it is generally accepted that every 8 to 10 % of magnesium is equivalent to 1 % of sodium. Table 6-37 presents the measured sodium and magnesium concentrations for the soils tested.

Table 6-37 Exchangeable Sodium and Magnesium in the Cation Exchange Complex (%).

Sample	Exchangeable Sodium (%)	Exchangeable Magnesium (%)
1A	0.45	29
2A	1.7	34
3A	0.33	28
5A	1.9	33

Sample	Exchangeable Sodium (%)	Exchangeable Magnesium (%)
6A	0.43	25

The soil test results demonstrate ESP levels below 2, which taken alone are non-sodic. However, coupled with the relatively high exchangeable magnesium percentage (approximately 30) the soils become borderline sodic. The relatively low organic carbon levels (organic matter = organic carbon * 1.72) which are less than one, indicates these soils would be subject to crusting and potentially high runoff if surface sealed. Surface sealing/crusting can be seen in the photos (Figure 6-37).

The lower organic carbon values from the soil tests is probably an indication of intense cropping over a number of years. Another indicator of potential instability of the soil is the Ca/Mg ratio of less than 2. A value of one, or close to one indicates extreme susceptibility to surface crusting/sealing and values <2 indicate there may be issues from raindrop impact particularly if freshly cultivated and bare.

K Factor – Erosion Factor

A number of factors can contribute to the erosion hazard at any particular site. The Revised Universal Soil Loss Equation (RUSLE) is one method commonly employed in NSW to estimate erosion hazard and allows risk assessment and comparison across various sites. It represents the product of various factors including rainfall erosivity, soil erodibility, landscape factors (e.g. slope gradient and length) and land management practices including surface cover and condition.

Soil erodibility (RUSLE K-factor) is a key factor in assessing erosion hazard. K-factor relates to both the susceptibility of a soil to erosion and the rate of erosion-causing water runoff. It is chiefly affected by soil texture but also structure, organic matter content and profile permeability.

Following is a general guide to K-factor based on soil texture:

- Soils high in clay typically have low K values, about 0.005 to 0.015, because they are resistant to detachment
- Similarly, coarse textured soils such as sands usually have low K values, about 0.005 to 0.02, due to the associated high profile permeability and low runoff, even though these soils are easily detached
- Medium textured soils, such as the silt loam soils, have moderate K values, about 0.025 to 0.04, because they are moderately susceptible to detachment and they produce moderate runoff
- Soils having a high silt content are most erodible of all soils. They are easily detached; tend to crust and produce high rates of runoff. Values of K for these soils tend to be greater than 0.04.

Four of the test pit samples were analysed for K factor, and the results showed a range of 0.037 to 0.055 (refer Table 6-38) which indicates the soils tested have a moderate to high K-factor value.

Table 6-38 Particle size analysis and K factor

Lab No.	P7C/2 Particle Size Analysis – mechanical (%)							
	Sample ID	OC (%)	Clay	Silt	F sand	C sand	Gravel	Soil Erodibility – K Factor
1	Gunnedah 1A	1.82	25	54	15	2	4	0.048
2	Gunnedah 1B	1.62	21	59	13	3	4	0.055
3	Gunnedah 3A	0.82	26	30	24	11	9	0.042
4	Gunnedah 4B	0.68	39	44	10	2	5	0.037

Test Pit 1

Test Pit 2

Test Pit 3

Test Pit 4

Test Pit 5

Test Pit 6

Figure 6-38 Test Pit Photos

Nutrients

Phosphorus

Phosphorus levels vary widely across the site. They range from extremely high (320 mg/kg, sample 1A) to low (9.9 mg/kg, sample 5A). Without knowing the full history of the sampling sites, it may be surmised that high rates of phosphorus fertilizer application are being used to support the crops grown on the site. The samples to depth also indicate that there probably been leaching of P down the profile which will occur with high rates of application that are not taken up by the plants.

Nitrogen

Soil nitrogen was determined as total nitrogen by combustion. This method is not very relevant to mineral availability for plants as 95 – 99% of the total nitrogen is tied up as organic matter. This means that only 1 – 5% of soil nitrogen is in the mineral forms (NH_4^+, NO_3^-, NO_2^-) and available to plants. Availability of this nitrogen is determined by the mineralisation of the organic nitrogen. There is a general rating for total soil nitrogen as a guide to what mineral N may be available to plants. Cross referencing this with the soil tests, <0.05 is very low and 0.05 to 0.15 is low. This means the soils generally have low to very low mineral nitrogen levels for plant growth.

Sulfur

The level of sulfur generally recommended for crop growth needs to be greater than 8 to 10 mg/kg. The site soils display values below this level. Another recommendation is that pasture plants require a total N to total S ratio of about 17:1 for healthy growth and ratios greater than this are indicative of sulfur deficiency. The site soils display marginal sulfur deficiency.

Erosion Hazard Analysis

Soil disturbance is expected principally during the construction stage of solar farm development. A site-specific erosion hazard assessment has been undertaken to help assess the magnitude of risk associated with soil erosion and sedimentation of waterways.

Managing Urban Stormwater: Soils and Construction (Landcom, 2004; the "Blue Book" outlines a method for estimating erosion hazard using the Revised Universal Soil Loss Equation (RUSLE). Erosion hazard can be estimated by comparing the site specific RUSLE value with guideline values published in Figure 4.6 in the Blue Book.

Table 6-39 summarises the Revised Universal Soil Loss Equation (RUSLE) factors and assumed values for the site.

Table 6-39 Revised Universal Soil Loss Equation.

Factor	Value	Description
R-factor	1500	Rainfall erosivity: related to average rainfall energy and intensity. Data taken from R-factor maps published in Annex B of the Blue Book
K-factor	0.055	Soil erodibility: conservative value calculated from soils data including texture, structure, organic matter content and permeability (refer Rosewell 1993)
LS-factor	0.24	Slope length/gradient factor: describes the combined effect of slope length and gradient on soil loss. Conservative slope length = 200m; slope gradient = 1% (Refer table A1 in the Blue Book)
P-factor	1.3	Practice-factor: related to site management practices and surface condition, and their relationship to runoff generation. A factor of 1.3 is standard on construction sites.

Factor	Value	Description
C-factor	1.0	Cover factor: describes the effect of surface cover in reducing exposure of soils to erosion. A nominal value of 1.0 is adopted for construction sites where soils are bare and compacted.
Annual estimated soil loss	26	Soil loss (in T/ha/yr.) calculated by RUSLE equation, as $A = R \times K \times LS \times P \times C$
Soil Loss Class	1 (Very Low)	The Blue Book describes seven soil loss classes ranging from 1 (very low, 0-150 T/ha/yr.) to 7 (extremely high,>1500 T/ha/yr.). The Blue Book also prescribes management requirements dependent on soil loss class.

The annual estimated soil loss for the Project footprint is 26 tonnes per hectare per year, which is very low. A conventional suite of erosion and sediment controls should be sufficient to manage the erosion and sedimentation risks associated with construction activities.

6.8.3 Assessment of Potential Impacts

Construction

The potential to impact upon soils on the site is greatest during construction. During this period the soils will be subject to disturbance associated with site preparation, access and construction activities. Works with potential to impact soils include:

- Site establishment and preparation for construction
- Disturbance within the construction laydown area (approximately 5ha area) including works to flatten the surface. The construction laydown area will likely be capped with gravel to create a hardstand surface. This will be removed when the construction phase is complete
- Installation of environmental controls
- Minor vegetation clearing (grasses and shrubs) including:
  - Targeted clearance of low laying vegetation around trenching areas to steel post installation to minimise disturbance to existing ground cover
  - Clearance of larger vegetation such as bushes and shrubs
- Preliminary civil works including:
  - Drainage works
  - Setting up foundations for the substation
  - Earthing works (see below)
- Installation of steel post and rail foundation system for the solar panels
- Installation of underground cabling (trenching) and installation of inverter stations
- Construction of 132kV substation, including:
  - Site Establishment and clearing (if required)
  - Bulk earthworks via a range of plant that may include scrapers, bulldozers, excavators, rollers, trucks and loaders
  - Detailed civil works including drainage, earthing, foundations etc. generally using excavators, piling rigs, trucks and cranes.

If these activities are not adequately managed, impacts that could result include the following:

- Erosion of exposed soil and stockpiled materials
- Dust generation from excavation and vehicle movements over exposed soil
- Compaction and surface sealing of exposed soils, leading to increased erosion and runoff and poor vegetation condition
- Poor storm water quality due to erosion and increased sediment loads, causing turbid stormwater runoff and impacts on receiving waters
- Potential disturbance of historical land contamination
- Contamination of soil due to spillage of hazardous chemicals such as fuels, oils, and other hazardous substances.

Soils have the potential to be unstable which could lead to increased wind and water erosion across the site. By utilising the relatively flat topography, well established vegetation cover, and standard erosion and sediment control measures, the potential for erosion and the movement of sediments could be managed effectively given the relatively low erosion hazard as assessed by RUSLE calculations. Nonetheless, erosion and sediment control plans would be implemented in accordance with *Managing Urban Stormwater: Soils and Construction Vol 1.* (*Landcom 2004*).

Overall the soils do not present any major physical or chemical constraints that cannot be managed. In summary:

- The soils are quite deep and relatively well drained
- pH's are generally within the acceptable range. If pH becomes an issue, the addition of ameliorants such as organic mulches and lime can assist in reducing alkalinity or acidity
- Soils are non-saline
- K factors suggest soil erodibility is moderate to high, though the overall erosion hazard is very low due to climate and landform factors
- Fertility can be improved through targeted addition of nutrients and ameliorants.

Panels within the solar array area are designed to sit above the ground and ground cover would be maintained underneath and around the panels (excluding formal access tracks) throughout the operational phase of development. The objective is to maintain the current vegetation (or alternative grass cover) throughout the construction phase as far as possible, which will minimise the erosion hazard. Apart from the permanent hardstands (for the substation, inverter stations and parking areas) and formal access tracks, areas disturbed by construction would be revegetated promptly and progressively including throughout the solar arrays.

Synthetic dust suppressants, can be employed effectively to manage wind erosion and reduce dust.
Internal drainage of the site will remain similar to existing and there will not be any major new storm water diversions (e.g. contour banks) or watercourses. The existing irrigation channels and irrigated paddock borders will continue to act as diversions to capture and divert storm water run-on from slopes to the north and away from core construction areas, and this will reduce potential impacts from sheet erosion and storm water runoff.

In relation to engineering suitability, limited soil laboratory data has currently been collected to determine specific properties for design of structures such as drains, roads and building bases. Further geotechnical investigations and detailed design of structures would be undertaken post approval. Nothing in the data collected to date suggests there are significant risks for building structural work though possible high shrink swell soils will need to be considered for design of foundations.

Compacted structures such as roads and drains should present no issues if constructed well. Banks and drains should be revegetated as quickly as possible.

Operation

The potential for the Solar Farm to impact on site soils during operation of the farm, after all areas disturbed during construction have been rehabilitated and groundcover has been established, is minimal. The site will be accessed regularly for maintenance of the Solar Farm and management of grazing livestock, generally using 4WD vehicles. These activities will not involve significant levels of soil disturbance and potential impacts can be minimised by maintaining groundcover.

The maintenance of a protective groundcover and general soil management and monitoring measures will be included in a Land Management Plan. This Plan will address operation of the solar farm and general farm management activities to achieve several key goals relevant to environmental management and social responsibility:

- Maintain sustainable soil and plant systems to preserve the agricultural values of the land, including BSAL values
- Promote and continue productive agriculture alongside electricity generating operations
- Minimise impacts to surrounding farmlands and the rural community.

The ground cover within the Site would be affected by shading to varying degrees depending on time of year and time of day but is not expected to inhibit the maintenance of an effective groundcover.

It is anticipated that the soils will benefit from a break in cultivation activities and that on decommissioning of the solar farm will be in an equivalent or improved condition to support continued agricultural activities such as irrigated cropping. During solar farm operation, the soils will not be affected by regular cultivation or the constant addition of mineral fertilisers. An improvement in accumulated organic matter can be anticipated under a permanent pasture scenario and this will assist in improving fertility as well as soil structure.

If stock (dorper sheep) are used to graze the area to cut down maintenance costs (i.e. to reduce the need for slashing, mowing and herbicides), the area needs to be established to improved grasses and legumes with adequate fertiliser before any construction works. Strategic electric fencing and watering points would also need to be established to assist with management of grazing livestock.

The specifics of livestock management would need to be included in the Land Management Plan to address stock movement to control vegetation and weeds, stock movement in times of flood and drought and whether they would breed lambs to offset some costs.

To improve soil stability and reduce the potential for erosion and surface crusting, soils would benefit from increased organic matter. At the moment, soils have a tendency to surface crust which is exacerbated by the borderline combined sodium and magnesium levels which are tending to make the soils slightly sodic. The best way of improving organic matter levels and provide ground cover to prevent erosion is with actively growing pastures and fertiliser application (N, P and S). From the soil tests, it is evident that some lime is needed to address potential acidity.

Pastures would be established to provide competition to reduce the potential for weed propagation. Well managed pasture is a cost-effective alternative to slashing and herbicides for weed control and will be more practical within a solar farm setting. Apart from the improved grasses suggested below, there would have been some useful native grass and legume species existing prior to them being cultivated out. Over time, some of these may recruit from seedbanks along roadsides and nearby forested areas.

There are a large range of potential pasture plant recommendations for the area which are listed in Table 6-40. Local agronomists would be consulted on the best up to date pasture recommendations for the Gunnedah area and on these soils.

Table 6-40 Potential pasture plant recommendations

Temperate Grass Species	Temperate Legume Species	Tropical Grass Species	Tropical Legume Species
Phalaris (*Phalaris aquatica*) Cocksfoot (*Dactylis glomerata*) Fescue (*Festuca arundinacea*)	Lucerne (*Medicago sativa*) Snail medic (*Medicago scutellata*) Barrel medic (*Medicago truncatula*) Sub clover (*Trifolium subterraneum*) Rose clover (*Trifolium hirtum*) Serradella (*Ornithopus spp.*) Biserrula (*Biserrula pelecinus*) Disc/Strand hybrid medic (*Medicago tornata/ littoralis*) Gland clover (*Trifolium glanduferum*) Sulla (*Hedysarum coronarium*) Arrowleaf clover (*Trifolium vesiculosum*) Purple clover (*Trifolium purpureum*)	Panic (*Panicum spp.*) Setaria (*Setaria incrassata*) Rhodes (*Chloris gayana*) Digit (*Digitaria eriantha*) Buffel (*Cenchrus ciliaris*) Bluegrass (*Bothriochloa spp.*)	Annual lablab (*Lablab purpureum*) Perennial lablab (*Lablab purpureum*) Atro siratro (*Macroptilium atropurpureum*) Burgundy bean (*Macroptilium bracteatum*) Cowpea (*Vigna unguiculata*) Butterfly pea (*Clitoria ternata*) Desmanthus (*Desmanthus virgatus*)

No impacts in addition to those mentioned for construction are anticipated for soils during the decommissioning phase.

6.8.4 Mitigation / Management Measures

Reference	Mitigation Measures
Construction and Decommissioning Mitigation Measures	
S1	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP, in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004). This will include an erosion and sediment control plan for implementation during construction.

Reference	Mitigation Measures
S2	Minimise the footprint of disturbance during construction and employ progressive rehabilitation strategies to reduce the erosion hazard
S3	During trenching activities and backfilling, as far as practicable separate topsoil and subsoil and when backfilling return the soil layers in their original order.
S4	Employ dust management measures on unsealed roads, stockpiles and other areas of loose or disturbed soil prone to dust generation. Controls may include covering of stockpiles, watering roads and synthetic soil stabilisers. Dust management techniques shall be outlined in the Soil and Water Management Plan.
S5	Maintain erosion and sediment controls until construction works are complete.
S6	Install a stabilised site entrance that all construction vehicles will use to access the site. The stabilised entrance shall be designed to minimise tracking of sediment onto adjoining roads from departing vehicles.
S7	Undertake site inspections at least weekly and following significant rainfall events to observe the condition and operation of erosion and sediment controls and water management systems and schedule any required maintenance.
S8	Undertake soil amelioration and vegetation improvement works in line with the requirements of a Land Management Plan. This should include undertaking required land or vegetation improvement works at an appropriate stage during solar farm development. For example, soil amelioration and fertilising might be most practically undertaken prior to solar panel installation. For similar reasons the desired pasture crop should be sown before solar panel installation.
S9	Design arrays to allow sufficient space between panels for essential maintenance activities and to facilitate maintenance of an effective ground cover beneath the panels to reduce erosion and help suppress weeds.
S10	Develop and implement a protocol for management of an unexpected finds of soil contamination in the CEMP and OEMP.
S11	Stabilise batters required for ancillary infrastructure raised off the ground.
Operational Mitigation Measures	
S12	Implement a Land Management Plan that addresses the ongoing land management and maintenance activities (Refer **Appendix G**). This would address: • Ongoing agronomic management of the land including stock, water, vegetation and soils management • Measures required to maintain healthy soil and plant systems and maintain the agricultural capability of the land • Stock management programs and infrastructure (e.g. fencing, watering points) • Soil amelioration, pasture management and weed control • Monitoring programs for soil fertility and groundcover • Measures to manage the site before, during and after a flood.

