Sapphire Solar Farm

Environmental Impact Statement

January 2018

Delivering Energy, Powering Communities.

DOCUMENT TRACKING

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Submission of an Environmental Impact Statement (EIS)

State Significant Development: Section 78A (8A).

EIS Prepared by:

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Development Application:	SSD 8643
Applicant Name:	Sapphire Solar Farm Pty Ltd
Applicant address:	PO Box 1708, Newcastle NSW 2300
Lot No. DP No. Land to be Developed:	Sapphire Solar Farm, Kings Plains NSW

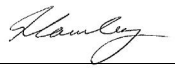
Lot	DP	Lot	DP	Lot	DP
1	435844	202	1227324	49	753316
209	750121	201	1227324	99	753316
18	750121	1	1140309	79	753316
16	750121	133	753316	1	128314
13	750121	103	651984	265	750076
139	750121	81	753316	266	750076
17	750121	48	753316		
2	1200772	57	753316		

Environmental Impact Statement

This Environmental Impact Statement (EIS) assesses the potential environmental impacts associated with the proposed Sapphire Solar Farm accordance with the Secretary's Environmental Assessment Requirements, issued to the proponent on 23 August 2017 and updated on 10 January 2018.

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

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

Signature:	
Name:	Robert Cawley
Date:	15 January 2018

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Abbreviations

Abbreviation	Description
µT	Microtesla
AC	Alternating Current
ACHA	Aboriginal Cultural Heritage Assessment
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
ANZECC	Australian and New Zealand Environment Conservation Council
ARENA	Australian Renewable Energy Agency
ARPANSA	Australian Radiation Projection and Nuclear Safety Agency
BAR	Biodiversity Assessment Report
BBCC	BioBanking Credit Calculator
BC Act	*Biodiversity Conservation Act 2016*
BMP	Biodiversity Management Plan
BOM	Bureau of Meteorology
BOS	Biodiversity Offset Strategy
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
CHMP	Cultural Heritage Management Plan
DC	Direct Current
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DEM	Digital Elevation Model
DotEE	Department of the Environment and Energy
DPE	Department of Planning and Environment
EEC	Endangered Ecological Community
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ELA	Eco Logical Australia Pty Ltd

Abbreviation	Description
ELF	Extremely Low Frequency
EMF	Electromagnetic Field
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPC	Engineering Procurement Construction
EPL	Environment Protection Licence
ERP	Emergency Response Plan
ESD	Ecologically Sustainable Development
FBA	Framework for Biodiversity Assessment
FM Act	*Fisheries Management Act 1994*
GDE	Groundwater Dependent Ecosystems
GWh	Gigawatt hours
ICNG	DEEC Interim Construction Noise Guideline
ISEPP	*Infrastructure State Environmental Planning Policy 2007*
KFH	Key Fish Habitat
kV	Kilovolt
LEP	Local Environment Plan
LGA	Local Government Area
MW	Megawatt
MNES	Matters of National Environmental Significance
NHMRC	National Health and Medical Research Council
NOW	NSW Office of Water
NPW Act	*National Parks and Wildlife Act 1974*
NSR	Noise Sensitive Receiver
NV Act	*Native Vegetation Act 2003*
OEMP	Operation Environmental Management Plan
OEH	Office of Environment and Heritage
PAC	Planning and Assessment Commission
PCT	Plant Community Type
PCU	Power Conversion Unit

Abbreviation	Description
PEA	Preliminary Environmental Assessment
POEO Act	*Protection of the Environment Operations Act 1997*
PTSNL	Project Target Noise Levels
PV	Photovoltaic
RAP	Registered Aboriginal Parties
RBL	Rating Background Level
RET	Renewable Energy Target
RMS	Roads and Maritime Services
SAT	Single Axis Tracking
SEARs	Secretary Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SRP	Spill Response Plan
SSD	State Significant Development
TEC	Threatened Ecological Community
TSC Act	*Threatened Species Conservation Act 1995*
TTM	TTM Consulting Pty Ltd
WM Act	*Water Management Act*
ZTV	Zone of Theoretical Visibility

Executive Summary

Introduction

This Environmental Impact Statement (EIS) has been prepared for CWP Solar Pty Ltd (CWP Solar) on behalf of Sapphire Solar Farm Pty Ltd to support a Development Application to build and operate a utility-scale photovoltaic solar farm with battery storage at Kings Plains, within the Inverell Shire Local Government Area 30 km east of Inverell in northern NSW.

CWP Solar are a long-established renewable energy developer, owner and asset manager. The company has over two decades of renewable energy development experience and offices in New South Wales, Queensland, South Australia and the Australian Capital Territory, with key development activities coordinated from the NSW base in Newcastle.

The Proposal

Fully constructed, the Sapphire Solar Farm (SSF, the 'Proposed Development') is currently expected to have an electricity generation capacity of approximately 180 megawatts (MW_{AC}) at the point of connection, producing enough energy (370 GWh) to power the equivalent of 66,000 average NSW households each year. The addition of battery-based storage (c.100 MWh) will allow for the Proposed Development, along with the Sapphire Wind Farm (SWF), to dispatch scheduled and reliable renewable energy generated power to the National Electricity Market (NEM).

The electricity generated and dispatched by the Proposed Development would result in significant carbon savings due to the electricity displaced from the current NSW generation supply, which is heavily reliant on coal powered generation. Based on current NSW emission figures of 0.87 kg of CO_2-equivilent per kWh, up to 330,000 tonnes of CO_2 would be displaced by the Proposed Development annually.