6.9 Bushfire risk

A Bushfire Impact Assessment (BIA) was undertaken by Eco Logical Australia Pty Ltd (Eco Logical) to investigate the potential construction and operational bushfire hazards of the Proposal and how these risks could be suitability reduced and managed (see **Appendix F**). A summary of the key findings of this assessment are outlined below.

6.9.1 Existing Environment

Vegetation within the site is largely cleared of native vegetation excluding several remnant patches (refer 6.1.2) and crops. The Subject Land is isolated from the forested Kelvin Hills to the north-east of the proposal and native riparian vegetation to the south. The topography of the Site is very flat as it is located on a flood plain (refer Section 3.2.1).

Fire History

A search of the NSW Rural Fire Service (RFS) bush fire prone land mapping tool on the 19 January 2018 identified that the Proposal is not be located on Bushfire Prone land. RFS fire records indicate that many grass fires and bush fires have occurred in the general Gunnedah area in the last 16 years, although no grass or crop fires have been mapped closer than 6km from the Proposal.

The main sources of ignition in the district are:

- Lightning
- Crop harvesting equipment.

Water resources on the Subject Land include the farm dam in the north-east and water bores and irrigation channels throughout. There are no natural watercourses within the Subject Land.

Fire Climate

Data from the Bureau of Meteorology weather station at Gunnedah Pool, which is approximately 8.2km south-west of the Site, indicates the frequency of occurrence of grassland fire weather as summarised in Table 6-41. A grass fire danger index (GFDI) of 25 to 49 (Very High fire danger) occurs on average 1.2 days per year, while days of GFDI >50 are very rare (three severe days recorded in 38 years).

Table 6-41 Average number of days per year of daily Grassland Fire Danger Rating

Fire Danger Rating & GFDI	Average Days per Year
Catastrophic (150+)	0.0
Extreme (100 – 149)	0.0
Severe (50 – 99)	0.1
Very High (25 – 49)	1.2
High (12 – 24)	4.3
Low – Moderate (0 – 11)	233.8
Incomplete	125.9
Total	**365.2**

High fire danger conditions, or worse, occur in the months of December, January, February and March and rarely, if at all, in the other months (refer Table 6-42).

The wind directions associated with Very High, or worse, grassland fire danger are predominantly northwest, west and southeast. Days of significant grassland fire danger with a northeast wind direction that would carry a fire towards the town of Gunnedah are very rare.

Table 6-42 Number of days in each month of daily Fire Danger Rating and GFDI categories at 3pm at Gunnedah Pool

	Incomplete	Low – moderate (0-11)	High (12 – 24)	Very High (25 – 49)	Severe (50 – 99)	Extreme (100 – 149)	Catastrophic (150+)
January	390	727	47	14	0	0	0
February	363	663	40	8	0	0	0
March	410	714	40	12	2	0	0
April	430	710	0	0	0	0	0
May	415	763	0	0	0	0	0
June	451	689	0	0	0	0	0
July	438	740	0	0	0	0	0
August	378	800	0	0	0	0	0
September	416	724	0	0	0	0	0
October	401	777	0	0	0	0	0
November	349	791	0	0	0	0	0
December	42	786	38	10	1	0	0
Totals	**4,783**	**8,884**	**165**	**44**	**3**	**0**	**0**
Note: The table is based on daily records at 3pm from 1980 to 2017							

6.9.2 Potential Impacts

Construction and decommissioning

Bushfire impacts associated with the Proposal relate to the risk of the solar farm causing a bushfire or the risks of bushfire affecting the solar farm. Potential ignition sources associated with construction and decommissioning of the Proposal would include:

- Site preparation activities involving the use of other petrol-powered tools, and slashing machinery which could cause sparks
- Operating a petrol, LPG or diesel-powered motor vehicle (or other plant and equipment) over land containing combustible material
- Storage of fuels and dangerous goods
- Smoking from site personnel
- Electrical faults during testing
- Existing ignition sources such a lighting and cropping equipment.

With the exception of electrical faults, the activities listed above are undertaken regularly in this rural environment. The main sources of ignition in the existing environment (lightning and crop harvesting equipment) will remain however as the cropping area will be reduced the ignition risk from crop harvesting equipment will decrease and lightning protection including lightning arrestors will be installed at the solar farm.

The risks of bushfire within the site are limited by the following factors:

- The site is not located on bushfire prone land

- The site is on flat land with no significant slope
- The majority of the site is cleared so there is a limited amount of fuel for the fire
- The vegetated clusters within the Subject Land are not connected to a larger vegetated area
- The solar array, which would occupy the majority of the site, would be largely constructed of glass, silicon, steel and aluminium which all have very low flammability
- All electrical components would be designed and managed to minimise potential for ignition
- Irrigation channels and water storage dams are already located on site.

The ignition risks can be minimised further by installing electrical equipment in accordance with Australian standards and the implementation of the mitigation measures outlined in section 6.10.4.

No bushfire impacts in addition to those mentioned for construction are anticipated during the decommissioning phase.

Operation

During operation, crops and pasture surrounding the site are the main fuel for bushfires. Activities associated with operation of the Proposal and existing activities in the area that may cause or increase the risk of bush fire include:

- Storage of any dangerous goods (such as pesticides) will be within the maintenance storage container, however fuel will be stored in a bunded above ground tank outside the container
- Powerline failure or contact with vegetation within clearances
- Electrical infrastructure such as inverters, transformer and electrical cabling as they represent ignition risks
- Substation overheating
- Operating a petrol, LPG or diesel-powered motor vehicle (or other plant and equipment) over land containing combustible material
- Existing ignition sources such a lightning and cropping equipment.

The PV solar panels are non-reflective and present no risk of ignition from the concentration of solar energy.

Ignitions from other electrical equipment is theoretically possible from electrical faults such as arc faults, short circuits, ground faults, overheating and reverse currents. It is conceivable that arcs or melted components resulting from a fault could ignite grass fuels under or surrounding installations and start a bushfire. This risk can be managed by the mitigation measures specified in Section 6.9.3.

Potential hazards to fire fighters

The RFS is the primary response agency for fighting grass and structural fires within the Site. As such, the fire-fighters likely to respond to a bushfire in this area would be volunteers and/or individual property owners; the latter are mostly equipped with one or more of their own small fire units. Any fire-fighters from the RFS or neighbouring farms attending bushfires in this area may not be equipped with appropriate breathing apparatus and are unlikely to be trained in structural fire-fighting.

The risks to fire-fighter safety associated with a fire burning the solar panels and associated equipment include:

- Electrocution – solar panels would be energised under any natural or artificial light conditions
- Conduction of electrical current through water is also a risk when operational personnel spray the high-powered engine hose at the inverter or the components of the solar PV system

- Inhalation of potentially toxic fumes and smoke from any plastic components such as cables or other decomposed products of the panels, although the majority of the site, would be largely constructed of glass, silicon, steel and aluminium.

Each inverter station will be fitted with an isolation switch allowing for the isolation and the turning off parts or all of the solar farm. This can be done remotely from GSF's or Photon's control centre. When the inverter station is turned off then the solar panels will be isolated and disconnected from the grid. This will mitigate risks to fire fighters by reducing their risk of electrocution.

Firefighting water supplies
Given the safety concerns for fire-fighters, fire-fighting equipment for fire-fighters will not be located on site because the equipment could not be utilised safely and effectively. One tank outside the APZ with a capacity of 50,000L will be located near the substation.

6.9.3 Mitigation/ Management Measures

Reference	Mitigation Measures
Design	
BF1	All electrical components would be designed and managed to minimise potential for ignition
BF2	The design would consider that the access track must be trafficable by Category 1 fire appliances.
Construction and Decommissioning Mitigation Measures	
BF3	Maximise use of construction components using materials such as glass, silicon, steel and aluminium rather than plastic
BF4	Develop an Emergency Response Plan (ERP) in consultation with the NSW RFS District Fire Control Centre prior to construction. The FMP should include: • Foreseeable on-site and off-site fire events • Clearly states work health safety risks and procedures to be followed by fire-fighters, including: – Personal protective clothing – Minimum level of respiratory protection (e.g. rubber fire fighter's boots and gloves, a self-contained breathing apparatus) – Minimum evacuation zone distances – A safe method of shutting down and isolating the PV system – Training for fighting fires within solar farms – Any other risk control measures required to be followed by fire-fighters • Evacuation triggers and protocols • Suppression response strategies and tactics, including aerial suppression options/management.
BF5	Two copies of the ERP should be permanently stored in a prominent 'Emergency Information Cabinet' to be located at the main entrance point to the solar farm, external to any security fence or locked gate, and a copy provided to local emergency responders.
BF6	An APZ will be constructed around the solar farm with the following requirements: • The APZ will be 15 m wide around the entire perimeter of the solar farm footprint, and 20 m wide for areas abutting the remnant treed areas and landscaping areas.

Reference	Mitigation Measures
	• The external edge of the APZ setback at least 25 m from the external edge of PV panels or other components. • The APZ must be either a mineral earth fire break (i.e. dirt or gravel) or a heavily grazed area. • Trees and tall shrubs associated with the landscape plan should not be planted close to the APZ. • APZ preferably located external to any security fence. • The substation should have a 20m asset protection zone with no internal vegetation (gravel surface).
BF7	The APZ or a fire break is to be constructed as part of the first stage of the development.
BF8	Construction between 1 December and 31 March would be undertaken in accordance with the following: • All plant, vehicles and earth moving machinery will be cleaned of any accumulated flammable material (e.g. soil and vegetation) • A suitable fire appliance (e.g. fire extinguisher) is present on site with at least two personnel trained in bushfire fighting • On days when Very High fire danger or worse is forecast for Gunnedah, the "fires near me" app is to be checked hourly for the occurrence of any fires likely to threaten the site • All operations involving machinery will cease while the GFDI is or forecast to be 35 or greater.
BF9	Installation of electrical equipment such as, junction boxes, inverters, transformer and electrical cabling, is to be in accordance with AS 3000:2007 Electrical installations and undertaken by qualified professionals.
BF10	Install a water supply tank with a capacity of 50,000L outside the APZ near the substation.
Operational Mitigation Measures	
BF12	Fit PV arrays with an earthing and lightning protection system connected to the main earth link.
BF13	Vegetation fuel levels internal to the APZ and throughout the solar farm will be maintained by grazing, slashing or mowing.
BF14	The solar farm will be monitored via off-site control centres to monitor to ensure systems are working correctly, investigate any alarms and monitor panel performance.

6.10 Hazards

Hazards that could be associated with the Proposal and the Subject Land include risks associated with bushfire (refer 6.9), hazardous goods, electromagnetic interference and also flooding (covered in section 6.7).

6.10.1 Existing Environment

Hazardous goods

Current sources of hazardous goods on the Subject Land are:

- Petrol
- LPG
- Lubricating and hydraulic oils and greases
- Pesticides/ herbicides.

Electromagnetic interference

Current sources of electromagnetic fields (EMF) on the Subject Land are:

- 132kV transmission line parallel to Orange Grove Road
- House-hold items (such as televisions, microwave ovens, computers, Wi-Fi)
- Existing electrical wiring in residences
- Cell phones and cell towers
- Radio and TV station broadcasts.

6.10.2 Assessment Methodology

Hazardous goods

Hazardous goods expected to be used by the proposal will be compared against the Dangerous goods and SEPP 33 thresholds to determine whether they are exceeded or not. If the screening thresholds are exceeded the proposal would be considered potentially hazardous, and a Preliminary Hazard Assessment (PHA) would be prepared. However, for quantities below the given thresholds, the SEPP indicates that there is unlikely to be a significant off-site risk, in the absence of other risk factors and no further assessment is warranted.

Electromagnetic interference

Electric and magnetic fields (EMFs) are a physical field produced by electricity or electrically charged objects. EMFs occur both in the natural environment (e.g. discharges during thunderstorms or the earth's magnetic field) and by man-made objects (*WHO, 2018*).

EMFs can be hazardous to human health, the World Health Organisation (WHO) has concluded that short-term exposure to very high levels of EMFs can be harmful to health however exposure to low EMFs is inconclusive (*WHO, 2018*). In Australia, electrical devices and infrastructure such as transmission lines and substations, operate at a frequency of 50 Hz. This frequency falls within the Extremely Low Frequency (ELF) range of 0-300 Hz.

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) published *Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz*) in 1998 and an updated version in 2010.

The guideline provides a reference document for limiting exposure to EMF that will provide protection against established adverse health effects including direct interactions of fields with the body and indirect effects from interactions with a conducting object where the electric potential of the object is different from that of the body. Reference levels for occupational and general public exposure are shown in Table 6-43.

The strengths of the fields decrease rapidly with increasing distance from operating electrical equipment and can also be reduced by shielding. Trees, tall fences, buildings and most other large structures provide shielding from electric fields. As such electromagnetic fields, would vary in different locations at the Site.

Table 6-43 ICNIRP reference levels for 50Hz for occupational and general public exposure to time varying electric and magnetic fields (*ICNIRP 2010*)

Exposure characteristics	Electric Field	Magnetic Field
Occupational exposure	10kV/m	10,000mG
Public exposure	5kV/m	2,000mG

An impact assessment of potential hazards and risks associated with Electric and Magnetic Fields (EMFs) was completed. This included a comparison of magnetic and electrical field levels with the ICNIRP Guidelines.

Typical EMF levels and the ICNIRP exposure criteria for these types of infrastructure are shown in Table 6-44.

Table 6-44 Example magnetic and electrical field levels (Transgrid N.D, and EMF info)

Object	Electric Field Levels (kV/m)	Magnetic Field Levels (mG)
ICNIRP Public exposure criteria	**5kv/m**	**2,000mG**
Distribution Line		
Directly beneath the line	0.3 – 2.6	2 – 20
40m from the line	0.01 – 0.1	1 - 10
High Voltage Transmission Line (132 kV)		
Directly beneath the line	0.3 – 3.6	10 – 200
Edge of the line easement	0.01 – 0.1	2 – 50
Substations		
Substations at the fence-line (excluding where overhead supply lines enter or leave the station)	≤ 0.1	1 – 8
Underground cables		
Directly above underground cables (1m depth)	Underground cabling would not produce external electric fields due to shielding from soil	5 – 200
Example: House hold appliance (Kettle)		
300mm away from the appliance	0.01 – 0.05	2 – 10

6.10.3 Impact Assessment

Hazardous goods

Construction and operation

Potential hazards and risks during construction and operation would be associated with the on-site storage, use and transport of dangerous goods and hazardous substances. Dangerous goods that would require transportation and storage during construction or operation of the Proposal are identified in Table 6-45. These substances do not exceed SEPP 33 thresholds therefore further assessment, in the form of a PHA, is not required.

Some components of solar infrastructure can contain hazardous substances such as cadmium however the components to be used for the Proposal do not contain hazardous substances.

Table 6-45 Dangerous goods criteria and SEPP 33 thresholds relevant to the construction and operation of the proposal

Hazardous Material	Storage threshold	Transport Thresholds		Storage Method	Anticipated quantities	Exceedance of SEPP 33 thresholds
		Movements	Quantities			
	Class 2 – Gases					
Fire Extinguisher	Not subject to regulations	Not subject to regulations	Not subject to regulations	Compressed in a steel bottle and housed in the construction compound	2	No
LPG	10 tonnes or 16m3 (above ground)	>500 cumulative >30/week	2-5 tonnes	Cylinders stored in a secure area within the Proposal boundary	<1 tonne	No
	Class 3 – Flammable liquids					
Fuel (Petrol)	5 tonnes (stored with other class 3 flammable liquids)	>750 cumulative >45/week	3-10 tonnes	Stored in drums in a bunded area. Class 3 goods will only be stored with other class 3 goods.	< 3 tonnes	No
Lubricating and hydraulic oils and greases	Not subject to regulations	Not subject to regulations	Not subject to regulations	Stored in drums or original containers in a bunded area. Class 3 goods will only be stored with other class 3 goods.	< 1 tonne	No
	Class 6 – Toxic and infectious substances					
Pesticides (herbicides)	2.5 tonnes	All	1 to 3 tonnes	Stored in a secure area within the Proposal boundary	<1 tonne	No

Electromagnetic interference

EMF may be generated during construction and operation of the solar farm including from the following components when operational:

- Transmission Lines
- Substation
- Cabling (underground)/ collection circuits
- Central inverters
- Solar PV panels.

Transmission Lines
High voltage transmission lines are already present in the area. The expected transmission line EMF levels, as specified in Table 6-44, are below the ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)'.

Substation
The substation boundary fence will create a suitable buffer to reduce EMF to negligible levels.

Cabling (underground)
The solar farm would require installation of cabling between panels and the inverters. This cabling would be under ground. The levels specified in Table 6-44 are below the public and occupational exposure levels recommended by the ICNIRP Guidelines.

Central Inverters
Approximately 45 double inverter stations are expected to be installed across the site. The AC power frequency range of the inverters will fall into the Extremely Low Frequency (ELF) range of 0-300Hz, with the inverters expected to have a frequency of between 47 to 53Hz.

PV Panels
The layout of the Proposal has been designed to provide a buffer between the facility, sensitive receivers, road users and the general public. The site is surrounded by agricultural land and rural residences with the closest receiver over 800m away from the solar farm boundary. The majority of the infrastructure that would generate EMF would be located within the secured solar farm Site with no public access, aside from new electricity transmission lines similar to those already present in the area.

Given the levels associated with the infrastructure components, and the distance to publicly accessible land and the nearest receiver, EMFs from the proposed development are likely to be indistinguishable from background levels at the boundary fence.

Construction
Up to 150 staff may access the site during the 12-month construction period. No other access to the Site is anticipated and the Proposal will be fenced with a 1.8 to 2.5m chain link security fence with three barbed wires on top to restrict any public access**.** There is one resident within 1km of the proposed Site, and six residences located within 1 to 2km of the Site.

As a result of the low EMF, short term construction period and distance between components producing EMF and receivers there will be low to negligible potential for EMF impacts upon human health.

Operation
During operation of the solar farm limited staff (six to ten) will irregularly attend the site and the landowner and other farm staff may also access the site for stock management activities. In consideration of the security

fencing and distance from sensitive receivers with the potential to be impacted by EMF during operation the risk of impacts from EMF generated during operation of the Proposal will be limited.

No dangerous goods or hazard impacts in addition to those mentioned for construction are anticipated during the decommissioning phase.

6.10.4 Mitigation / Management Measures

Reference	Mitigation Measures
Construction and Decommissioning Mitigation Measures	
Hazardous Goods	
Haz 1	Dangerous or hazardous materials would be transported, stored and handled in accordance with AS1940-2004: The storage and handling of flammable and combustible liquids and the ADG Code where relevant.
Electromagnetic Interference	
Haz 2	All electrical equipment would be designed in accordance with relevant codes and industry best practice standards in Australia.
Haz 3	The layout of the Proposal has been designed considering buffer distances between the solar farm and sensitive receivers, road users and the general public.

6.11 Air Quality

Air quality can be affected by dust caused by soil disturbance and emissions from vehicles, plant and equipment. This can impact the amenity of the local area and become a nuisance to nearby sensitive receivers (such as residences and adjoining farm properties).

6.11.1 Existing Environment

Local Climate

Long term climatic data from the Gunnedah Pool (Site No. 055023) BoM weather station has been reviewed to characterise the local climate in the proximity of the Proposal.

Review of the data indicates that January is the hottest month with a mean maximum temperature of 34.0 degrees Celsius (°C) and July is the coldest month with a mean minimum temperature of 3.0°C. Humidity levels exhibit some variability and seasonal flux across the year. Mean 9am humidity levels range from 79 % in June to 58 % in December. Mean 3pm humidity levels vary from 55 % in June to 40 % in November and December.

The annual average rainfall for Gunnedah is approximately 621 mm with rainfall peaking during the summer months and declining during autumn and winter. The data indicates that January is the wettest month with an average rainfall of 71.5 mm and April is the driest month with 37.1 mm. Wind speeds during the warmer months have a greater spread between the 9am and 3pm conditions compared to the colder months. Mean 9am wind speeds range from 8.3 km per hour (km/h) in February to 5.3km/h in July. Mean 3pm wind speeds range from 11.0km/h in November to 7.5km/h in May. The most common winds are from the south-east and north-west sectors.

Local Air Quality

The main sources of particulate matter emissions in the area surrounding the site include emissions from anthropogenic activities such as motor vehicle exhaust, locomotive emissions, wood heater emissions and various commercial, agricultural and industrial activities. Motor vehicle emissions include those from nearby

roads including the Oxley Highway. Additionally, some of the nearby roads including Orange Grove Road directly south of the Proposal site are unsealed and traffic would contribute to air quality and impacts from dust. Regional air emission sources include mining, extractive and agricultural activities and leather processors.

The National Pollution Inventory lists three sources of substance emissions in Gunnedah:

- Gunnedah Depot – Boggabri Road, Gunnedah NSW 2380
- Gunnedah Leather Processors – Quia Road, Gunnedah NSW 2380
- Whitehaven Rail Sliding – Kamilaroi Highway, Gunnedah NSW 2380.

However, all three are located in the main township of Gunnedah with the closest approximately 9.5km south-west of the site.

Air quality monitoring data was collected from a monitoring station, operated by OEH, located in Hyman Park Tamworth (approximately 58km south-east from the Site) (*OEH, 2018*). The OEH station monitors particulate matter less than 10 microns (PM10). PM10, particulate matter with equivalent aerodynamic diameters of 10µm or less which can pass through the throat and nose and enter the lungs. Exposure to PM10 can adversely affect lung health.

Table 6-46 presents a summary of the PM10 concentrations from the monitoring stations from 2012 to 2016. The Tamworth data indicates that for PM10, annual average levels were below the relevant EPA criterion (DEC, 2005) of 30µg/m³ (end 2016) and 25µg/m³ (from 2017) and measured levels on a 24-hour average basis are on occasion above the 24-hour average criterion of 50µg/m3.

Table 6-46 Summary of PM10 levels from NSW OEH monitoring sites (µg/m³)

	Annual Average PM_{10}, µg/m3	Maximum 24-hour average PM_{10} -	Exceedances PM_{10} Derived from 24h average count
Criteria	**Criteria 30µg/m3 till end 2016, 25µg/m3 from 2017**	**Criteria 50µg/m3**	**Number of days greater than 50µg/m³**
2012	15.9	**55.1**	1
2013	16.5	47.5	0
2014	15.8	**66.6**	1
2015	14.1	**52.7**	1
2016	15.3	**51.7**	1

Figure 6-39 presents measured 24-hour average PM10 concentrations at the surrounding OEH monitoring stations over the period reviewed. The concentrations are nominally highest later in the year in the spring months with the warmer weather raising the potential for drier ground elevating windblown dust, pollen levels and the occurrence of bushfires and hazard reduction burns.

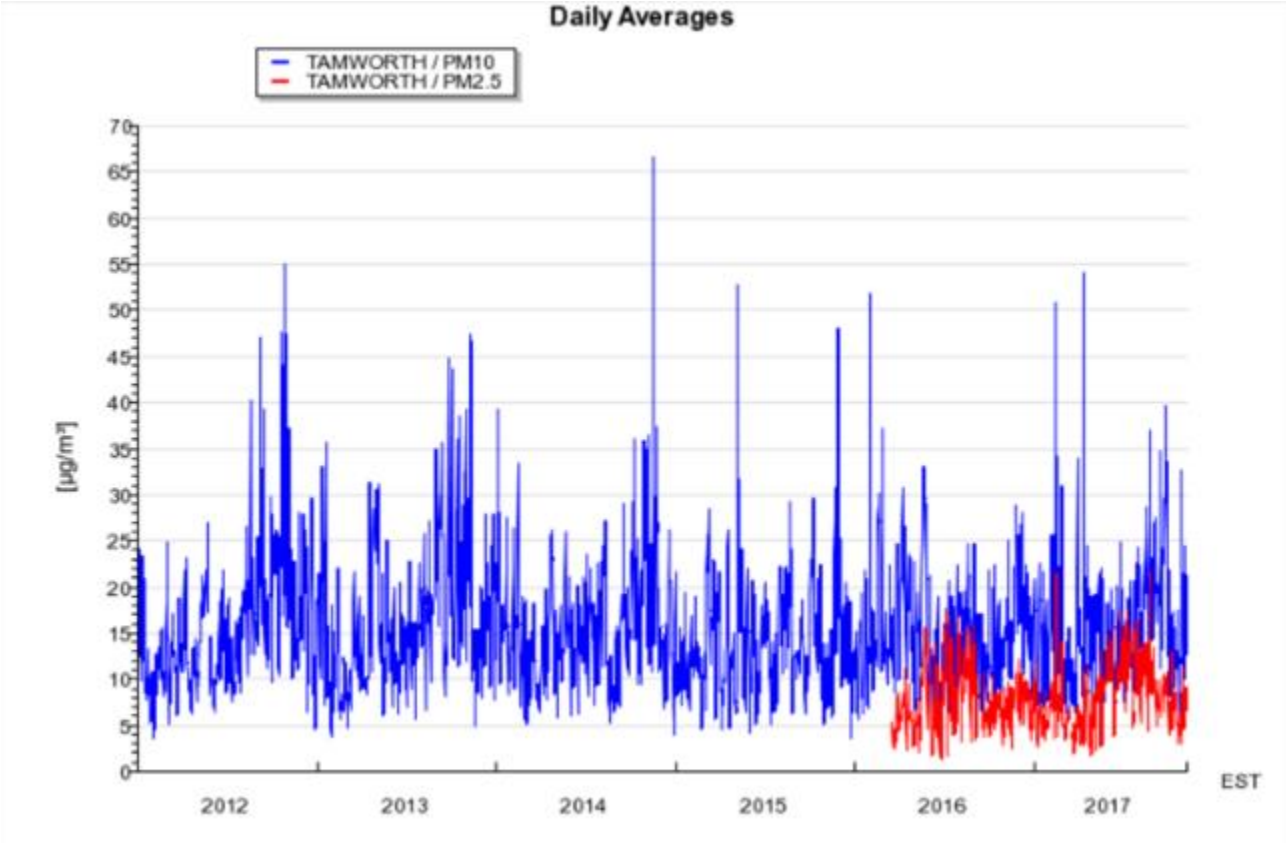

Figure 6-39 24-hour average PM10 concentrations (Department of Environment and Climate Change)

6.11.2 Impact Assessment

Construction

During construction of the proposal the primary emissions will be dust generated from material handling, vehicle movements, land preparation and windblown dust generated from exposed areas. These sources of dust are temporary in nature for the duration of the construction period. Particulate emissions would also be generated from the exhaust of construction vehicles and plant.

The site is susceptible to westerly winds which can be problematic for wind erosion. The soils are high in silt and a reasonable clay content which would powder very readily with the use of heavy machinery and concentrated construction activities, exposing them to wind erosion. The risk from dust would be high if there are strong winds and soils are left in a dry powdery condition. However, conventional dust management activities such as watering of soils using a water cart and application of synthetic dust suppressants, can be employed effectively to manage wind erosion and reduce dust. These measures will form a key part of the erosion and sediment control plan.

However, there will be limited dust generating activities and earthworks. Additionally, construction would be staged and construction areas would be stabilized before moving on to a new section thereby limiting the extent of any exposed ground. As such, air quality impacts during construction are not anticipated to be significant.

No air quality impacts in addition to those mentioned for construction are anticipated during the decommissioning phase.

Operation

The generation of renewable energy during operation of Proposal would not generate any emissions or affect air quality, excluding minor emissions from vehicles associated with maintenance activities.

During operation, the Proposal is expected to have a positive impact on regional and national air quality as the plant would not generate any emissions and would reduce Australia's reliance on fossil fuels for electricity generation.

Ground cover would be established following construction and maintained across the site by grazing and other management measures as outlined in the Land Management Plan to be implemented. This will significantly reduce any potential windblown dust impacting upon local air quality during operation.

6.11.3 Mitigation Measures

The following mitigation and management measures are recommended to minimise potential air quality impacts.

Reference	Mitigation Measures
Construction and Decommissioning Mitigation Measures	
A1	Activities shall be assessed during adverse weather conditions and modified as required to reduce dust generation (e.g. cease activity where reasonable levels of dust cannot be maintained).
A2	Engines to be switched off when not in use for any prolonged period.
A3	Water suppression on exposed areas, haul roads and stockpiles when required.
A4	Temporarily excavated soil and other materials that exhibit significant dust lift off would be wet down, stabilised or covered to manage dust.
A5	Development of a complaints procedure to promptly identify and respond to complaints.
A6	Vehicles and plant would be fitted with suitable pollution reduction devices wherever possible and maintained according to manufacturer's specifications.
Operational Mitigation Measures	
A7	Establish and maintain ground cover in accordance with the Land Management Plan for the site.

6.12 Socio-Economic & Property

6.12.1 Existing Environment

At the 2016 census, Gunnedah LGA had a population of 12,215 and an area of 4,994km^2. The population of the Gunnedah LGA is projected to grow to 13,600 people by 2036, an average of 0.3 percent annually (*ABS, 2017b*). This is a lower rate to other areas with 1.20 percent in NSW, 1.58 percent in the Sydney Metropolitan area and 0.67 percent in Regional NSW (*DP&E, 2016*).

The median age of people in 2016 in Gunnedah LGA was 40 years, children aged 0 – 14 years made up 21.2 % of the population and people aged 65 years and over made up 19.3 % of the population (*ABS, 2017b*). The Department of Environment and Planning expects that by 2036, children aged 0 – 14 years will make up 20.6 % of the population and people aged 65 years and over will make up 23.9 % of the population (*DP&E, 2016*). Based on these results Gunnedah LGA will have a larger proportion of older people than the state average of 20.88 %.

In Gunnedah LGA, 86.1 % of people were born in Australia. The other most common countries of birth were England 1.0 %, New Zealand 0.8 %, Philippines 0.4 %, South Africa 0.3 % and China (excludes Special administrative regions of China and Taiwan) 0.3%. Aboriginal and/or Torres Strait Islander people made up 12.8 % of the population. The most common ancestries in Gunnedah LGA were Australian 38.8 %, English 28.5 %, Irish 8.4 %, Scottish 7.2 % and German 3.5 % (*ABS, 2017b*).

In 2016, 5,694 people in the Gunnedah LGA reported being in the labour force in the week before Census night. The most common occupations in the Gunnedah LGA are provided in Table 6-47.

Table 6-47 Comparison of employment data averages from Gunnedah, NSW and Australia

	Gunnedah LGA	%	NSW	%	Australia	%
Occupation (Employed people aged 15 years and over)						
Managers	905	16.8	456,084	13.5	1,390,047	13.0
Machinery Operators and Drivers	780	14.5	206,839	6.1	670,106	6.3
Technicians and Trades Workers	726	13.5	429,239	12.7	1,447,414	13.5
Professionals	717	13.3	798,126	23.6	2,370,966	22.2
Labourers	689	12.8	297,887	8.8	1,011,520	9.5
Clerical and Administrative Workers	539	10.0	467,977	13.8	1,449,681	13.6
Community and Personal Service Workers	500	9.3	350,261	10.4	1,157,003	10.8
Sales Workers	426	7.9	311,414	9.2	1,000,955	9.4
Industry of employment (Top responses)						
Coal Mining	659	12.4	19,153	0.6	46,491	0.4
Beef Cattle Farming (Specialist)	188	3.5	13,478	0.4	44,309	0.4

	Gunnedah LGA	%	NSW	%	Australia	%
Takeaway Food Services	147	2.8	56,957	1.7	189,447	1.8
Local Government Administration	145	2.7	43,378	1.3	142,724	1.3
Supermarket and Grocery Stores	143	2.7	74,487	2.2	254,275	2.4

Gunnedah LGA's Gross Regional Product was $0.63 billion in the year ending June 2016, declining -1.5 % since the previous year ($0.62 billion) (*Idcommunity, 2016*).

At the 2011 Agricultural Census, Gunnedah LGA had 581 rural producers, with the gross value of agricultural production being $195.3 million. This equated to 7.8 % of the gross value of agricultural production in the Northern Inland Region and 1.7 % of the gross value of production in NSW (*Gunnedah Shire Council, 2014a*).

In 2011, cropping was the dominant agricultural activity, having a gross value of $152.2 million, and accounting for 77.9 % of the total gross value of agricultural production within the LGA (*Gunnedah Shire Council, 2014a*).

Social infrastructure and facilities

Community services and facilities are present within the Gunnedah LGA which cater for the needs the local community (refer Table 6-48).

Table 6-48 Community services, facilities and Attractions available in Gunnedah LGA (adapted from Gunnedah Economic Development Strategy: Volume 1(*Gunnedah Shire Council, 2014a*))

Type	Facilities and Services in Gunnedah LGA
Sport and recreational facilities	• Memorial Pool – 50m outdoor, 25m indoor and wading pool • Playing Fields • Netball Courts • Tennis Complex • Showground • Golf Course • Basketball Stadium • PCYC • Lyle Griffiths Centre Gymnasium • Lake Keepit State Park – land and water-based activities • Parks and Reserves including picnic facilities, playgrounds and walking trails. • Cycleways.
Cultural and Entertainment Facilities	• Civic Complex – performances, Smithurst Theatre, Creative Art Gallery • Licensed Clubs & Hotels • Community halls • Arts Council • Gunnedah Conservatorium • Gunnedah Library • Curlewis Branch Library (2 half days per week).
Religious facilities	• Gunnedah Presbyterian Church

Type	Facilities and Services in Gunnedah LGA
	• Gunnedah Seventh-day Adventist Church • Gunnedah Baptist Church.
Children's Services	• Pre-schools and long day care • Family day care • Playgroups • Early Childhood Intervention Services.
Community Services	• Counselling (range of services available) • Community housing • Community transport.
Education facilities	• New England Institute of TAFE – Gunnedah Campus • Gunnedah Community College • Two Secondary Schools in Gunnedah (Public & Catholic) • Eight Primary Schools – Gunnedah (2 Public, 1 Catholic, 1Christian), public schools in Tambar Springs • Curlewis, Mullaley and Carroll • Pre-schools • GS Kidd Memorial School – School for children with disabilities • Five organisations providing vocational training • College of Equine Dentistry • Flight training – Gunnedah Airport • Driver Training • Interest / Activity based tuition – music, dance, tennis.
Health and medical facilities	• Gunnedah Hospital - 48 beds, including Emergency, Maternity, Operating Theatre • Gunnedah Rural Health Centre • General Practitioners • Visiting Specialists • Dental • Allied and Alternative Health Services including – Physiotherapy, Occupational • Therapy, Psychologists, Podiatry, Chiropractic, Skin Cancer, Optometrist, Massage and Pathology • Ambulance station.
Aged Care Facilities	• Gunnedah Aged Care Services – 88 bed nursing home and retirement village with 48 independent living units • Alkira Nursing Home (41 beds) • Yallambee Aged Accommodation (13 units) • Home and Community Care Services and Transport • Meals on Wheels.
Emergency Services	• SES: Namoi Region • Gunnedah Police station • Gunnedah Fire Station • Ambulance station.