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

- Solar arrays: solar panels supported by a mounting system[1] installed on piles driven, screwed into, drilled and concreted or ballasted the ground;
- Lithium-ion battery-based power storage facilities;
- Power Conversion Units (PCU's) inclusive of Inverters/Rectifiers, Ring Main Units, LV/MV step-up Transformers located throughout the Proposed Development;
- Collector systems: above and/or below ground onsite cabling and electrical connections between the existing SWF substation (the 'Substation') and the respective PCU's;

[1] The mounting system will either be fixed-tilt or a single axis tracker (SAT) or a combination of both. Fixed tilt systems hold the modules in a fixed orientation in relation to the sun and have no moving parts. A SAT system tracks the daily movement of the sun and motorised linkages rotate the modules from the east in the morning to the west in the afternoon, constantly aligning towards the sun to maximise energy output performance. The modules are laid out in rows, typically referred to as arrays, approximately 4 to 7 m apart depending on the technology used. The choice of fixed-tilt or SAT will determine the arrangement of the racking system: east-west (fixed-tilt) or north-south (SAT). The racking system will be supported by steel piles, typically comprised of hollow section or I-section component which are driven into the ground or otherwise placed in bored holes and concreted in place.

- Operation and maintenance (O&M) building including workshop, warehouse, offices, ablutions, and carpark;
- Site access and onsite access tracks;
- Fencing and security system;
- Meteorological stations;
- Vegetation buffers (if required) for visual screening; and
- Firebreaks.

In addition to the key components outlined above, there would be a temporary construction compound required to facilitate the construction and decommissioning phases of the Proposed Development. In order to minimise environmental impacts, the SSF temporary construction compound is proposed to be located within the temporary construction compound currently in use for construction of SWF.

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

It is anticipated that the Proposed Development would take up to 18 months to construct and would be operational over an initial term for approximately 25 years. It is anticipated that the Proposed Development could extend for a further term depending on market and commercial circumstances.

It is expected that upgrading or repowering of the PV modules and ancillary equipment may be required throughout, or to extend, the operational life of the project. This will be a commercial decision made at the time based on the relative economics of solar PV generation and battery-based storage compared to alternatives. Decommissioning and restoration would occur at the end of the operational life of the Proposed Development. As such, planning consent for the Proposed Development is sought for 55 years to cover two full terms of operation and associated construction, upgrading and decommissioning periods.

Statutory position

The Proposed Development has a capital investment value estimated to be approximately $280 million, and is classified as State Significant Development under Clause 8 and Schedule 1 of the *State Environmental Planning Policy (State and Regional Development) 2011*.

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

The NSW Minister for Planning is the consent authority for State Significant Development applications. This Environmental Impact Statement has been prepared in accordance with the requirements of Division 4.1 of the *Environmental Planning & Assessment Act 1979*, Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* and the Secretary's Environmental Assessment Requirements 10th January 2018

replacing those dated 23rd August 2017 to incorporate the Commonwealth Environment Minister's assessment requirements under the bilateral agreement).

During the preparation of the EIS according to the SEARs, it was identified that approval was likely required from the Australian Government Environment Minister due to impact significance on MNES, and the Proposed Development was referred to the Minister for consideration. The Minister determined the action as a Controlled Action (i.e. that approval was required under the EPBC Act) on 5th January 2018 (Appendix A). The Bilateral Agreement under section 45 of the EP&A Act, between the Commonwealth and NSW Governments mandates that where an action is determined as a Controlled Action, the assessment responsibilities are vested in the NSW Major Projects assessment process with the provision of Commonwealth Assessment Requirements by the Commonwealth DotEE to the NSW DP&E. Those assessment requirements were provided to the NSW DP&E who incorporated them into revised SEARs which were issued on 10th January 2018.

Consultation

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

Activities that have taken place are listed below:

- Identification and consultation (ongoing) with host landholders and neighbouring residents;
- Local public information sessions at Kings Plains fire shed;
- Consultation with the Sapphire Wind Farm Community Consultative Committee;
- Consultation with the Aboriginal community through the preparation of a Cultural Heritage Assessment;
- Consultation with Mining Lease holders;
- Local Government consultation;
- State Government consultation;
- Website information (www.cwprenewables.com.au); and
- Media coverage at the local and regional scale.

Consultation activities remain ongoing at the time of preparing this Environmental Impact Statement.

Environmental Assessment

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

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

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

Biodiversity

As State Significant Development, the impacts of the Proposed Development on biodiversity must be assessed under the Framework for Biodiversity Assessment. As a Controlled Action under the EPBC Act, the project will be assessed in accordance with the manner specified in Schedule 1 of the NSW Assessment Bilateral Agreement 2015. Accordingly, a Biodiversity Assessment Report and a Biodiversity Offset Strategy have been prepared to assess the impacts to biodiversity, propose mitigating and ameliorating options, calculate offsets for unavoidable impacts, and identify a strategy which if implemented would offset any unavoidable impacts.

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

- Co-locates services, access, infrastructure, and construction facilities with existing disturbance areas of the SWF;
- Locates panel arrays within areas of cultivation;
- Provides for a facility that compliments the existing SWF development; and
- Avoids drainage lines, high quality vegetation, and known threatened species records.