Type	Facilities and Services in Gunnedah LGA
Events	• Country Music Muster • Annual Gunnedah Show • Show Jumping Festival • Camp-Draft • Fuchs Gunnedah Agquip Bull Ride • Ladies Aux Rose Show.
Tourism and Attractions	• Lake Keepit • The Waterways Wildlife Park • Rural Museum • Lookouts • Galleries • Parks and Reserves • Namoi River • Gunnedah promotes itself as the '*Koala Capital of the World*'.
Retail and Services	• Gunnedah is a sub-regional centre providing a range of retail, commercial, professional and personal services. • Gunnedah shopping centre is anchored by Coles and Woolworths supermarkets. The town also has a number of national traders including Harvey Norman, Target Country, Millers, Best & Less, Telstra Shop, Crazy Prices and the Reject Shop.

Gunnedah Economic Development Strategy

The objective of economic development in Gunnedah is to develop the local community into one where people wish to live, work, invest and enjoy. It involves improving the economic wellbeing of the community by focusing on retaining, strengthening and growing local businesses, attracting new investment and creating jobs. It explores opportunities to provide a positive and supportive environment for local businesses, including providing businesses with access to the advice and services needed to enable them to capitalise on external opportunities and to plan for and manage change and external threats.

The Proposal is consistent with a number of the objectives outlined in the Gunnedah Economic Development Strategy including:

- Enhanced access to essential services – by providing a source of electricity
- Balance between development and environmental protection – by considering environmental factors in design (refer Section 2.4.3)
- Investment in new technologies and renewable energy – The Proposal is a source of renewable energy
- Manage our exposure and contribution to the changing climate – The Proposal will reduce reliance on fossil fuels and produce energy free of greenhouse gas emissions.

Economic Indicators

Socio-Economic Indices for Areas (SEIFA) broadly defines relative socio-economic advantage/disadvantage in terms of people's access to material and social resources and their ability to participate in society. All LGAs are ranked, the lowest ranged LGA will have a score of 1 and the area with the highest score is given the highest rank – 153 for NSW and 565 for Australia.

A preliminary review of the surrounding LGAs (Tamworth, Liverpool Plains, Narrabri, Warrumbungle and Moree Plains) showed that the Gunnedah LGA generally ranked higher than Liverpool Plains, Warrumbungle and Moree Plains but lower than Tamworth and Narrabri aside from the 'Education and Employment' SEIFA where it ranks lower than all except Liverpool Plains.

Gunnedah ranks within the lower 30% of the State for the Indices of Socio-Economic Disadvantage, Socio-Economic Advantage and Disadvantage and Economic Resources and in the lower 20% of the State for Education and Occupation.

Key economic activities within the Gunnedah LGA

The largest economic / employment sectors within Gunnedah LGA are agriculture (19.9 %), retail trade (9.9 %), healthcare and social assistance (8.5 %), education and training (7.9 %), accommodation and food services (7.0 %), manufacturing (6.4 %) and construction (5.7 %).

Agriculture

Agriculture is the dominant land use and economic activity in Gunnedah Shire. Most of the land employed for agricultural use is used for dryland cropping and livestock production, with a small percentage being irrigated or used for intensive production. There are a diverse range of services available in Gunnedah Shire to support the agricultural sector, such as: spraying, contract harvesting, consultants, veterinary, silos and storage. The majority of farming enterprises in Gunnedah Shire are mixed farms, which helps to spread financial risk and improve land management. The crops produced are determined by the climate / weather, expected availability of water, market demand and commodity prices. Common crops include: cereals, oilseeds, legumes, cotton, citrus and olives. Livestock production in Gunnedah includes cattle, sheep, goat and other animal production for meat, poultry for meat & eggs, as well as horses.

Retail

Retailing in Gunnedah Shire is concentrated in the township of Gunnedah, with the larger villages each having a general store and/or post office. The performance of the retail sector is very closely tied with the performance of the agricultural sector, and to a lesser extent, to the performance of the mining sector. Uncertainty and/or contractions in either sector translates almost immediately to a contraction in retail expenditure. The retail sector in Gunnedah is comprised primarily of small businesses or businesses employing between one and four people. Types of retail businesses in Gunnedah include automotive sales or storage, clothing and footwear, speciality retail, home appliances and furniture, books and hobby stores and fresh food.

Healthcare and social assistance

Within Gunnedah Shire the main service areas are health care, aged care and child care. Health care services are concentrated in Gunnedah, with no resident services in the villages. Like most inland rural areas, the Shire has struggled to attract and retain doctors, dentists, nurses and health care professionals. Gunnedah Shire has a higher incidence of risk and disease than the average for NSW and Regional NSW.

Education and Training

Educational facilities are listed in Table 6-48 above. There is one University within the Region – the University of New England, which has campuses at Armidale (main campus) and Tamworth. TAFE courses within the Region are limited, however the Gunnedah Trades Training centre provides trade courses and Tamworth also has trade training capacity.

Accommodation and Food Services

Gunnedah Shire council lists 58 accommodation or food service businesses within the LGA.

Manufacturing
Gunnedah Shire has a relatively strong and diverse manufacturing base, with most of the businesses having been operating for more than a decade within the Shire. Types of manufacturing businesses in Gunnedah include grain and seed milling & processing, engineering and metal fabrication, brick and paver production, sawmilling, leather processing and cotton ginning.

Construction
Types of construction businesses in Gunnedah include design and assessment, site preparation, building and construction and trade installation (e.g. plumber or electrician).

Strategies and Actions

The Gunnedah Community Strategic Plan recognises the strategic importance of diversifying the economic base of the Shire, and articulates a range of desired outcomes for 'Building the Shire's Economy' as well as engaging and supporting the community, retaining the quality of life, and protecting and enjoying Gunnedah's beautiful surrounds.

The Community Strategic Plan recognises that Gunnedah Shire has a strong agricultural- based economy as well as substantial mineral resources. At the same time, it acknowledges that the Shire faces a number of challenges, including the 'boom and bust' cycles in the agricultural and mining sectors, the competition between these two sectors for access to land, resources and infrastructure, competition from Tamworth and infrastructure constraints. The need to expand or enhance infrastructure (transport, sewerage, electricity, etc.) to accommodate growth was identified by the Community Strategic Plan as the most immediate challenge facing the Shire.

As outlined above, the Gunnedah Economic Development Strategy identifies four priorities for economic development including Priority 4 – To target new businesses and economic activities.

The proposal is consistent with priority 4 as it will help to diversify the economic base of Gunnedah, will provide income to the landowner that is resilient to cyclical fluctuation, and provided a new economic activity that complements the existing activity.

Accommodation within Gunnedah Township

There are 11 accommodation options within Gunnedah (*Gunnedah Shire Council, 2018*). There is also the possibility to stay in the local caravan park or to rent a house through an accommodation website such as stayz.

Renewable Energy Projects in the Region

The New England region has more than 770MW of solar or wind projects either approved, under construction or operational. That includes the White Rock Wind Farm at Glen Innes (300MW), the Sapphire Wind Farm at Inverell (270MW), the Metz Solar Farm near Armidale (100MW) and Ironbark Energy's Gunnedah Solar Farm (IEGSF) (27MW).

Renewable energy projects at various stages of planning and development within the Gunnedah LGA include:

- IEGSF Construction of IEGSF is underway and expected to be finished within the first half of 2018. The solar farm was approved by the Joint Regional Planning Panel (JRPP) in April 2016. IEGSF is located 4.5km west of Gunnedah, off the Oxley Highway, and will have a capacity of 27MW
- Orange Grove Solar farm – a PV solar facility generating over 30MW of power and occupying 417 ha of land off Orange Grove Road located approximately 12km east of the township of Gunnedah
- Narrabri – 60MW PV solar facility occupying 200 Ha of land off old Gunnedah Road located approximately 7.5km south-east of the township of Narrabri.

6.12.2 Stakeholder and Community Engagement

As part of the EIS, a Community and Stakeholder Engagement Plan (CESP) has been developed to inform the level of engagement required, identity key stakeholders and included an implementation plan. The intent is to speak to the Community and other stakeholders to understand the potential constraints and opportunities for the proposed development and consider this feedback through the environmental and engineering design components of the development.

The following key stakeholders have been identified

- Local residents surrounding the proposal area
- Gunnedah community
- Road users along the primary haulage routes
- Gunnedah Shire Council
- Various government agencies including DP&E, Roads and Maritime Services, SES, OEH, DPI, DRG, RFS and CASA
- Companies holding mining or exploration licences in the area (Australian Coalbed Methane Pty Ltd and Santos QNT Pty Ltd)
- Local aboriginal community and local aboriginal land council
- TransGrid
- Gunnedah Airport.

A summary of consultation undertaken, consultation findings as well as responses to issues raised and any ongoing consultation requirements is summarised in section 5 of this EIS.

6.12.3 Community Views

Attitudes to renewable energy proposals in NSW

In November 2015, NSW OEH published a paper entitled '*Community Attitudes to Renewable Energy in NSW*' (*NSW OEH, 2015*). They surveyed 2,000 individuals over the age of 18 across seven regions of NSW with strong results around recognition and knowledge or renewable energy in particular solar and wind.

The OEH survey results showed that nine-in-ten people supported the use of renewable technology to generate electricity in NSW and approximately five-in-ten people strongly supported it. There was also a widely-held view that NSW should be producing more of its electricity from renewables rather than maintaining current levels or producing less. Most people surveyed supported the use of both wind farms (81 %) and solar farms (89 %).

The principal advantages respondents saw in renewables were:

- Benefits to the environment
  - Cleaner/creating less 'pollution' or fewer greenhouse gases
  - More sustainable, reducing reliance on non-renewable resources such as coal
  - Benefits in the preservation of the landscape and agricultural land, e.g. by not digging up the landscape
- Lower cost, or at least the potential for reduced cost in the long run.

The principal disadvantages people saw in renewables were:

- Higher cost, particularly in the set-up phase
- Concerns about efficiency and reliability
- Effects on wildlife, e.g. bird mortality associated with wind farms.

It was clear that along with the environment, cost was a pivotal element in community thinking about renewables. The most prevalent community view was that renewable energy was a good idea provided it did not generate additional costs to electricity.

Attitudes towards local wind and solar farms

The survey also sought people's attitudes to having renewable energies in their local region and even closer, within 1–2km of where they lived. The majority of respondents still supported or strongly supported wind and solar farms within their local region or within 1-2km of where they lived. However, as the renewable energy got closer to the respondent there was a corresponding increase in opposition and decrease in support (refer Figure 6-40). At closer proximity, more respondents would strongly support a solar farm than a wind farm.

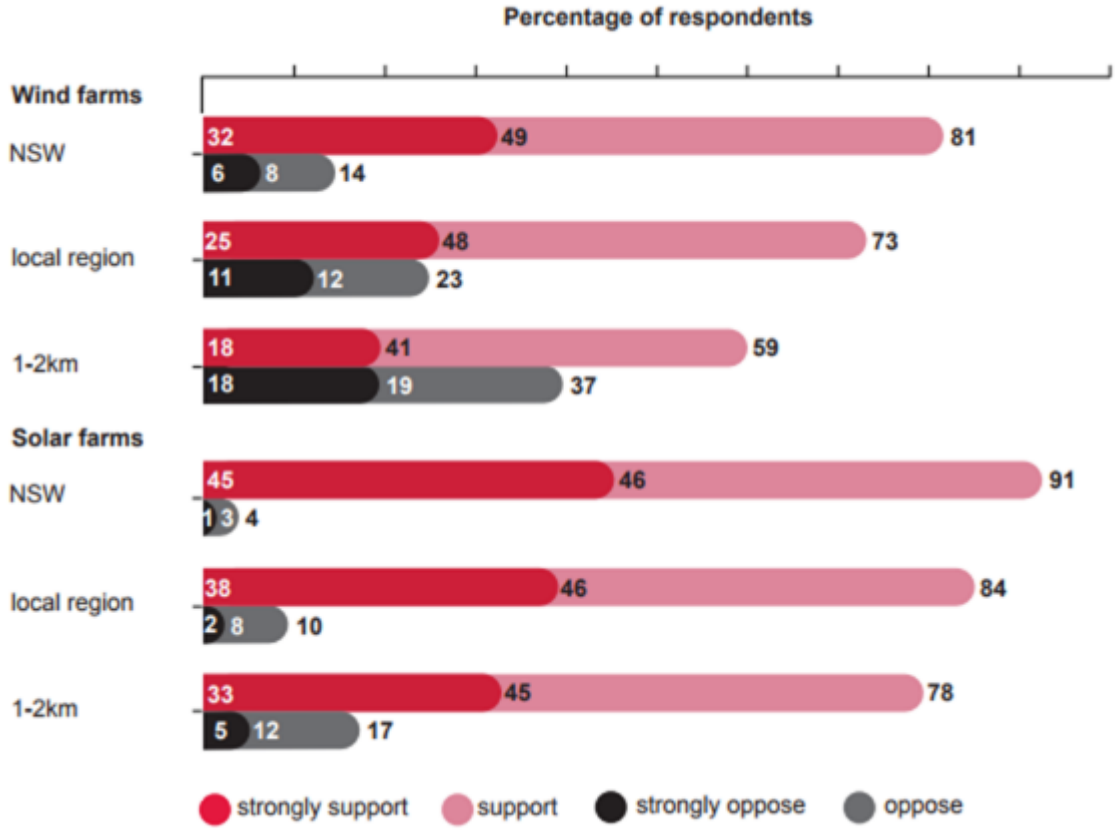

Figure 6-40 Support for and opposition to building wind/solar farm in three proximities – in NSW, within the respondent's local region, and within 1-2km of where the respondent lived.

Community feedback on this proposal

The feedback from the community within 2km of this Proposal has identified a number of concerns around the impact of the Proposal on residents as well as support for renewable energy. Further detail on the feedback including concerns raised and consultation undertaken is outlined in Section 5.

6.12.4 Cost Benefit Analysis

Renewable Energy Sector

Employment in the renewable energy sector is considered a positive driver for the economy; the Australian Bureau of Statistics estimated that renewable energy projects that were progressed in 2016 for construction in 2017 represent more than $6.9 billion of investment, 3,725 direct jobs and 3,150 MW in new power generation capacity (*Clean Energy Council, 2016*).

Case Studies

Data from the recently constructed Nyngan and Broken Hill Solar Farms provide an example of the cost benefit analysis. These projects have a combined capacity of 150 MW (AC) similar to this Proposal.

Nyngan and Broken Hill solar farms will generate 360,000 megawatt hours of electricity each year and represent a total investment of $440 million. During construction, they will provide 450 direct jobs (*First Solar, N.D.*) and contribute to regional development in the following ways:

- On-site jobs involved in the delivery of the projects
- Off-site jobs involved in the supply of materials for the projects
- Off-site jobs involved in the design, management and support of the projects.

Other local benefits were identified from the Nyngan and Broken Hill Solar Projects with data indicating that approximately 56 % of the procurement budget was spent on local good and services (local defined as Australia) including $66 million spent on cables, mounting structure and power conversion equipment from local companies. The total value of local subcontractor procurement for services provided on the Nyngan and Broken Hill projects is over $76 million (*First Solar, N.D.*).

Gunnedah Solar Farm

The Proposal will generate 300 gigawatt hours (GWh) of electricity each year. The Proposals represent a total investment of $200.6 million and are estimated to provide 150 direct construction jobs at peak period. Section 6.12.5 below details how the Proposal will contribute to regional development. The solar farm will provide a source of clean, renewable electricity.

The key benefit of the Proposal is the production of renewable electricity reducing our greenhouse gas emissions and reliance on fossil fuels. The production of renewable electricity will help contribute to NSW Governments Renewable Energy Action Plan and other schemes and agreements made. On an annual basis, the Proposal will produce enough electricity to meet the needs of approximately 49,500 households.

The proposal will have a positive effect on the National Energy Grid. On an annual basis, the Proposal will produce enough electricity to meet the needs of approximately 48,000 average Australian Homes (based on *AER data (AER 2013-14*)). Additionally, the Proposal will reduce greenhouse gas (GHG) emissions by over 290,000 tonnes of CO2 equivalent per annum, assuming a rate of 0.948 tonnes per MWh of electricity. This is roughly equivalent to removing approximately 125,000 cars from the road. Particulate and heavy metal emissions will also be reduced.

6.12.5 Impacts

The Proposal would change the character of the Subject Land from cropping agriculture to electricity generation coupled with grazing agriculture. The change in land use is mitigated by several factors:

- The site has only been used as cropping lands for 20 years since it was purchased in 1997. Prior to that it was used for grazing land. As such the proposal, will revert the land to a former use whilst adding a new use

- The solar farm will cover 39 % of the entire site and the remaining area (61 %) can continue to be used for cropping agriculture
- The solar farm will help rest the land and allow the nitrogen content of the soil to rise naturally
- The reversible nature of the development also means they can easily be decommissioned and the land returned to its former agricultural use at the end of the operational period.

The change in land use can be seen as positive or negative depending on the individual. Solar farms have been met with opposition as they can be considered to conflict with existing environment and scenic values. They have also been supported as they provide opportunity for jobs and economic stimulus within the region, provide long term energy stability and assist in the protection of the environment by creating renewable sources of energy.

Other adverse social impacts include:

- Increased traffic on local roads and hazards associated with construction traffic. These potential impacts are assessed in detail in section 6.6
- Additional traffic may be noticeable and could present an adverse effect on local tourism, if coinciding with local festivals
- Influx of workers putting pressure on local accommodation and health services (see below)
- Amenity impacts including, visual, noise and air quality during operation. These potential impacts are assessed in detail in sections 6.3.5, 6.5 and 6.11 including relevant mitigation measures to reduce and manage these impacts.

The proposal will also create benefits for the region by:

- Increased employment – there is the potential for local employment to be generated during the construction phase where suitable local contractors and labour hire are available
- Stimulation and diversification of the local economy creating greater resilience
- Developing regional skills in renewable energy technology.

The proposal will also create benefits for the land owner as they will receive an annual rental fee which will help diversify the land holder's income stream, reducing reliance on agricultural commodity prices and ensuring a long term guaranteed income. This diversification of income is not uncommon in the region as most of the agricultural properties in Gunnedah are involved in diversification of farming by growing crops as well as raising livestock, which helps to spread financial risk and improve land management (*Gunnedah Shire Council, 2014a*).

Socio-economic benefits

The Proposal represents a total investment of $200.6 million and 150 direct construction jobs at the peak construction period and approximately three jobs during operation.

The influx of employees to the Gunnedah township is likely to result in the following expenditure for the local economy per employee:

- Accommodation – Approximately $120 per night per room, (based on figures from 'booking.com' from 6 motels in Gunnedah at four points during the year)
- Food – Approximately $80 to $280 per week (based on figures from the Australian Government: Study Australia)

- Entertainment – Approximately $80 to $150 per week (based on figures from the Australian Government: Study Australia)
- Petrol – Approximately $36 per week, Transport is likely to be provided by the Proposal or via private means but petrol would need to be purchased locally (based on figures from a 2017, Canstar Blue survey of over 2,000 motorists).

Gunnedah Economic Development strategy has also identified retail, construction and service sectors as responders whose performance is dependent on performance in the agricultural and mining sectors and also on investment in the region. Due to the influx of people to the area for construction the solar facility is expected to have a positive economic influence on retail, construction and service sectors in Gunnedah.

Employment opportunities

The proposed development will have a positive employment impact during construction, and is likely to create in the order of 150 onsite jobs during the peak construction period. Of these workers, it is expected that the majority will be sourced from the local area. The Proposal will also supply off-site jobs involved in the supply of materials and off-site jobs involved in the design, management and support of the Proposals. The Proposal will also offer scope to develop regional skills and create more sustainable employment.

Employment multiplier effect

The construction industry has important linkages with other sectors, so the impacts on the economy go well beyond the direct contribution of construction activities. For every $1 spent on construction generates $2.6 in the economy as a whole. Money spent on construction leads to jobs in the construction industry and then increases spending in businesses that manufacture materials such as steel frames and concrete and this increases demand for quarrying and raw steel production. Additionally, spending of wages and salaries from employees in this industry induces a further round of consumption effects in other areas of the economy. Where required, the Proposal would engage with local accommodation providers and Gunnedah Shire Council to provide additional short term and temporary accommodation.

Workforce

The Proposal represents a total investment of $200.6 million and 150 direct construction jobs at the peak construction period and one to three during operation. There will be no displaced jobs from the current site use as agriculture will continue on the site. The number of people employed during different stages of construction is detailed in Table 6-49.

Local opportunities provided during plant construction may include:

- Civil engineering and site preparation
- Post, racking, and module installation
- High voltage power system work
- Construction and supervision roles
- Administration and construction support roles.

Table 6-49 Expected labour force during different stages of construction

Stage of the Proposal	Estimated Number of Employees	Job type	Estimated employment time Timeframe
Construction			
Site establishment and preparation for construction including vegetation clearing	50	Trade Assistant, Subcontractor	1 month
Preliminary civil works (such as drainage works, and foundations for the substation)	100 (Peak)	Civil, Trade Assistant, Sub-contract, Electrician	1 month
Construction of internal access tracks and installation of: • Steel post and rail foundation system for the solar panels. • PV panels and DC wiring beneath the panels. • Underground cabling (trenching) and installation of inverter stations.	150 (peak)	Civil, Trade Assistant, Sub-contract, Electrician, Electrician QA	6 Months
Construction of 132kV substation and new transmission line from substation to existing 132 kV transmission line.	100 (Peak)	Civil, Trade Assistant, Sub-contract, Electrician, Electrician QA, Commissioning	2 Months
Offsite electrical works on existing transmission line	30 (Peak)	Civil, Trade Assistant, Sub-contract, Electrician, Electrician QA, Commissioning	1 Months
Removal of temporary construction facilities and rehabilitation of disturbed areas	50	Trade Assistant, Sub contract Electrician	1 Month
Operation			
Operation and maintenance	6-10		Approximately 25 years

The labour force may be constrained by:

- Access to accommodation within a reasonable distance from the proposed development and during tourism events such as AgQuip
- Competition from the mining sector, the agricultural sector and other major infrastructure Proposals for access to local labour
- Availability of local labour with the required skill set.

The Proposal expects to use both local labour and non-local labour. Local labour is preferred due to the socio-economic benefits however due to the estimated number of skilled labour and the labour requirements of other local project (refer Section 7) it is anticipated that non-local labour will also be required. It is anticipated that approximately 50% of these jobs will be sourced within 100km of the site, subject to the labour force being available. Due to the size of the Gunnedah township and proximity of Tamworth and Narrabri (within 100km) to the Site it is considered there are suitably sized populations proximate to the site to enable this level of local labour supply to be met based on discussions with local council and review of ABS data (ABS 2017a and ABS 2017b).

Currently, the season agricultural production industry is well serviced by labour supply companies who are also supplying labour to solar developments in the region and across the State meaning they have developed a good understanding of the skill based required for their delivery, the timing of the labour requirements and the commitments to meeting local content.

An Australian Industry Participation Plan will be prepared and identify the minimum requirement of 50% of the labour within 100km of the site.

A skills and employment strategy for the Proposal will be developed in consideration of the NSW Infrastructure Legacy Program. Whilst this Program is aimed at multi-billion-dollar projects being delivered in metropolitan Sydney with greater scope to achieve the specified targets, it is considered an excellent guide to determining priorities and approach for the Proposal.

Both the plan and strategy will form part of the engineering, procurement and construction (EPC) contract.

Any non-local specialised contractors are likely to come from across other areas of NSW and would utilise accommodation in Gunnedah, and Tamworth if necessary. Accommodation within Gunnedah is limited to 11 establishments of varying size and levels of facilities and services, as detailed in Table 6-50.

Tamworth has over 40 accommodation options that should be able to accommodate the overflow of people travelling to Gunnedah during tourism events or competing events and developments. As such is anticipated that most workers would be accommodated at existing accommodation within the local area and work camps would not be required.

Table 6-50 Accommodation options within the township of Gunnedah

Location	Accommodation Type	Name	Number of rooms
Gunnedah	Motel	Comfort Inn Harvest Lodge	47
Gunnedah	Motel	Red Chief Motel	29
Gunnedah	Motel	Maynestay Motel	10
Gunnedah	Hotel	Gunnedah Hotel	30
Gunnedah	Motel	Mackellar Motel	30
Gunnedah	Motel	The Plains Motor Inn	15
Gunnedah	Motel	Gunnedah Lodge Motel	14
Gunnedah	Motel	Alyn Motel	13
Gunnedah	Motel	Gunnedah Motor Inn	20
Gunnedah	Motel	Billabong Motel	33
Gunnedah	Motel	Overlander Motor Lodge	16
TOTAL			**257**

It is anticipated the workforce needed for the Proposal will travel to site through a combination of shuttle buses from Gunnedah and potentially from Tamworth or Narrabri. In addition, labour will travel to site via private vehicles. The EPC Contractor will be required to minimise traffic to the site using buses and carpooling wherever possible.

Potential traffic impacts are assessed in detail in section 6.6.

Impact on available accommodation and services

The proposal would provide a positive impact on the accommodation sector of Gunnedah by increasing occupancy rates however during events and other peak periods the Proposal may create a strain on local accommodation. Additionally, should other major infrastructure Proposals commence within proximity to Gunnedah there may be a significant strain on accommodation.

Influx of workers would put pressure on local health services. It is considered that the demand for health care could be dispersed throughout surrounding towns based on where they are staying to minimise the impact.

Flooding

The impacts of the Proposal on Flooding are provided in Section 6.7, however in summary the introduction of a partial obstruction in the flood plain (the security fence) will affect flood levels in the flood plain as the obstruction diverts some of this flow. The main effects are changes to the direction of flow and increased depths, rather than changes to velocity. It is considered that the overall impacts of the Solar Farm result in small changes to overall flood depths at the receivers. These changes are conservatively estimated to be less than about 18mm.

Modelling undertaken indicates that four properties would be affected by the change during a 1:100 year flooding event and 11 properties would be affected during a probable maximum flood (PMF). Each property would experience small changes to flow depths.

The flooding assessment concluded that the Proposal would not have appreciable adverse social or economic costs to the community based on a lack of change to water velocities and the existing flood conditions of the area.

Amenity

The potential adverse social impacts associated with the Proposal relate to amenity aspects including, visual, noise, traffic and air quality during construction and visual amenity during operation. These potential impacts are assessed in detail in Sections 6.3.5, 6.5, 6.6 and 6.11 but a short summary is provided below.

Amenity impacts from noise would involve construction noise from plant and equipment during the 12-month period of construction during standard construction hours.

Key traffic and transport impacts for the Proposal relate to haulage of plant equipment and materials as well as employee transport during construction and disruption to existing services including school buses. Increased vehicle numbers have the potential to impact road condition and create indirect impacts such as noise and dust. Dust generation and reduced air quality may occur as a result of earthworks and vehicle movements.

Two types of visual impacts will be generated by the proposal which are:

- Impact to landscape character of the site and the surrounding area
- Visual impact to the surrounding viewpoints, both public and private.

The assessment results of Impact to landscape character finds there is a moderate impact. The assessment results of visual impact to public viewpoints finds that there would be a low-moderate impact to views from Orange Grove Road and a low impact to views from the Porcupine Hill lookout. Additionally, there were 22 potentially affected private viewpoints. Of these 22 the visual impact assessment found that there were three viewpoints with a moderate-high impact, five with a moderate impact and eight viewpoints with a low-moderate impact and six with a low impact.

Large scale solar farms can create polarised reactions in communities; some see solar farms as eye sores and a large change to existing land use, lifestyles and land character, others see the benefits of less polluting, renewable sources of energy and the economic benefits of such Proposals.

Land Use

The potential impacts on land use are assessed in detail in section 6.3.

6.12.6 Mitigation Measures

The following management and mitigation measures will be implemented to address potential impacts

Reference	Mitigation Measures
Construction and Decommissioning Mitigation Measures	
Socio 1	The Community Stakeholder Engagement Program (CSEP) will continue to be implemented, including: • Providing regular updates to the community • Inform relevant stakeholders of potential impacts (for example noise impacts) • Establishment of a complaints handling procedure and a response protocol • Responding to any complaints received.
Socio 2	Liaise with local industry representatives to maximise the use of local contractors, manufacturing facilities and materials. Create a resourcing plan to ensure jobs will be local.
Socio 3	Local accommodation options for staff will be maximised.
Socio 4	Continued engagement with Shire of Gunnedah to discuss community and business concerns.

6.13 Waste

6.13.1 Impact Assessment

Activities proposed during the construction and operation of the Proposal have the potential to generate waste. Potential waste streams generated during the construction, operation and decommissioning stage include:

- Green waste (from vegetation removal and some from ongoing maintenance activities)
- Wood/plastic pallets and cable drums
- Plastic wrapping and straps
- Liquid waste
- Paper and cardboard
- Soil from trenching and backfill works for cable laying that cannot be reused on site

- Electrical components (from repair, replacement or removal of PV infrastructure)
- Metals
- General construction waste (offcuts)
- Sewage
- General domestic waste.

The classification and description of each of the general waste types to be potentially generated by the proposal is summarized in Table 6-51.

Table 6-51 Potential waste generated on-site during construction and operation

Waste material and description	Waste classification	Management Details
Green Waste Shrubs, clearing of groundcover	General Solid Waste (non-putrescible)	Management options for green waste include beneficial offsite reuse or disposal to a green waste facility or landfill. If suitably weed free the green waste could also we used as mulch for other vegetated areas.
Wood Pallets and cable drums	General Solid Waste (non-putrescible)	Pallets and cable drums will be separated for reuse or recycling. Pallets can be recycled by processing the wood into products like particleboard, wood chips, mulch, animal bedding, biofilters (for storm water) or used as biomass - a source of renewable energy. GSF will investigate whether a “take-back” arrangement for the pallets can be organized so the pallets can be re-used.
Plastic Plastic wrapping and straps associated with packaging of solar infrastructure.	General Solid Waste (non-putrescible)	Plastic wrapping and straps will be disposed to landfill.
Liquid waste Oil, fuels, etc. Contaminated water from equipment washing	Liquid waste	Onsite testing may be carried out on the waste water generated onsite to see if it is within discharge limits. If the waste water is not within discharge limits the wastewater collected in the tanks would be pumped out and taken to an offsite licenced facility on a regular basis.
Paper and cardboard From packaging of solar infrastructure	General Solid Waste (non-putrescible)	Recyclables will be collected by a suitably qualified waste management contractor and sent to a recycling facility.
Soil From trenching and backfill works for cable laying	General Solid Waste (non-putrescible)	The soil would be reused to backfill trenched areas. If there is excess soil after backfilling, then this soil will be reused elsewhere on site. Potential Acid Sulphate Soils (PASS) have not been identified on site however in the event of an unexpected find Acid Sulphate Soils (ASS) would be treated using lime and then reused. If following treatment (or for other reasons) these

Waste material and description	Waste classification	Management Details
		soils are still not considered suitable then soil should be transported to the nearest licenced waste disposal facility.
Electrical components Repair, replacement or removal of infrastructure components	General Solid Waste (non-putrescible)	During decommissioning or in the event of repair works all above ground infrastructure and materials would be removed from the site and recycled or otherwise disposed of at approved facilities.
Metals Repair, replacement or removal of infrastructure components	General Solid Waste (non-putrescible)	Metals will be separated for recycling.
Construction waste Metal, steel, timber, fittings,	General Solid Waste (non-putrescible)	The construction of infrastructure will involve prefabricated components which are manufactured off site and transported to the site for installation/ assembly. As such, the construction of the Proposal is not expected to generate a significant amount of construction waste. All attempts would be made to separate and reuse or recycle building materials.
Sewage	Liquid Waste and General Solid Waste (putrescible)	Biological waste will be collected as part of a service agreement with the temporary amenity hire contractor and disposed of appropriately.
General domestic waste Paper, cardboard, aluminum cans, steel, plastics, glass, food waste, plastic wrap, etc. generated by onsite staff	General Solid Waste (non-putrescible and putrescible)	General waste will be collected by a waste management contractor and disposed of to a suitably licensed facility (putrescible landfill).

Potential impacts from the generation, handling, storage and disposal of waste from the Proposal includes:

- Pollution of land and waterways
- Air pollution
- Overuse of scarce resources
- Human and animal health impacts
- Decreased amenity.

It is proposed that all waste generated during the construction of the proposal will be segregated in accordance with the construction waste management plan (WMP). The waste management plan will include management options for stockpiles.

Table 6-52 below provides details for potential recycling facilities and disposal points that will be used to remove waste and recyclables. Discussions with Shire of Gunnedah has identified that a notice period must be given to the Gunnedah Waste Management Depot for any large quantities of waste. Discussions with Tamworth Council revealed that Tamworth will is unlikely to give permission for waste to be transferred to their landfill. If waste cannot be adequately disposed of in the two facilities in Gunnedah, then it will have to be transported back to an alternate facility within the metropolitan areas of Newcastle or Sydney for disposal.