The Site is currently used for agricultural purposes as well as a wind farm, and has been substantially cultivated. 76% of the development site is considered cleared land, with only 7% of the development site occupied by poor condition woodland vegetation.

There are native remnant trees throughout the development within pasture improved and cultivated paddocks. There are three plant community types (PCTs) that occur within the development site which are represented by three biometric vegetation types as described:

- PCT510: Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion
- PCT921: Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tableland Bioregion and NSW North Coast Bioregion
- PCT1383: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion.

Based on the likelihood of occurrence of each species, the following candidate species were selected for further assessment: *Thesium australe*, *Dichanthium setosum*, Koala, Pale-headed Snake, and Regent Honeyeater. Other species such as *Picris evae* (Hawkweed) and *Polygala linariifolia* (Native Milkwort) were also considered during surveys given local records of each species. A number of small and discrete populations

of *D. setosum* was identified within the SSF Development Footprint, however, potential impacts to *D. setosum* will be avoided through detailed design process.

Avoidance measures to minimise impacts to biodiversity have been proposed, including siting of the project, alternative options, as well as methodologies to minimise impacts during construction and operation of the project. Following consideration of minimisation methods, the residual unavoidable impacts of the project were calculated in accordance with the Framework for Biodiversity Assessment by using the BioBanking Credit Calculator.

A total of 662 ecosystem credits are required to offset the unavoidable impacts of the project. This included 73 BR240 credits, 170 BR272 credits, and 419 BR153 credits. No species credits are required at this stage, as threatened species have not been detected on site.

A Biodiversity Offset Strategy (BOS) to achieve the offset requirement has been proposed, as part of applying the Framework for Biodiversity Assessment. The BOS will seek to acquire, and retire the full quantum of credits as required by the BBCC.

Heritage

The process of Aboriginal community consultation has been undertaken in accordance the NSW Office of Environment and Heritage's *Aboriginal cultural heritage consultation requirements for proponents*. The study has sought to identify and record Aboriginal cultural areas, objects or places, assess the archaeological potential of the Site and formulate management recommendations based on the results of the community consultation, background research, field survey and a significance assessment.

A search of the NSW Office of Environment and Heritage's Aboriginal Heritage Management Information System (AHIMS) was conducted for on 8 September 2017, yielding twenty seven Aboriginal sites for a broad search area that included the Site. A field assessment was conducted on 6, 7, 8 and 9 November 2017. The Site was found to contain 14 discrete distributions of stone artefacts, as well as a scar tree.

The artefacts are highly valued by Aboriginal people given its symbolic embodiment and physical relationship with their ancestral past. The archaeological significance of the recorded Aboriginal artefacts in the project area are of low local significance for the stone artefacts and potentially moderate significance for the scarred tree (status as an Aboriginal scarred tree not confirmed).

Potential direct impacts as a result of the Proposed Development could lead to the total loss of six artefacts. Wherever possible, avoidance should be the primary management option, but if avoidance is not feasible, agreed measures shall be taken to mitigate against impacts to Aboriginal items.

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

Database searches identified three registered heritage items all located more than 5 km from the Proposed Development, these are:

- Kings Plains Private Cemetery;
- Kings Plains Castle; and
- Presbyterian Church at Wellingrove.

Proposed Development will not have any direct or indirect impacts on known historic heritage items. It is unlikely any items of historic significance remain unidentified within the Site, however, an unexpected archaeological finds procedure will be adopted and included in site induction processes.

Land

The Site is located within an undulating landscape, where elevation ranges between 810 - 1000 m Australian Height Datum (AHD). The Site has been historically cleared and grazed for sheep and cattle production and is typical of farmland in the region. A number of stock dams have been developed across the Site. A considerable portion of the Site has been cultivated for improved pasture and other fodder crops (these areas are prioritised for the solar farm development). Surrounding land uses include agriculture, sapphire exploration and mining, and wind farm operations.

Two Mining Lease (ML) and two Exploration Licence (EL) areas exist within the Site. ML1687, ML1374 and EL8536 are held by Eastern Feeder Holdings Pty Ltd, and EL8230 by Bond Resources Pty Ltd. Consultation with Eastern Feeder Holdings Pty Ltd has resulted in agreement for SSF to progress with the proposal within ML1687, ML1374 and EL8536. To facilitate ongoing activities in the area by Eastern Feeder Holdings Pty Ltd, Coordination Deeds between the parties are in the process of being drafted. Consultation with Bond Resources Pty Ltd has confirmed their acceptance of SSF insofar as it impacts upon EL8230.

The Site contains land suitable for grazing and cultivation, and 527 ha is mapped as Biophysical Strategic Agricultural Land (BSAL). BSAL is mapped throughout the north-eastern and the north-western solar array areas. No critical industry clusters have been mapped in the region.

The Proposed Development would have a life span of up to 55 years and would not involve permanent changes to the landscape. The scale of the Proposed Development would not compromise or significantly diminish the availability of land for primary production purposes within the Local Government Area. Furthermore, the Proposed Development would not compromise the capacity for immediate neighbours to conduct existing or proposed primary production.

This EIS identifies a series of environmental controls and measures to ensure that land resources are protected from adverse impacts. Once the Proposed Development is decommissioned, the land would be returned to a suitable state to permit a return to agricultural use.

Visual

Landforms within the Site consists of undulating hills with relatively low to medium gradients. The landscape grades gently from hillsides with granite outcroppings, to alluvial basins with moderately fertile soils. The valleys are broad and there are no cliffs, escarpments, or gorges within the Site, though some hillsides are relatively steep. Land within the Site and wider landholding has been historically cleared for grazing purposes

and much has been sown with improved pastures. There are patches of retained native woodland scattered throughout.