Table 6-52 Material reuse, recycling and disposal facilities which can be used to dispose of waste and recyclables

Name of the facility	Address	Opening Hours	Materials and Services	Distance from the Site
Gunnedah Waste Management Depot and Community Recycling Centre 02 6742 3943	418 Quia Road, Gunnedah NSW 2380	8:00am to 5:00pm Monday to Sunday	• General domestic waste • Metals • Lighting • Paints • Green waste • Wood • Batteries • Pallets • E-waste.	14km
Recyclit facility Recycling plant 02 6742 1522	Located within the Council facility at 418 Quia Road Gunnedah NSW 2380	8:00am to 4:00pm Monday to Thursday 8:00am to 3:00pm Friday 9:00am to 11:00am Saturday	• Chemical drums • Some pallets – Wood (for re use, but cannot take large quantities) • Timber- untreated • Aluminium cans and tins • Cardboard – cartons • Paper – mixed and office.	14km
Gunnedah waste management facility is licenced to accept: general solid waste (putrescible); general solid waste (non-putrescible); asbestos waste; waste tyres; any waste received on site that is below licensing thresholds in Schedule 1 of the POEO Act.				

General contingency procedures and remedial actions for the management of potentially contaminated material discovered will be illustrated in an Unexpected Finds Protocol (Waste). The protocol will be developed by the contractor within a site-specific Waste Management Plan (WMP) prior to the commencement of construction works and implemented in the case of unanticipated discovery of contaminated material during construction of the proposal

During decommissioning, all infrastructure (excluding the substation) and materials would be removed from the site and recycled or otherwise disposed of at approved facilities.

6.13.2 Mitigation Measures

The following mitigation and management measures are recommended to manage waste.

Reference	Mitigation measures
Construction and Decommissioning Mitigation Measures	
W1	A WMP will be prepared and implemented as part of the CEMP to manage any construction waste. The WMP will include but not be limited to: • Measures to avoid and minimise waste associated with the Proposal. • The procedure for assessing, classifying and storing waste in accordance with the EPA 's Waste Classification Guidelines (EPA, 2014) and management options. • Procedures for storage, transport and disposal of waste. • Monitoring, record keeping and reporting, e.g. waste tracking data demonstrating the lawful disposal of contaminated products, waste or residues generated at the facility.
W2	An Unexpected Finds (Waste) Protocol would be established and implemented in case potentially contaminated, hazardous or unsuitable material are encountered during the site works.
W3	Waste management strategies and mitigation measures will be communicated to all employees and contractors during site induction, prior to commencing works at the site.
W4	A scheduled will be created with the temporary amenity hire contractor to remove sewage.
W5	The proposed facility will comply with the relevant Protection of Environment Operations Act waste-tracking requirements for any wastes assessed or classified as hazardous waste, industrial waste or 'Group A' waste (such as solvents, paints or oils).
W6	Waste generated from the Proposal will be managed in accordance with the principles of the waste hierarchy. A decommissioning environmental management plan will be prepared for the proposed facility with a Waste Management Plan.
W7	Gunnedah Waste Management Depot given appropriate notification before any large quantities of waste are deposited at the Gunnedah Waste Management Depot. Consultation will be undertaken with Shire of Gunnedah to determine what these notification periods will be and what waste can be taken by the facility.
Operational Mitigation Measures	
W7	A WMP will be prepared and implemented as part of the OEMP to manage any waste operational waste.

7. Cumulative Impacts

The cumulative impact assessment has considered the local government area of Gunnedah.

Background

A search of the Major Projects Register on the DPE website was undertaken on the 5 January 2017 to identify any other major projects within the vicinity of the development site which would likely to contribute to cumulative impacts. A search was completed for the Gunnedah LGA. This search identified the following projects in the council area that may add to cumulative impacts.

- Orange Grove Solar Farm
- Vickery Mine Extension project
- Rocglen Mine
  - Modification
  - Coal extension project
- Sunnyside Mine – Five-year extension to mining operations
- Whitehaven coal handling and preparation plant
- Watermark Coal mine
- Queensland Hunter Gas Pipeline
- Keepit Dam upgrade – This project was approved in April 2009 and completed in 2011 and thus will not affect the Gunnedah Solar Farm.

Other major projects identified include:

- Kamilaroi Highway overpass.

Potential Impacts

Developments that have been approved, or are proposed to be carried out in the vicinity of the Proposal are outlined in Table 7-1 and shown in Figure 7-1. The timing of these projects may or may not coincide.

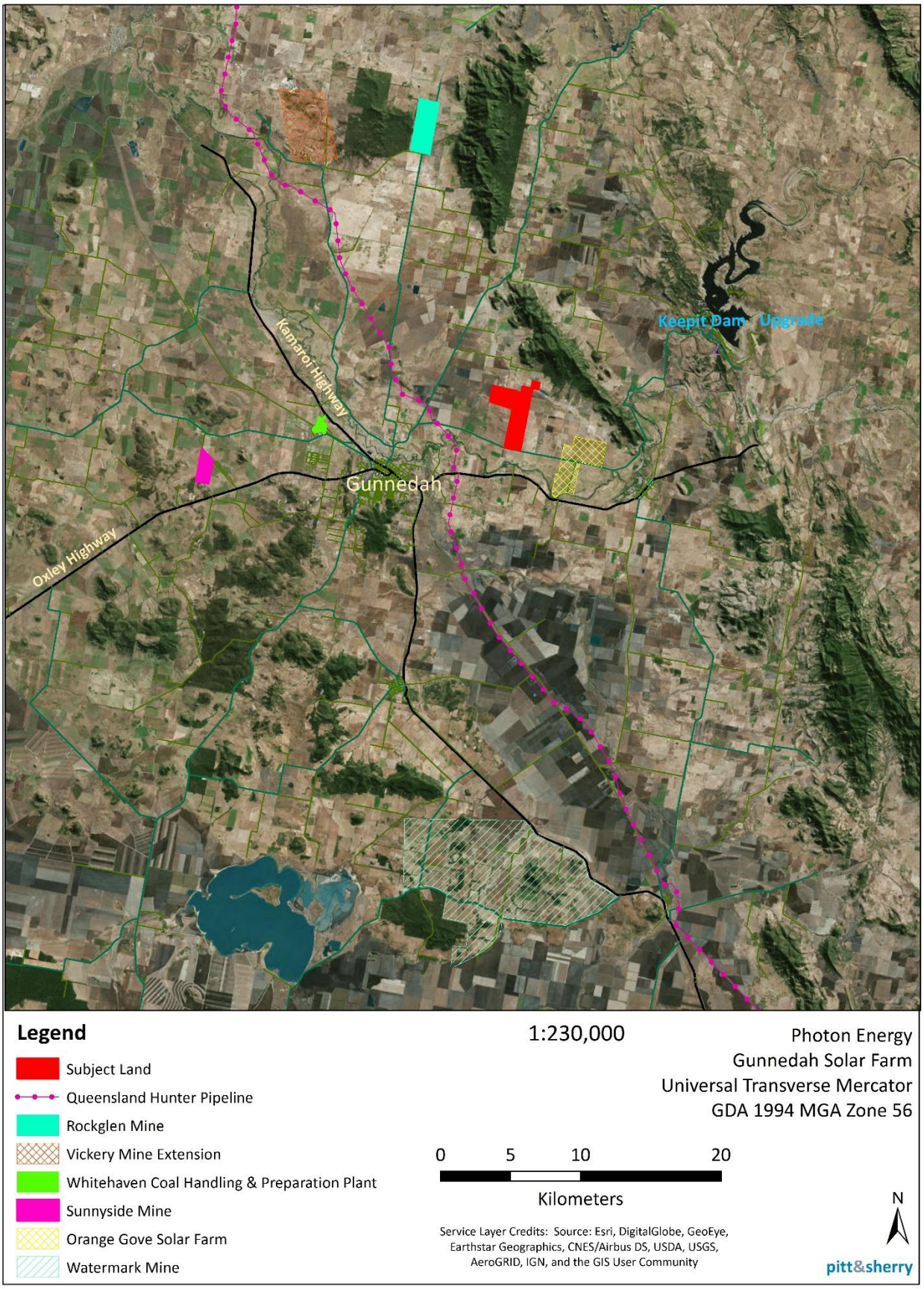

Figure 7-1 Location of other major projects in the Gunnedah LGA in relation to the Proposal

Table 7-1 Developments that are proposed to be carried out within the Gunnedah LGA

Project	Cumulative construction Impacts	Cumulative operational Impacts
Orange Grove Solar The proposal intends to build a PV solar facility generating over 110MW of power and occupying 417 ha of land off Orange Grove Road located approximately 12km east of the township of Gunnedah and approximately 4km from the Gunnedah Solar Farm.	The current timing of this proposal for construction is unknown. Currently the EIS is being prepared. If the development proceeds the timing may overlap with this Proposal. Cumulative construction impacts may include: • Additional construction traffic causing congestion, increased collision risk, damage to road infrastructure, associated noise and dust (if the road is unsealed) and disruptions to existing public transport services • Haulage routes (particularly Orange Grove Road and Kelvin Road) do not have suitable capacity to cater for concurrent construction of the two projects • Additional traffic management during construction causing congestion and delays • Increased impacts on local amenity (noise, air quality and visual impact) • Land clearing • Use of construction water • Major electricity infrastructure upgrades will be required to accommodate both farms • Conditions of approval for one project (such as sealing Orange Grove Road) may affect the other project. This has not been assessed as the conditions of approval are not yet known • Should the development go into development local labour may not be available to accommodate both projects increasing the demand for local accommodation and health services	Cumulative operational impacts of the proposal may include: • Visual impact of solar infrastructure for local residents and road users • Loss of vegetation due to land clearing • Increased renewable energy production • Additional loss of agricultural land (BSAL).

Project	Cumulative construction Impacts	Cumulative operational Impacts
	• Construction of the Development is expected generate waste. Local waste disposal centres may not be able to accommodate waste disposal from both projects during construction.	
Vickery Mine Extension project The Vickery Coal Project, owned by Whitehaven Coal Limited (Whitehaven) is an approved, but yet to be developed, open cut coal mining operation situated in the Gunnedah Coalfield approximately 25km north of Gunnedah. Whitehaven is seeking a new Development Consent for extension of open cut mining operations at the Vickery Coal Project. This would include a physical extension to the approved mine footprint to gain access to additional ROM coal reserves, an increase in the footprint of waste rock emplacement areas, an increase in the approved ROM coal mining rate and construction and operation of an onsite CHPP, train load-out facility and rail spur.	Cumulative construction impacts of the proposal may include: • Additional construction traffic causing congestion along haulage routes, increased collision risk, damage to road infrastructure and associated noise from additional traffic • Should the mine go into development local labour may not be available to accommodate both projects increasing the demand for local accommodation and health services • Construction of the mine is expected generate additional waste. Local waste disposal centres may not be able to accommodate waste disposal from both projects during construction. These impacts would be temporary and are manageable with the implementation of safeguards (refer to mitigation measures below).	Operational traffic impacts associated with the mine will need to be assessed and managed by the proponent of that development as part of their development application processes. There are not expected to be any cumulative impacts resulting from the operation of the Proposal and Vickery Mine.
Rocglen Mine *Modification* Rocglen Mine is located 28km north of the Gunnedah township. The Road Haulage modification was only	Due to the timeframe of this modification there are no expected impacts.	Due to the timeframe of this modification there are no expected impacts.

Project	Cumulative construction Impacts	Cumulative operational Impacts
approved for the 2016 and 2017 calendar years and will not affect this development.		
Rocglen Mine *Coal rejects management* Relates to coal rejects management and disposal methods. The proposal will change the rejects management strategy so that the rejects disposed of at Rocglen will not be restricted to just Rocglen-sourced coal. This modification would involve a combination of back-haulage using returning coal trucks as well as trucks specifically to carry reject material.	According to the environmental assessment submitted to DP&E the average daily heavy vehicle movements associated with the transport of coal rejects to and from the mine would remain unchanged. As such, there are no expected cumulative impacts.	As the daily heavy vehicle movements, would remain unchanged there are no expected operational impacts.
Rocglen Mine *Coal extension project* The Project, will permit up to 5 million tonnes (Mt) of coal, not previously considered in the life of mine plan, to be extracted. This represents an increase in coal recovery from Rocglen by close to 30 %. At a maximum recovery rate of 1.5 Mt run-of-mine (ROM) coal annually, this will increase the projected life of the operation for coal extraction by up to four years.	Cumulative construction impacts of the proposal may include: • Additional traffic associated with plant and equipment, staff and waste disposal needed for the mine extension. Additional traffic could cause congestion along haulage routes, increased collision risk, damage to road infrastructure and associated noise impacts • Should the mine extension require additional staff not associated with the current running of the mine then additional staff may be required. This may involve bringing in non-local labour increasing the demand for local accommodation and health services • Construction of the mine extension is expected generate additional waste. Local waste disposal centres	Cumulative operational impacts of the proposal may include: Additional traffic associated with haulage of coal. However, as the environmental assessment states that the Project does not involve any change to the coal production rate, transport fleet, hours of coal haulage or coal haulage route used between Rocglen and the Whitehaven CHPP. On this basis, the Project does not pose any additional annual impacts upon the local road network or traffic volumes, nor does it pose any additional conflict with other road users.

Project	Cumulative construction Impacts	Cumulative operational Impacts
The footprint of the open cut pit will increase by approximately 50 hectares to a total open cut mined area of approximately 164 hectares.	may not be able to accommodate waste disposal from both projects during construction. These impacts would be temporary and are manageable with the implementation of safeguards (refer to mitigation measures below).	
Sunnyside Mine The Sunnyside Coal Mine is located approximately 15km west of Gunnedah township. *Modification* The modification requires approval to continuation of mining of the approved coal reserves beyond November 2015 for a further period of 5 years (i.e. until the end of 2020). This modification was approved in November 2015.	As this is merely a continuation of a mine already in operation at the time that this EIS is being prepared so there will be no construction impacts from the mine that will create a cumulative impact.	During operation traffic from Sunnyside Mine would utilise the Oxley Highway and the Kamilaroi Highway causing additional heavy vehicle traffic on the road network. Both the Oxley Highway and the Kamilaroi Highway have suitable capacity to cater for operation traffic from the mine and construction traffic from the solar farm as both are key freight routes in NSW and designated as '*oversize, over mass load carrying vehicles network approved roads*' by Roads and Maritime.
Whitehaven Coal Handling and Preparation Plant (CHPP) The Whitehaven CHPP is located approximately 5km north-west of Gunnedah township. Rejects from Whitehaven CHPP need to be disposed of at an alternative site. The proposal is to install belt press filters (BPF) at the Whitehaven CHPP and use them to produce a dewatered fine reject 'filter cake'	As this project was approved in August 2015 it is assumed that the BPF has been constructed and therefore there would not be any cumulative construction impacts.	The trucks used to transport the rejects back to the mine site would be a combination of returning coal trucks and reject-specific trucks. However, environmental impact statement for the projects states that the total number of heavy vehicle movements transporting coal and/or rejects would remain unchanged and operating hours would also remain the same. As a result, no material impacts on the local road network, other road users or adjoining residences would occur.

Project	Cumulative construction Impacts	Cumulative operational Impacts
which would be transported to Whitehaven open cut mines (Melville or Rocglen) via truck (either combined with coarse rejects or separately)		
Watermark Coal Mine The project is located approximately 25km south south-east of the Township of Gunnedah and to the immediate west of the village of Breeza within the Gunnedah LGA. The proposal is the construction and operation of an open cut mine extracting up to 10 million tonnes of coal per annum over 30 years. This project was approved in January 2015 but construction had not started at the time this EIS was written.	Cumulative construction impacts include: • Additional construction traffic causing congestion, increased collision risk, damage to road infrastructure. Watermark coal mine will utilise the Kamilaroi Highway. The Kamilaroi Highway is a State road, which carries high traffic volumes. Additional construction vehicle traffic generated by the Coal mine as well as the Proposal would have a minor traffic impact, as this additional construction vehicle traffic would be within the range of daily variation in traffic on these routes • Construction of the mine increasing the demand for local accommodation and health services for construction staff. These impacts would be temporary and are manageable with the implementation of safeguards (refer to mitigation measures below).	The operation of the mine will create increased traffic in the Breeza area and on the Kamilaroi Highway from staff moving to and from work and also operational traffic from the haulage of coal. Operational traffic impacts associated with the mine will need to be assessed and managed by the proponent of that development as part of their development application processes. The operational traffic of the Proposal will be minimal and expected to be within the changing daily limits of the local road network.
Queensland Hunter Gas Pipeline Hunter Gas Pipeline Pty. Ltd. (HGP) proposes to build and operate a high pressure, underground (minimum depth of cover 750mm) 420km steel gas pipeline to transport gas from the proposed Narrabri Gas Project	Cumulative construction impacts include: • The proposed underground pipeline route will cross Kelvin Road and Orange Grove road causing potential traffic disruptions. Short-term partial road closures may occur however all public roads would remain open with controlled single direction traffic flow (as required) through the works areas	There are no expected cumulative operational impacts

Project	Cumulative construction Impacts	Cumulative operational Impacts
to Newcastle via, Gunnedah, Quirindi, Scone, Muswellbrook, Singleton and Maitland. The project was approved in 2009 but construction had not started at the time the EIS was written. The project was granted approval for commencement within 10 years, given the time uncertainties with the Narrabri Gas Project progressing.	• Additional non-local labour would need to be housed in the area • Local waste disposal centres may not be able to accommodate waste disposal generated by the project during construction. These impacts would be temporary and are manageable with the implementation of safeguards (refer to mitigation measures below).	
Kamilaroi Highway overpass A second rail overpass (road-over-rail bridge) is due for construction in Gunnedah. The rail overpass will be located within the town of Gunnedah and will run from the Oxley Highway on the western side of the township of Gunnedah over the railway and exit onto Warrabungle Street. The project is expected to commence in July 2018 and take 2 years to construct.	As the overpass is on the western side of the town however there will be traffic impacts from required traffic management measures along the Oxley Highway and construction traffic. Cumulative construction impacts of the proposal may include: • Increased heavy vehicle movements for hauling of construction materials and equipment, staff and service vehicles causing congestion, increased collision risk and damage to road infrastructure • Additional traffic management during construction causing congestion and delays • Increased traffic movements in surrounding road network resulting from diversion of vehicles during temporary road closures (View Street, New Street, Barber Street, Warrabungle Street) • Should the development go into development local labour may not be available to accommodate both	There are no cumulative operational impacts expected from the operation of the Kamilaroi Highway and the Gunnedah Solar farm.