The Proposed Development has a relatively confined area of visibility due to topography and areas of remaining woody vegetation. The Site is generally most visible from elevated areas to the north east and to the west of the Proposed Development area. Views from these locations are generally buffered by distance and vegetation. The Proposed Development site has approximately 3 km of direct road frontage to Waterloo Road and the Western Feeder Road. Topography and vegetation in adjoining public areas naturally obscures potential views of the development site. Distant views and glimpses of the site are possible from Waterloo Road, Western Feeder Road, Eastern Feeder Road, Woodstock Road and Kings Plains Road.

Spatial analysis indicates that the Proposed Development is visible to six non-associated residences located within 2 km from the Proposed Development site, and a further 11 non-associated residences located between 2 and 5 km. Public viewpoints within 5 km of the Proposed Development area are restricted to public roads.

There are currently three commercial scale PV solar farms, in differing stages of development, proposed for the New England Renewable Energy Precinct, approximately 10 km from the proposed PV array areas identified for the Proposed Development. Based on topography and separation distances it is anticipated that there is limited potential for significant views of the Proposed Development and any other solar farm development.

Wind turbines will be visible from most locations assessed as part of this EIS. However, wind turbines possess a very different visual presence to PV solar arrays and it is anticipated that these disparities in visual characteristics and setting will help to mitigate the potential for cumulative impacts involving the Proposed Development and nearby wind turbine generators, including SWF.

Mitigation measures, including ongoing stakeholder consultation and potential landscaping strategies have been developed, where necessary, to provide low or insignificant visual impacts at all identified receptors.

Noise

The Proposed Development is located within a rural landscape and despite current construction activities associated with Sapphire Wind Farm, background noise sources and levels are considered to be typical of the rural setting. Two non-associated residences are located within 2 km of the Proposed Development site.

Acoustic modelling indicates that construction noise is attenuated within 2 km of construction activities, and that the highly noise impacted threshold of 75 db(A) is not exceeded at any residences.

Predicted operational noise levels indicate that noise generated from operational activities to non-associated residences are considered negligible, with only the worst-case assessment of upgrading and repowering potentially impacting a single non-associated residence.

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

Transport

The Proposed Development is located north of the Gwydir Highway (B76) approximately halfway between Glen Innes and Inverell. General site access is from the Gwydir Highway via Woodstock Road and/or Waterloo Road, or via Kings Plains Road via Western Feeder Road. Immediate access to site via Waterloo Road and/or the Western Feeder Road. All intersections within the vicinity of the Site are priority controlled. The intersection between the Gwydir Highway and Waterloo Road has been upgraded to accommodate over-dimensional equipment associated with the construction of SWF, and it is not expected that further upgrades would be required for the Proposed Development.

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

Construction and operational access for staff and material deliveries to the Site shall be from the Gwydir Highway via Waterloo Road or Woodstock Road. Over-dimensional loads shall access the Site via Waterloo Road only. Material deliveries will depend on day to day operational requirements. Heavy vehicles into the site are estimated to be up to 30 vehicles per day during construction activities (12-18 months). Overall construction traffic movements during will be up to 100 light vehicles and 30 heavy vehicles daily. It is expected that two construction personnel would share a single light vehicle, however car-pooling and use of buses will further reduce these daily movements. Additional vehicle movements associated with the operational phase (up to 10 vehicles per day) are considered negligible. Construction phases of SWF and SSF shall not overlap.

Water

The Proposed Development is located within the upper tributaries of the Macintyre River, part of the Border Rivers Catchment. The Proposed Development occurs in the area covered by the *Water Sharing Plan for the NSW Border Rivers Unregulated and Alluvial Water Sources*. The majority of the site is located within the Kings Plains Surface Water Source, with a small southern portion falling within the Inverell Surface Water Source.

Most waterways in the Site are ephemeral and were dry during field investigations. In general, ephemeral streams within the Site lack aquatic vegetation and are dominated by terrestrial grasses. In some areas, extensive erosion has deepened the channel and left large parts of the bed and bank as bare soil. Pools persist in some higher order streams (i.e. 3rd order and above), and these pools become larger and more permanent downstream of the Proposed Development boundary.

Permanent water within the Proposed Development boundary is dominated by artificially deepened holes along the watercourses, or farm dams. Riparian vegetation and the riparian zone generally throughout the study area are degraded, having been cleared, grazed, sown and modified to support agricultural and sapphire mining activities. Habitat within the Site is generally unsuitable for threatened aquatic species.

Groundwater levels within the fractured rock aquifer are generally shallow across the Proposed Development area, and range from approximately 3.5 metres and 15.5 metres below ground level.

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

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

- Exclusion of 3rd order streams from the Development Footprint (except one internal access crossing of Kings Plains Creek);
- Application of a minimum 20 m (from stream centreline) buffer zone for 3rd order and higher riparian zones;
- Avoidance of footings and pilings, where practicable, within 1st and 2nd drainage lines;
- Minimisation of creek crossings for internal access and electrical cabling;
- Sourcing of non-potable water from onsite dams and existing licenced water sources; and
- Sourcing from offsite all potable water requirements.

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

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

Hazards and Risks

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

The Proposed Development incorporates a lithium-ion battery-based storage facility which would enable electricity generated by the SSF (and the SWF) to be stored for later dispatch to the National Energy Market NEM grid. A preliminary hazard assessment and risk prioritisation considered lithium-ion batteries, and found that not-insignificant but low level hazards related to the battery system included electrocution, crushing and toxicity, whilst the medium level hazards included fire and explosion.

Potential fire risk associated with the Proposed Development would include:

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

- Lightning strikes.

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

- Design principles;
- Battery Storage Facilities;
- Access and Firebreaks;
- Fuel reduction;
- Emergency Response Plan; and
- Safety protocols.

Existing potential sources of electromagnetic interference within the vicinity of the Site include a double-circuit TransGrid 330 kV transmission line, a TransGrid 330 kV substation, Essential Energy 11 kV distribution lines and SWF internal underground and overhead (up to) 33 kV electric cabling and associated wind turbine generators.

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

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

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

Waste

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

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

1. Reduce waste production;

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

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

Socio-Economic

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

Electricity produced from the Site provides a clean power source for local and regional consumers in a cost-effective manner. The Proposed Development would produce approximately 390 GWh of clean renewable energy to the local electricity transmission network, providing enough energy to power up to 78,000 average NSW homes each year. Moreover, the addition of battery-based storage will allow the dispatch of scheduled and reliable renewable energy generated power to the National Electricity Market the NEM. This would reduce up to 340,000 tonnes of CO_2 per annum through the displacement of conventional electricity supply.

SSF would have an overall positive impact on the local and wider economy during the construction period. Construction will take up to 18 months and up to 200 staff will be required. The construction and decommissioning stages of the Proposed Development will generate the largest economic gain for the greatest number of people and businesses in adjoining Local Government Areas. This is due to the hiring of a large temporary work force over these periods. Employment opportunities would involve concreting, earthworks, steel works and electrical cabling during construction, with demolition and removal during decommissioning.

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

There would be a reduction in farming related income on those areas of the Proposal Site within the Development Footprint, although income generated from the lease arrangements during this time would offset these losses.

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

Cumulative Impacts

The Proposed Development is co-located with the SWF and is situated within the New England Renewable Energy Precinct. Other renewable energy projects within the precinct include:

- Glen Innes Wind Farm – approved;
- White Rock Wind Farm – operational;
- White Rock Solar Farm – under construction; and
- Sundown Solar Farm – SEARs issued, EIS under preparation.

The close proximity of multiple construction and/or operational projects provides opportunity for potential cumulative impacts. Key mitigating factors for cumulative impacts are:

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

To minimise potential for cumulative impacts, construction phases of SWF and SSF shall not overlap.

Traffic assessment indicates shared access arrangements between SWF and SSF. These access routes have been upgraded to accommodate the construction requirements of SWF and shall be maintained for the duration of SSF construction. Daily traffic flows recorded on Gwydir Highway are relatively low and well within the capacity of the road leaving ample spare capacity to accommodate additional traffic associated with regional projects.

It is anticipated that disparities in visual characteristics and settings between wind farm infrastructure and solar farm infrastructure will help to mitigate the potential for cumulative impacts involving the Proposed Development and nearby wind turbine generators. Based on topography and separation distances, it is anticipated that there is limited potential for significant views of the Proposed Development and any other solar farm development. Travellers on the Gwydir Highway may catch distant glimpses of each solar farm as they travel between Inverell and Glen Innes, however, these views will be of only one solar farm at any given time and of short duration.

Environmental Management

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

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

- Relevant legislation;
- Conditions of consent; and

- Commitments provided in this Environmental Impact Statement.

Project Justification

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

Conclusion

Environmental impacts associated the construction, operation and decommissioning of the Proposed Development are compliant with the requirements for State Significant Development under the *Environmental Planning & Assessment Act 1979* and other relevant State and Commonwealth legislation. Potential environmental impacts are minor and can be appropriately managed through the application of identified mitigation strategies and ongoing stakeholder consultation.

1 Introduction

1.1 Purpose of this document

This Environmental Impact Statement (EIS) has been prepared on behalf of Sapphire Solar Farm Pty Ltd (the 'Proponent') to support a Development Application (DA) to build and operate a utility-scale photovoltaic (PV) solar farm and battery-based storage at Kings Plains, within the Inverell Shire Local Government Area (LGA) 30 km east of Inverell in northern NSW, the Sapphire Solar Farm (SSF). The proposal is expected to have an electricity generation capacity of approximately 180 megawatts (MW_{AC}), producing enough energy to power the equivalent of 66,000 average NSW households each year.

Additionally, the proposed battery-based storage (c.100 MWh) will allow SSF (the 'Proposed Development'), along with the Sapphire Wind Farm (SWF), to dispatch scheduled and reliable renewable energy generated power to the National Electricity Market (NEM).

Under the *State Environmental Planning Policy (State and Regional Development) 2011*, electricity generating works (including solar) that have a capital investment value of more than $30 million are classified as "State Significant Development" (SSD) and require approval under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) through the preparation of an EIS. The Proposed Development has an estimated capital value of c. $280 million.

As such, this EIS has been prepared under Part 4 of the EP&A Act, in accordance with the Secretary's Environmental Assessment Requirements (SEARs), dated 23rd August 2017, and the requirements of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation).

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Matters of National Environmental Significance (MNES) are protected. The Framework for Biodiversity Assessment requires proponents to identify and assess the impacts on all nationally listed threatened species and threatened ecological communities that may be on the development site. Other MNES' are considered elsewhere in Section 5.2.