Project	Cumulative construction Impacts	Cumulative operational Impacts
	projects increasing the demand for local accommodation and health services • Additional non-local labour would need to be housed in the area • Local waste disposal centres may not be able to accommodate waste disposal generated by both projects during construction. These impacts would be temporary and are manageable with the implementation of safeguards (refer to mitigation measures below).	

The cumulative impacts from projects in the Gunnedah LGA can be grouped into four broad categories:

- Traffic generation and associated risks (increased risk of collision, damage to infrastructure)
- Pressure on local accommodation and services
- Waste disposal
- Access to local labour.

Traffic generation

The major road networks affected by the additional projects include the Kamilaroi Highway, the Oxley Highway and Blue Vale Road. The Queensland Hunter Gas Pipeline may also affect Old Blue Vale Road and Kelvin Road.

Both the Oxley Highway and the Kamilaroi Highway have suitable capacity to cater for construction and operational traffic as both are key freight routes in NSW and designated as '*oversize, over mass load carrying vehicles network approved roads*' by Roads and Maritime. Both highways are State roads, which carry high traffic volumes and any additional construction or operational vehicle traffic on these major roads would be within the range of daily variation in traffic on these routes.

Blue Vale Road already has a number of heavy vehicle movements associated with Whitehaven Mining activities. The increase in heavy vehicle movements could cause some congestion. However, the movements associated with the Proposal would only impact 1.4km of Blue Vale Road before turning into Old Blue Vale Road so impacts would be limited to this section of road and its intersections with the Kamilaroi Highway and Old Blue Vale Road.

In addition to causing congestion along haulage routes, additional construction traffic may also increase collision risk, have the potential to cause damage to road infrastructure and increase noise levels along haulage routes. Traffic impacts would largely be temporary and are considered manageable with the implementation of safeguards (refer to section 6.6).

Pressure on local accommodation and services

Should several projects occur at the same time local labour may not be available to all projects and non-local labour will be required for construction increasing the demand for local accommodation and local health services. Strain on local accommodation and health services is expected to be spread over the region with employees staying primarily in Gunnedah or accommodated by Tamworth or Narrabri if necessary.

However, there is also potential for positive cumulative economic effects from the construction of multiple developments in the area (refer section 6.12.5). The increased creation of jobs and economic input into local businesses would provide a benefit to local communities.

Waste Disposal

Construction of the projects listed above is expected to generate additional construction related waste. Local waste disposal centres may not be able to accommodate waste disposal from multiple projects during construction. Should projects occur concurrently the WMP within the CEMP would need to be updated to incorporate and address potential cumulative impacts from surrounding development activities as they become known.

Access to Local Labour

Construction of the projects listed above is expected to use local labour however there is a limited amount in Gunnedah and the surrounding areas. It is expected that different projects will require different skills sets and different parts of the construction market will be used. However non-local labour is likely to be will be required for all projects listed above.

Mitigation

Cumulative impacts are best addressed through careful management of individual components, as set out in section 8. However, the following mitigation and management measures are recommended to minimise potential cumulative impacts.

Ref	Mitigation Measure
CU1	The CEMP would be updated as required to incorporate potential cumulative impacts from surrounding development activities as they become known. This would include a process to review and update mitigation measures as new work begins or if complaints are received. Key areas within the CEMP include WMP and TMP.

8. Environmental Management

8.1 Summary of Environmental Mitigation Measures

Throughout this EIS, a number of management and mitigation measures have been identified in order to minimise adverse environmental, social and economic impacts that could potentially arise from the Proposal. These management and mitigation measures would be implemented during the construction, operation and decommissioning of the Proposal. The identified management and mitigation measures will be incorporated into contractual arrangements with any future contractors for construction and operation of the Proposal.

These management and mitigation measures would minimise any potential adverse impacts arising from the Proposal on the surrounding environment. The management and mitigation measures for construction are summarised in Table 8-1 and Table 8-2. Similarly, management and mitigation measures for the operation of the proposal are summarised in Table 8-3 and Table 8-4 respectively.

Table 8-1 Summary of General Management and Mitigation Measures for Construction and Decommissioning

Mitigation Measure Reference	Description
G1	A project specific Construction Environmental Management Plan (CEMP) and all relevant sub-plans will be prepared by the Contractor prior to commencing Stage 1 construction. The sub-plans will include: • Land Management Plan (LMP) including a weed management plan • Soil and Water Management Plan (SWMP) including erosion and sediment (ERSED) control • Unexpected Finds protocol • Waste Management Plan (WMP) • Traffic Management Plan (TMP) • Emergency Contingency Plan.
G2	All employees, contractors and subcontractors are to receive a project induction. The environmental component may be covered in toolbox talks and should include: • Environmental mitigation measures • Vegetation clearing operations and controls to prevent unauthorised clearing • The Unexpected Finds Protocols (historic heritage, Aboriginal heritage and waste) • Aboriginal heritage (Types of aboriginal heritage objects, details of the NMH heritage object, legislative requirements and penalties associated with the harm or desecration of Aboriginal heritage objects) • Waste management strategies and mitigation measures.
G3	Implement community consultation measures to inform the community of construction activity and potential impacts.
G4	A complaint handling procedure and register will be implemented to assist in recording and managing potential conflict with the local community during construction.
G5	Mud and other debris shall be removed from the wheels and bodies of construction vehicles and equipment prior to leaving the project site and before entering the sealed public road network. Soil, earth, mud and other similar materials must be removed from the roadway preferably by dry methods (sweeping, shovelling).

Table 8-2 Summary of Management and Mitigation Measures for Construction and Decommissioning

Reference	Mitigation Measure
Biodiversity	
B1	A 10-m buffer shall be established between the perimeter of the remnant vegetation stands (V1, V2 and V3) and the works footprint.
B2	The works (e.g. plant, material stockpiling) should not encroach into remnant vegetation and buffer areas.
B3	A Land management plan which includes weed management has been developed (refer **Appendix G**) and will be incorporated into an overall construction environmental management plan (CEMP).
B4	Trenches should be backfilled as soon as possible to minimise the chance of fauna becoming trapped. Any trench sections left open for greater than a day would be inspected daily, early in the morning and any trapped fauna removed. The use of ramps or ladders to facilitate trapped fauna escape is recommended.
B5	Speed limits should be set to 20km per hour on internal roads and tracks.
B6	Preparation of procedures within the CEMP which detail how to care for animals found at risk of harm or injured at the solar farm Site.
Heritage	
Aboriginal Heritage	
AB1	An Unexpected Finds Protocol which addresses unexpected aboriginal heritage finds will be included in the CEMP to be completed by the construction contractor.
AB2	The Unexpected Finds Protocol will form part of the site induction and must be viewed by all relevant employees and contractors before working on site.
AB3	If suspected Aboriginal objects, such as stone artefacts are identified during works, works must cease within 10m of 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 or avoidance should be sought if Aboriginal objects are to be moved or harmed.
AB4	In the extremely unlikely event that human remains are found, works should immediately cease and the NSW Police are to 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.
Heritage	
H1	An Unexpected Finds Protocol which addresses unexpected non-indigenous heritage finds will be included in the CEMP to be completed by the construction contractor.
H2	The Unexpected Finds Protocol will form part of the site induction and must be viewed by all relevant employees and contractors before working on site.
H3	If an item (or suspected item) of heritage is discovered during construction, all work in the area of the find will cease immediately, and the Unexpected Finds Protocol implemented including notifying an officer from the Heritage branch of OEH immediately (in accordance with section 146 of the *Heritage Act 1977*) and seeking advice for management of the object.
Land Use	

Reference	Mitigation Measure
L1	Managed grazing will be used to maintain the height of ground cover during operation of the solar farm.
L2	Create and implement a remediation plan during end of operation and decommissioning.
L3	Implement the Landscape Plan (refer **Appendix C**)
L4	All pesticides will be used in accordance with the *Pesticides Act 1999*, such that only registered pesticides are used based on label instructions that are designed to minimise impacts on surrounding land
L5	All the infrastructure will be removed upon decommissioning with the possible exception of the substation, transmission lines to the substation and access road to the substation.
Visual	
V1	*Minimise impact through use of siting and design features* • Group ancillary facility structures where possible to minimise sprawl • Stabilise new access tracks formed within the Site required for operations, but do not seal with bitumen or other dark coating.
V2	*Minimise and repair ground disturbance* • Minimise grading across the Site and undertake the minimum levelling necessary to install panel supports • Rehabilitate exposed ground surfaces as soon as possible.
V3	Implement Concept Landscape Plan (refer **Appendix C**), which includes visual screening.
V4	Retain all existing trees
V5	Retain as much existing ground cover (pasture grasses) beneath solar panels as possible.
V6	Progressively stabilise disturbed area with pasture grasses.
Noise	
N1	Prepare a construction noise management protocol for site to manage noise emissions.
N2	Implement a formal complaint handling procedure to manage any potential concerns from the community. This will include: • Details of a readily accessible contact person • A well-documented process that includes an escalation procedure so that (if required) there is a path to follow should the complainant not be satisfied • Details regarding setting up a complaint's register. Each complaint would need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences, where the noise in question is in excess of allowable limits.
N3	Works are to be carried out during standard work hours (i.e., 7am to 6pm Monday to Friday; 8am to 1pm Saturdays). Any construction outside of these normal working hours would only be undertaken in the event of an emergency or with prior approval from relevant authorities. For non-emergency works outside standard hours, residents and other sensitive land use occupants should be informed of the works between 5 and 14 days before commencement.

Reference	Mitigation Measure
N4	Toolbox and induction of personnel prior to start of shift to discuss noise control measures that may be implemented to reduce noise emissions to the community, construction hours and nearest sensitive receivers.
N5	All plant should be shut down when not in use. Plant to be parked/started at farthest point from relevant assessment locations
N6	Avoid the operation of noisy equipment near noise sensitive areas and where possible, loading and unloading would be conducted away from sensitive areas.
N7	Noise levels will be considered when procuring equipment.
N8	All plant is to utilise a broadband reverse alarm in lieu of the traditional hi frequency type reverse alarm.
N9	Ongoing community consultation for residences within close proximity of the works. The information would include details of: • The proposed works and when these will occur • The duration and nature of the works • Details of what to do should they have a noise complaint • Updates on the progress of works.
N10	Where possible use localised mobile screens or construction hoarding around plant to act as barriers between construction works and receivers, particularly where equipment is near the site boundary and/or a residential receiver including areas in constant or regular use (e.g. unloading and laydown areas)
Traffic, Transport and road Safety	
T1	The proposed road improvements, as stated above, and any ancillary road works should be completed prior to the construction of the proposal.
T2	A Traffic management plan (TMP) for construction shall be developed in accordance with Roads and Maritime Guidelines and the Australian Standard AS1742.3. The plan would include: • The designated routes of construction traffic to the site • A map of the primary access routes highlighting critical locations • Drivers Code of Conduct • Carpooling/shuttle bus arrangements to minimise vehicle numbers during construction • Scheduling of deliveries • Community consultation requirements • Any restrictions on traffic movements (such as residential areas, school pick-up and drop-off times) • Traffic controls (speed limits, signage, etc.) • A complaint handling procedure • An induction process for vehicle operators.
T3	All Proposal personnel will be provided training on the requirements of the TMP through site inductions, toolbox talks or specific training
T4	The heavy vehicle route will be included within the Driver's Code of Conduct and will form part of the project inception meeting for the project for all staff and drivers

Reference	Mitigation Measure
T5	Traffic control will be provided in accordance with the approved construction TMP to manage traffic movements (vehicular, cycle and pedestrian) during construction and maintain the flow of traffic within the site and on surrounding public roads
T6	Traffic management controls will be communicated to appropriate stakeholders which will include the local community in the site vicinity via a letter box drop
T7	Directional signage will be installed to direct construction traffic, and warn other motorists of construction traffic. This signage is positioned in accordance with the approved Traffic Control Plans.
T8	All employees, subcontractors and suppliers will comply with the speed limits within the worksite, which are as follows: • 40km/h on formed roads • 20km/h during foggy/dusty conditions with headlights on • 10km/h when passing pedestrians.
T9	Develop a protocol will be provided for both undertaking dilapidation surveys and making any necessary repairs following construction. The dilapidation surveys will assess the existing condition of Old Blue Vale Road prior to construction and identify any damage once construction is complete. Should any damage be identified the road will be repaired in line with Council standards.
T10	A dilapidation survey will be completed along Old Blue Vale Road prior to upgrades on this road and after the works are complete. A dilapidation survey protocol is provided in **Appendix I**.
T11	A Traffic management plan (TMP) for decommissioning will be developed as part of the decommissioning management plan. This will include a decommissioning haulage route. The indicative decommissioning route provided in this EIS will be reviewed prior to the start of decommissioning.
Surface Water, Hydrology and Groundwater	
SW1	A Soil and Water Management Plan (SWMP) will be prepared and implemented by the Contractor as part of the CEMP.
SW2	Minimise the footprint of disturbance by implementing progressive construction and remediation works
SW3	Design solar panel arrays to allow sufficient space between panels to establish and maintain ground cover beneath the panels and facilitate weed control
SW4	Ensure all refuelling activities are undertaken in a bunded area at least 40m from any waterways.
SW5	Prior to construction, further flood modelling is undertaken including: • A revised hydrological model which identifies representative combinations of flooding from the Namoi and Mooki Rivers • New LiDAR data (north of Oxley Highway) to replace the current SRTM terrain data • Identification of additional mitigation measures such as further refinements to the fence configuration, if required, to reduce changes to flood levels and flow associated with the Proposal • Preparation of an addendum flood impact assessment report to describe the revised modelling outcomes and any subsequent flood mitigation requirements.

Reference	Mitigation Measure
SW6	Additional mitigation measures will be considered during detailed design.
Soils, Geology and Contamination	
S1	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP, in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004). This will include an erosion and sediment control plan for implementation during construction.
S2	Minimise the footprint of disturbance during construction and employ progressive rehabilitation strategies to reduce the erosion hazard
S3	During trenching activities and backfilling, as far as practicable separate topsoil and subsoil and when backfilling return the soil layers in their original order.
S4	Employ dust management measures on unsealed roads, stockpiles and other areas of loose or disturbed soil prone to dust generation. Controls may include covering of stockpiles, watering roads and synthetic soil stabilisers. Dust management techniques shall be outlined in the Soil and Water Management Plan.
S5	Maintain erosion and sediment controls until construction works are complete.
S6	Install a stabilised site entrance that all construction vehicles will use to access the site. The stabilised entrance shall be designed to minimise tracking of sediment onto adjoining roads from departing vehicles.
S7	Undertake site inspections at least weekly and following significant rainfall events to observe the condition and operation of erosion and sediment controls and water management systems, and schedule any required maintenance.
S8	Undertake soil amelioration and vegetation improvement works in line with the requirements of a Land Management Plan. This should include undertaking required land or vegetation improvement works at an appropriate stage during solar farm development. For example, soil amelioration and fertilising might be most practically undertaken prior to solar panel installation. For similar reasons the desired pasture crop should be sown before solar panel installation.
S9	Design arrays to allow sufficient space between panels for essential maintenance activities and to facilitate maintenance of an effective ground cover beneath the panels to reduce erosion and help suppress weeds.
S10	Develop and implement a protocol for management of unexpected finds of soil contamination
S11	Stabilise batters required for ancillary infrastructure raised off the ground.
Bushfire	
BF1	All electrical components would be designed and managed to minimise potential for ignition
BF2	The design would consider that the access track must be trafficable by Category 1 fire appliances.
BF3	Maximise use of construction components using materials such as glass, silicon, steel and aluminium rather than plastic
BF4	Develop an Emergency Response Plan (ERP) in consultation with the NSW RFS District Fire Control Centre prior to construction. The FMP should include: • Foreseeable on-site and off-site fire events

Reference	Mitigation Measure
	• Clearly states work health safety risks and procedures to be followed by fire-fighters, including: – Personal protective clothing – Minimum level of respiratory protection (e.g. rubber fire fighter's boots and gloves, a self-contained breathing apparatus) – Minimum evacuation zone distances – A safe method of shutting down and isolating the PV system – Training for fighting fires within solar farms – Any other risk control measures required to be followed by fire-fighters • Evacuation triggers and protocols. Suppression response strategies and tactics, including aerial suppression options/management
BF5	Two copies of the ERP should be permanently stored in a prominent 'Emergency Information Cabinet' to be located at the main entrance point to the solar farm, external to any security fence or locked gate, and a copy provided to local emergency responders.
BF6	An APZ will be constructed around the solar farm with the following requirements: • The APZ will be 15 m wide around the entire perimeter of the solar farm footprint, and 20 m wide for areas abutting the remnant treed areas and landscaping areas • The external edge of the APZ setback at least 25 m from the external edge of PV panels or other components • The APZ must be either a mineral earth fire break (i.e. dirt or gravel) or a heavily grazed area • Trees and tall shrubs associated with the landscape plan should not be planted close to the APZ • APZ preferably located external to any security fence • The substation should have a 20m asset protection zone with no internal vegetation (gravel surface).
BF7	The APZ or a fire break is to be constructed as part of the first stage of the development.
BF8	Construction between 1 December and 31 March would be undertaken in accordance with the following: • All plant, vehicles and earth moving machinery will be cleaned of any accumulated flammable material (e.g. soil and vegetation) • A suitable fire appliance (e.g. fire extinguisher) is present on site with at least two personnel trained in bushfire fighting • On days when Very High fire danger or worse is forecast for Gunnedah, the "fires near me" app is to be checked hourly for the occurrence of any fires likely to threaten the site All operations involving machinery will cease while the GFDI is or forecast to be 35 or greater
BF9	Installation of electrical equipment such as, junction boxes, inverters, transformer and electrical cabling, is to be in accordance with AS 3000:2007 Electrical installations and undertaken by qualified professionals.
BF10	Install a water supply tank with a capacity of 50,000L outside the APZ near the substation.