1.2 Project Overview

SSF would generate electricity through the conversion of solar radiation to electricity using PV panels laid out across the Site in a series of modules, mounted on steel racks with piled, screwed or ballasted supports. Other infrastructure on site would include battery-based storage facilities, electrical power conversion units, underground and/or above ground electrical cabling, telecommunications equipment, amenities and storage facilities, vehicular access and parking areas, along with security fencing and gates.

SSF will connect to the TransGrid Substation that was constructed to connect SWF to the electricity network. While SSF could operate as a stand-alone generator/battery-based storage facility, it is proposed that the project may operate in parallel with SWF project to provide firm, dispatchable electricity to the NEM. The connection configuration considered within this EIS accommodates for both scenarios, which will allow the

battery-based storage facility within SSF to be available to charge from SSF, SWF and/or the NEM, and to discharge all its stored electricity to the NEM.

1.3 Project Setting

The Proposed Development is located on land within the Inverell Shire Local Government Area (LGA) 30 km east of Inverell in northern NSW, some of which includes the same parcels as the SWF project. General access to the proposal site (the 'Site') is from either the Gwydir Highway or Kings Plains Road with immediate access to the study area via Waterloo and Western Feeder roads.

The Site comprises cleared agricultural land used for grazing and/or cultivation, with some portions having previously been subject to open-cut sapphire mining and quarrying. Land agreements have been negotiated with all of the five host landowners. Post operational activities, the Site will be decommissioned and returned to a suitable condition to allow the resumption of agricultural activities.

The existence and proximity of SWF provides the opportunity to co-locate certain facilities and share the same point of connection to the TransGrid 330 kV network through the SWF substation (the 'Substation'). This connection option will minimise the overall impact of the development while maximising the use of an existing connection asset.

Surrounding land is primarily agricultural in use, with associated dwellings comprising a mix of involved and non-involved residences, totalling eight within a 2 km radius of the study area. Of note, all eight residences are associated with SWF, either through a host or neighbour agreement with SWF, with three (R15, R17 and R19) not associated (non-involved) with SSF. Consultation with all eight owners for the purposes of the Proposed Development has been ongoing from inception of the proposed solar development. Where appropriate, visual screening and/or agreements with affected non-involved residents has been considered and is addressed within Sections 7.6.

Two Mining Lease (ML) and two Exploration Licence (EL) areas exist within the Site. ML1687, ML1374 and EL8536 are held by Eastern Feeder Holdings Pty Ltd, and EL8230 by Bond Resources Pty Ltd. Consultation with Eastern Feeder Holdings Pty Ltd has resulted in agreement for SSF to progress with the proposal within ML1687, ML1374 and EL8536. To facilitate ongoing activities in the area by Eastern Feeder Holdings Pty Ltd, Coordination Deeds between the parties are in the process of being drafted. Consultation with Bond Resources Pty Ltd has confirmed their acceptance of SSF insofar as it impacts upon EL8230.

1.4 The Proponent

CWP are a long-established renewable energy developer, owner and asset manager. The company has over two decades of renewable energy development experience and offices in New South Wales (NSW), Queensland, South Australia and the Australian Capital Territory, with key development activities coordinated from the NSW base in Newcastle.

Wind farm development has been the focus of the company over the past decade, and within Australia this has resulted in over 380 megawatts (MW) of greenfield projects having been developed, financed and either

under construction or in full operation since 2013. This includes the award-winning 113 MW Boco Rock wind farm development south of Cooma, NSW, and 270 MW SWF, currently the largest in size and capacity in NSW.

CWP is now applying this knowledge, awareness and expertise in site selection, development and delivery to solar farm development. The cost of utility-scale solar has fallen dramatically over recent years to a point where it is now, alongside wind energy, competitive with traditional fuel sources. Many of the attributes that have driven CWP's success in the wind energy space are transferrable to solar development, most notably CWP's commitment to staying with a project from inception through to full operation. This philosophy ensures genuine levels of engagement from the team with all stakeholders, but particularly the local community, at every stage of the development.

2 Alternatives considered

2.1 Do Nothing Scenario

Under the Do-Nothing Scenario the Proposed Development would not take place and the benefits resulting from the opportunity to generate additional and scheduled renewable energy, as well as the local socioeconomic benefits resulting from the Proposed Development, would be forgone.

2.2 Alternative Locations

This is a unique circumstance where the consideration of alternative locations is marginalised by the opportunity to co-locate a solar and battery project with a wind farm and connection asset, already consented and under construction, to establish the New England / Sapphire Renewable Energy Hub.

Decisions around alternatives will be made during detailed design with a view to minimising environmental and social impacts while maintaining the investment viability, however these will occur at the micro scale rather than macro, site selection, level.

Nonetheless, CWP is developing other renewable projects throughout NSW which may be considered as alternatives to SSF; though owing to the need for new renewable energy developments it is expected that these will be additive rather than alternative projects.

2.3 Project Design Principles

While a solar PV project can occupy a large area of land, the on-ground impacts upon that land are relatively minor by comparison. The vast majority of the land which is utilised for a solar PV project will only be subject to a temporary impact that is easily restored to its previous agricultural use at the end of construction and then, for the balance of the land, at the end of the operational life of the Proposed Development. This is illustrated through the Table 2-1 below.

2.4 Permanent Impacts

A typical 5 MW_{AC} rectangular block of modules on a single-axis tracking (SAT) system would occupy an area of approximately 11 ha. Within this area the following materials would typically be installed:

Table 2-1: Permanent Impacts

Item	Quantity	Notes	Permanent on-ground impact (ha)
Tracker row	196	*(Above ground)*	*n/a*
5 MW_{AC} PCU	1	12 m x 2.4 m (40 ft shipping container)	0.003
Access track	290 m	4 m wide	0.116
PV module	16,464	*(Above ground)*	*n/a*
Tracker DC cable	196	*(Above ground)*	*n/a*
Combiner box	26	*(Above ground)*	*n/a*
MV trench to Substation	290	4 m wide	0.116

Item	Quantity	Notes	Permanent on-ground impact (ha)
Motors	196	*(Above ground)*	*n/a*
Piers	2,352	Includes 196 motor piers and 2,156 standard piers (0.25m^2 pier)	0.015
Total Area			0.25 ha

The materials list above shows that of the 11 ha of land used to install 5 MW_{AC} of solar PV, only 0.25 ha or 2.3 % of the total land area would be permanently impacted over the life of the project.

Design considerations made throughout this EIS will refine this example 5 MW_{AC} estimation to project-specific circumstances, and moreover include other associated permanent impacts such as the operations facility building and battery-based storage facilities. Minor augmentation to the Substation is required to accommodate a new switch room and associated connection arrangement which will occur within the existing enclosed substation compound.

2.5 Temporary Impacts

Temporary impacts which will occur through construction include the stripping and storage of top-soil for construction of roads and trenches, laydown areas for components adjacent to each work front, and the construction compound and amenities buildings facility. Note, the construction compound and amenities buildings facility currently used for the construction of SWF is proposed to be used for SSF.

2.6 Agricultural Use

Post construction, it is proposed that the balance of land would continue to be used for agricultural purposes such as sheep grazing (Figure 2-1), resulting in only a minor net change to the existing land-use.

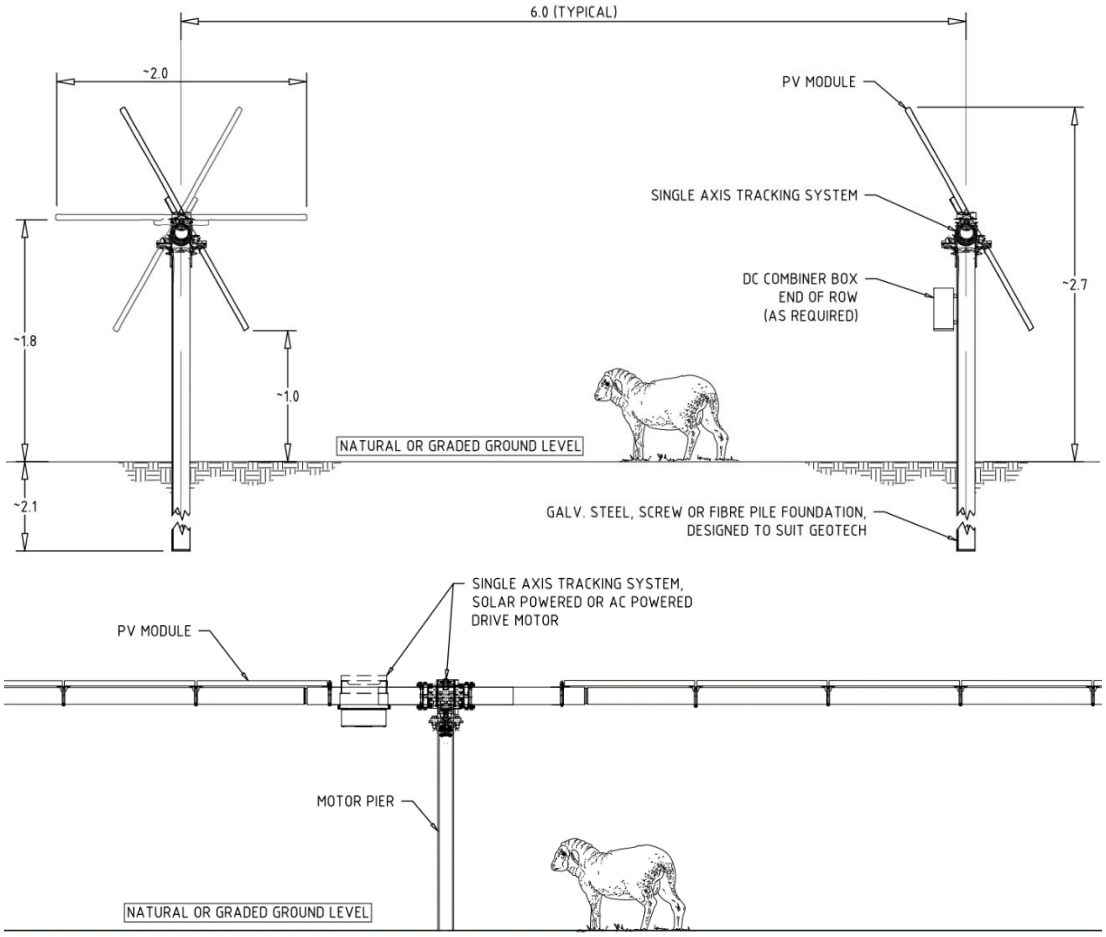

Figure 2-1: Generic Tracking System Single Axis Tracker Elevation View showing approximate dimensions (Images courtesy of Zenviron)