Reference	Mitigation Measure
Hazardous Goods	
Haz 1	Dangerous or hazardous materials would be transported, stored and handled in accordance with AS1940-2004: The storage and handling of flammable and combustible liquids and the ADG Code where relevant.
Haz 2	All electrical equipment would be designed in accordance with relevant codes and industry best practice standards in Australia.
Haz 3	The layout of the Proposal has been designed considering buffer distances between the solar farm and sensitive receivers, road users and the general public.
Air Quality	
A1	Activities shall be assessed during adverse weather conditions and modified as required to reduce dust generation (e.g. cease activity where reasonable levels of dust cannot be maintained).
A2	Engines to be switched off when not in use for any prolonged period.
A3	Water suppression on exposed areas, haul roads and stockpiles when required.
A4	Temporarily excavated soil and other materials that exhibit significant dust lift off would be wet down, stabilised or covered to manage dust.
A5	Development of a complaints procedure to promptly identify and respond to complaints.
A6	Vehicles and plant would be fitted with suitable pollution reduction devices wherever possible and maintained according to manufacturer's specifications.
Socio-economic	
Socio 1	The Community Stakeholder Engagement Program (CSEP) will continue to be implemented, including: • Providing regular updates to the community • Inform relevant stakeholders of potential impacts (for example noise impacts) • Establishment of a complaints handling procedure and a response protocol Responding to any complaints received.
Socio 2	Liaise with local industry representatives to maximise the use of local contractors, manufacturing facilities and materials. Create a resourcing plan to ensure jobs will be local.
Socio 3	Local accommodation options for staff will be maximised.
Socio 4	Continued engagement with Shire of Gunnedah to discuss community and business concerns.
Waste	
W1	A WMP will be prepared and implemented as part of the CEMP to manage any construction waste. The WMP will include but not be limited to: • Measures to avoid and minimise waste associated with the Proposal • The procedure for assessing, classifying and storing waste in accordance with the EPA 's Waste Classification Guidelines (EPA, 2014) and management options • Procedures for storage, transport and disposal of waste • Monitoring, record keeping and reporting, e.g. waste tracking data demonstrating the lawful disposal of contaminated products, waste or residues generated at the facility.

Reference	Mitigation Measure
W2	An Unexpected Finds (Waste) Protocol would be established and implemented in case potentially contaminated, hazardous or unsuitable material are encountered during the site works.
W3	Waste management strategies and mitigation measures will be communicated to all employees and contractors during site induction, prior to commencing works at the site.
W4	A scheduled will be created with the temporary amenity hire contractor to remove sewage.
W5	The proposed facility will comply with the relevant Protection of Environment Operations Act waste-tracking requirements for any wastes assessed or classified as hazardous waste, industrial waste or 'Group A' waste (such as solvents, paints or oils).
W6	Waste generated from the Proposal will be managed in accordance with the principles of the waste hierarchy. A decommissioning environmental management plan will be prepared for the proposed facility with a Waste Management Plan.
W7	Gunnedah Waste Management Depot given appropriate notification before any large quantities of waste are deposited at the Gunnedah Waste Management Depot. Consultation will be undertaken with Shire of Gunnedah to determine what these notification periods will be and what waste can be taken by the facility.
Cumulative Impacts	
CU1	The CEMP would be updated as required to incorporate potential cumulative impacts from surrounding development activities as they become known. This would include a process to review and update mitigation measures as new work begins or if complaints are received. Key areas within the CEMP include WMP and TMP.

Table 8-3 Summary of general operational management and mitigation measures

Reference	Mitigation Measure
Operational Management Mitigation Measures	
GO1	A project specific Operational Environmental Management Plan (OEMP) will be prepared by the Hospital Operator. This will consider and incorporate: • A Land Management Plan including weed management • An operational WMP • An Emergency Response plan.
GO2	A complaint handling procedure and register will be implemented to assist in recording and managing potential conflict with the local community during operations.

Table 8-4 Summary of Management and Mitigation Measures for Operation

Reference	Mitigation Measure
Biodiversity	
B7	The OEMP will include: • The land management plan – which will have a procedure or plan for monitoring vegetation cover and composition and allow for adaptive management

Reference	Mitigation Measure
	• The weed management plan – which will include weed monitoring and control • Vehicle speed limits, to reduce risk of collision with fauna.
Land Use	
L6	An OEMP will be prepared for the Proposal and will incorporate: • The land management plan • The weed management plan • Ongoing landscaping commitments.
Visual	
V7	*Minimise impact through use of siting and design features* • Signage required at the Site should be of sufficient size to be readable at driver height within short range (0-20m) and contain only information sufficient for basic facility and company identification, for safety, navigation, and delivery purposes. Large scale signage will not be installed.
V8	*Avoid Night Sky Impacts* • Lighting will be limited to compulsory lighting required for the substation. Substation lighting will be turned on if an intrusion is detected or if staff are on site undertaking works outside of daylight hours • Amber colour lights will be used rather than bluish-white lighting.
V9	An OEMP will be prepared for the Proposal and will incorporate: • A complaints management process.
V10	Monitor performance of screen planting areas six-monthly for first three years then annually. Replant as necessary if plants die, and supplement planting with alternative species of plants are not adapting to the Site.
Noise	
N11	Complete a one-off noise validation monitoring assessment to quantify emissions from site and to confirm emissions meet relevant criteria.
N12	Prepare an operational noise protocol that can be implemented to address any community concerns regarding project noise emissions for future operations of the project.
Surface water, Hydrology and Groundwater	
SW7	Construct fencing in accordance with Final Flood Impact Assessment to be prepared prior to construction.
SW8	Implement the Land Management Plan to ensure at least 80% groundcover is restored and maintained (Refer **Appendix G**)
Soils, Geology and Contamination	
S12	Implement a Land Management Plan that addresses the ongoing land management and maintenance activities (Refer **Appendix G**). This would address: • ongoing agronomic management of the land including stock, water, vegetation and soils management

Reference	Mitigation Measure
	• measures required to maintain healthy soil and plant systems and maintain the agricultural capability of the land • stock management programs and infrastructure (eg fencing, watering points) • soil amelioration, pasture management and weed control • monitoring programs for soil fertility and groundcover measures to manage the site before, during and after a flood.
Bushfire	
BF12	Fit PV arrays with an earthing and lightning protection system connected to the main earth link.
BF13	Vegetation fuel levels internal to the APZ and throughout the solar farm will be maintained by grazing, slashing or mowing
BF14	The solar farm will be monitored via off-site control centres to monitor to ensure systems are working correctly, investigate any alarms and monitor panel performance
Air Quality	
A7	Establish and maintain ground cover in accordance with the Land Management Plan for the site.
Waste	
W8	A WMP will be prepared and implemented as part of the OEMP to manage any waste operational waste.

9. Conclusion

This chapter provides the justification for the Proposal taking into account its biophysical, social and economic impacts, the suitability of the Site and whether or not the Proposal is in the public interest. The Proposal is also considered in the context of the objectives of the *EP&A Act 1979*, including the principals of ecologically sustainable development (ESD) as defined in Schedule 2 of the *EP&A Regulation 2000*.

9.1 Justification for Development

The project, identified as a SSD has been subject to an environmental impact assessment under Part 4, Section 4.1 of the *EP&A Act*. As noted in Section 4.1, the Project is classified as SSD in accordance with the State and Regional Development (SRD) SEPP.

This EIS has examined and taken into account all matters affecting or likely to affect the environment by reason of the proposed activity.

The environmental impact assessment that was undertaken concludes that the project would have impacts on:

- Visual landscape
- Flooding
- Traffic
- BSAL
- Bushfire
- Public amenity.

A summary of the impacts for these is provided below. Appropriate mitigation and management measures outlined in Section 8 will be carried out during the construction, operational, and decommissioning phases.

The Proposal would be visible to 22 potentially affected private viewpoints as well as 2 public viewpoints along Orange Grove and Tudgey Road. The VIA concluded that no viewpoints had a high impact and only three viewpoints had a moderate – high impact. The VIA also concluded that these impacts could be further reduced through the implementation of mitigation strategies, such as landscape screening.

Flood modelling was considered at the sensitive receivers surrounding the Solar Farm by comparing predicted flood levels under the baseline (existing) situation with flood levels under Fence Configuration 3. The modelling concluded that the Proposal will result in small changes to overall flood depths at sensitive receivers. These changes are conservatively estimated to be less than about 18mm. The fences for the proposed solar farm are expected to change the direction of flow locally but will not greatly change the magnitude of the velocities over the flood plain.

The accuracy and quality of the flood modelling results depends chiefly on the quality of the terrain data and as the flood modelling for the EIS was conducted on a catchment basis further flood modelling will be undertaken to provide greater accuracy for flood levels, depths and velocities and to inform detailed design. The refined model will also be used to identify additional mitigation measures to reduce potential flood risks and socio-economic costs as required.

Traffic is expected to increase during construction from staff movements and deliveries however the haulage routes have adequate capacity to accommodate these vehicle movements without causing a significant impact.

The land used for the Proposal is classified BSAL and the Proposal would result in the temporary loss of the site for cropping agriculture for approximately 25 years. However, due to water restrictions approximately 180 hectares is estimated to be effectively used for cropping agriculture.
The Proposal would use a proportion of land and the remaining parts of the Subject land can be used for cropping agriculture. As such the impact on BSAL land is considered reasonable and the implementation of a land management plan would ensure that the land can be returned to agricultural use upon decommissioning.

The Bushfire risk assessment concluded that potential ignition sources from construction and decommissioning of the proposal were generally consistent with the existing environment apart from any electrical faults. Similarly, ignitions from electrical equipment is theoretically possible during operation. Solar farms also present unusual risks to fire fighters such as electrocution and inhalation of fumes. However, the land is flat and is not mapped as fire prone land. It has been concluded that these risks can be managed by the mitigation measures specified in section 8.

Construction of the Proposal would cause an increase in noise and dust levels however the noise impact assessment concluded that no receivers would be noise impacted based on assessment against the ICNG and dust levels can be effectively reduced with the mitigation measures specified in Section 8.

Mitigation measures identified would effectively reduce these to an acceptable level of environmental risk and enable the project to be constructed, operated and decommissioned without impairment to existing or future land uses.

9.2 Objects of the EP&A Act

Table 9-1 Objectives of the EP&A Act

Object	Comment
1.3 (a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	The Proposal does result in the loss of cropping agricultural land for a period of approximately 25 years however in the meantime it can be used for grazing agriculture (sheep) and can be returned to cropping agricultural use upon decommissioning. The Proposal will not result in the sterilisation of natural resources including mineral resources.
1.3 (b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment	Ecologically sustainable development is considered in Section 9.3.
1.3 (c) To promote the orderly economic use and development of land.	The Proposal would diversify sources of income for the agricultural sector, allowing financial resilience whilst retaining its cropping agricultural use on other parts of the Subject Land and conducting grazing agriculture within the Site.
1.3 (d) To promote the delivery and maintenance of affordable housing.	Not relevant to the project. The Proposal will not reduce available land for affordable housing as the land is not zoned for residential use and minimum lot size in the Gunnedah LEP is 200ha.
1.3 (e) To protect the environment, including the conservation of threatened and other species of	The Proposal will not impact on any threatened species or communities. Vegetation removal will be

native animals and plants, ecological communities and their habitats.	limited and all remnant areas of vegetation will be retained with s buffers from the Site boundary.
1.3 (f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The proposal will not impact upon any areas of built and cultural heritage (including Aboriginal heritage). However, an Unexpected (heritage) Finds protocol will be developed prior to construction.
1.3 (g) To promote good design and amenity of the built environment.	Not relevant to the project.
1.3 (h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	Not relevant to the project.
1.3 (i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	Not relevant to the project.
1.3 (j) To provide increased opportunity for community participation in environmental planning and assessment.	Consultation activities are outlined in Section 5. GSF will continue to consult the community and stakeholders during the Proposal's development.

9.3 Ecologically Sustainable Development

Ecologically Sustainable Development (ESD) involves the effective integration of social, economic and environmental considerations in decision-making processes. In 1992, the Commonwealth and all State and Territory governments endorsed the *National Strategy for Ecologically Sustainable Development*.

Clause 7(1)(f) of the *Environmental Planning and Assessment Regulation 2000* requires an EIS to provide justification for a development with specific reference to the principles of ecologically sustainable development (ESD) as set out in the Regulation. This is provided below.

The Precautionary Principle

The precautionary principle states that where '*there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation*'. Implementing the precautionary principle includes:

- Careful evaluation to avoid serious or irreversible damage to the environment wherever practicable
- An assessment of the risk-weighted consequences of various options.

This EIS assesses environmental aspects and impacts associated with the Proposal with the purpose of eliminating (where practicable) and reducing the risk of serious and permanent impacts on the environment. Specialist studies were undertaken to provide accurate information to assist with the evaluation and development of the Proposal. Mitigation measures are provided in Section 8.

Intergenerational Equity

The intergenerational equity principle recognises 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 Proposal would result in amenity impacts, however would not result in any impacts that are likely to adversely impact on the health, diversity or productivity of the environment for future generations. The Proposal would benefit future generations by reducing the reliance on energy sources derived from non-renewable resources, which produce GHG emissions.

Should the Proposal not proceed, the principle of intergenerational equity may be compromised, as the impacts of climate change continue to be realised, due to a continued dependence on GHG emitting energy resources.

The solar farm would be decommissioned at the end of its operational life, removing all above and below ground infrastructure. Decommissioning would therefore result in returning the site to its existing land capability for future generations. The Proposal is therefore consistent with the principles of intergenerational equity.

Conservation of Biological Diversity and Ecological Integrity

Ecologically Sustainable Development mandates that the conservation of biological diversity and ecological integrity should be a fundamental consideration in environmental planning and decision-making processes. Biodiversity refers to the variety of all life.

An assessment of the existing local flora and fauna has been undertaken in order to recognise and manage any potential impacts of the Proposal on local biodiversity. This assessment is provided in **Appendix D** and summarised in Section 6.1. The assessment included avoidance of areas of higher conservation value and management prescriptions to minimise and manage residual impacts. The Proposal is expected to have negligible adverse impacts on biodiversity.

Improved valuation, pricing and incentive mechanisms

This principle requires that environmental factors should be included in the valuation of assets and services in terms of the overall costs to the Proposal.

The environmental consequences of the Proposal have been assessed in this EIS and mitigation measures identified for factors with potential for adverse impact. Implementing the mitigation measures would impose an economic cost on the proponent, increasing both the capital and operating costs of the Proposal. This signifies that environmental resources have been given appropriate valuation.

The Proposal has been designed with an objective of minimising potential impacts on the surrounding environment. This indicates that the concept design for the Proposal has been developed with an environmental objective in mind.

The aims, structure and content of this EIS have incorporated these ESD principles. The mitigation measures in Section 8 provide an auditable environmental management commitment to these parameters. This proposed development would be considered ecologically sustainable, due to the social, economic and environmental benefits provided in Section 2.3, and the mitigation measures put in place to protect from adverse impacts on the environment.

10. References

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Appendix A

Secretary's Environmental Assessment Requirements (SEARs)

Appendix B

Table of Summary SEARs

Appendix C

Visual Impact Assessment and Landscape Management Plan

Appendix D

Biodiversity Assessment Reports

Appendix E

Aboriginal Heritage Impact Assessment

Appendix F

Bushfire Risk Assessment

Appendix G

Draft Land Management Plan

Appendix H

Noise Impact Assessment

Appendix I

Traffic Impact Assessment

Appendix J

Flood Impact Assessment

Appendix K

Soil Log Sheets and Laboratory Results

Appendix L

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