2.7 Site Selection

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

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

In addition, the following specific principles were adopted:

- Minimise vegetation clearing – areas of high conservation value and/or native vegetation shall be strategically avoided;

- Minimise land disturbance – solar arrays shall be attached using piles either driven, screwed or ballasted to the ground. Ground disturbance shall be limited to the area of contact between the pile and the ground. Design footprints for tracks, cable trenches, support buildings, and the Substation shall be limited further to the minimum area required;
- Protect riparian zones – defined 3rd order (Strahler) and higher riparian zones shall be excluded from the developable area;
- Use previously disturbed land – as much as possible the Proposed Development shall be located on previously cultivated and cropped land;
- Protect cultural heritage values – through the identification and evaluation of cultural heritage assets at the site;
- Protect agricultural values – existing agricultural values shall be preserved, and a negotiated lease shall offset forgone landholder income while diversifying income streams for the duration of the project life;
- Minimise direct and indirect impacts – as far as practicable, infrastructure shall be located away from nearby residences and adjoining properties; and
- Adopt a flexible approach to design – the final project design shall respond to identified environmental impacts and constraints.

2.8 Design Evolution and Constraints

From the outset, the project has adopted a methodology to, in the first instance, avoid possible environmental impacts. This design ethic is central to the current proposal and has been adopted at all stages of design. The evolution of the design is summarised below:

- Locality – the Kings Plains region was chosen as the Proposal Site based on the grid connection opportunity and strong stakeholder awareness and acceptance that compared it favourably with other potential locations in the region;
- Proposal Site – based on the opportunity to co-locate with the SWF, the selected properties were chosen as the preferred Proposal Site based on an early consultation with the local community, consideration of impacts on agricultural land and surrounding residences within the locality and high-level constraints analysis;
- The Site – within the Proposal Site an initial Option Area was defined with the landowners, with the intention of minimising agricultural and environmental impacts. This resulted in the adoption of the Proposal Study Area considered for the Preliminary Environmental Assessment (PEA);
- Preliminary Study Area – High-level constraints identified during the PEA and preliminary ecological surveys were used to inform a Refined Study Area within the wider Proposal Study Area. High level constraints included areas of Ecologically Endangered Community (EEC), continuous native vegetation and design/engineering considerations;
- Refined Study Area – the Proposal's footprint continued to evolve in response to environmental constraints until a definitive Development Footprint was identified;
- Infrastructure Footprint – the Development Footprint forms the basis of this environmental impact assessment. In accordance with the 'Avoid' principle of the design hierarchy noted above, it was refined downwards in size as a response to ecological constraints identified on the periphery of the footprint;
- Residual Constraints Layer – The assessment process identified a number of constraints that have also been considered in the design of the Proposed Development. The Residual Constraints Layer illustrates

constraints following mitigation and demarcates areas not subject to development within the Development Footprint. Additional site constraints adopted include:
  - Avoidance of development under or adjacent to overhead high voltage transmission lines; and
  - 20 m (from stream centreline) buffer zone surrounding 3rd order (Strahler) streams.
- Site Plan – the Residual Constraints Layer informs an Indicative Site Layout proposed in this EIS. The Residual Constraints Layer and Indicative Site Layout formed the basis for consultation with neighbours and the local community;
- Detailed Design – the modular nature of PV solar farms provides scope for further impact avoidance during the Detailed Design stage which will follow project approval and the tendering process. Where practicable infrastructure will be located/positioned to avoid unnecessary physical impacts to:
  - Scattered Aboriginal artefacts;
  - Scattered native vegetation; and
  - 1st and 2nd order streams.
- Mitigation – mitigation strategies identified within this EIS shall be applied to residual impacts that remain following the application of the above impact avoidance strategies.

The evolution of the project footprint is shown in Figure 2-2 and summarised in Table 2-2 below. Residual Constraints and subsequent Developable Land are shown in Figure 2-3. Following this process provided a final Development Site Plan (Figure 2-4).

Table 2-2: Project footprint evolution

Footprint	Area (Ha)	Comments	Map
Proposal Site	8,755	Kings Plains was initially chosen as the preferred location for the Proposed Development and battery-based storage facilities due to the opportunity to co-locate the development with the approved SWF.	Figure 2-2
The Site	2,423	The Proposal Study Area reflected initial site inspections and landholder negotiations. The PEA was developed based on the study area. At this stage, the project was for a solar farm and battery-based storage facilities generating up to 200 MW_{AC}.	
Preliminary Study Area	503	The Refined Study Area responded to site constraints identified in PEA and initial ecological surveys, removing areas of threatened ecological communities and continuous native vegetation. The EIS commenced at this proposal.	
Refined Study Area	459	The footprint was refined further to reduce the impact area, reflecting findings made during detailed environmental assessments.	
Infrastructure Footprint	445	The Development Site represents the final extent of this development application and was reduced further in size as a response to identified ecological constraints on the periphery of the Footprint.	
Constraints Layer	-	Identifies further constraints to concept design, as well as environmental impact mitigation commitments.	Figure 2-3
Site Plan	-	All mitigation strategies, infrastructure, construction and operational activities will be undertaken within the Site. A	Figure 2-4

Footprint	Area (Ha)	Comments	Map
		solar farm of approximately 180 MW_{AC} and battery-based storage facilities can be accommodated within this area.	

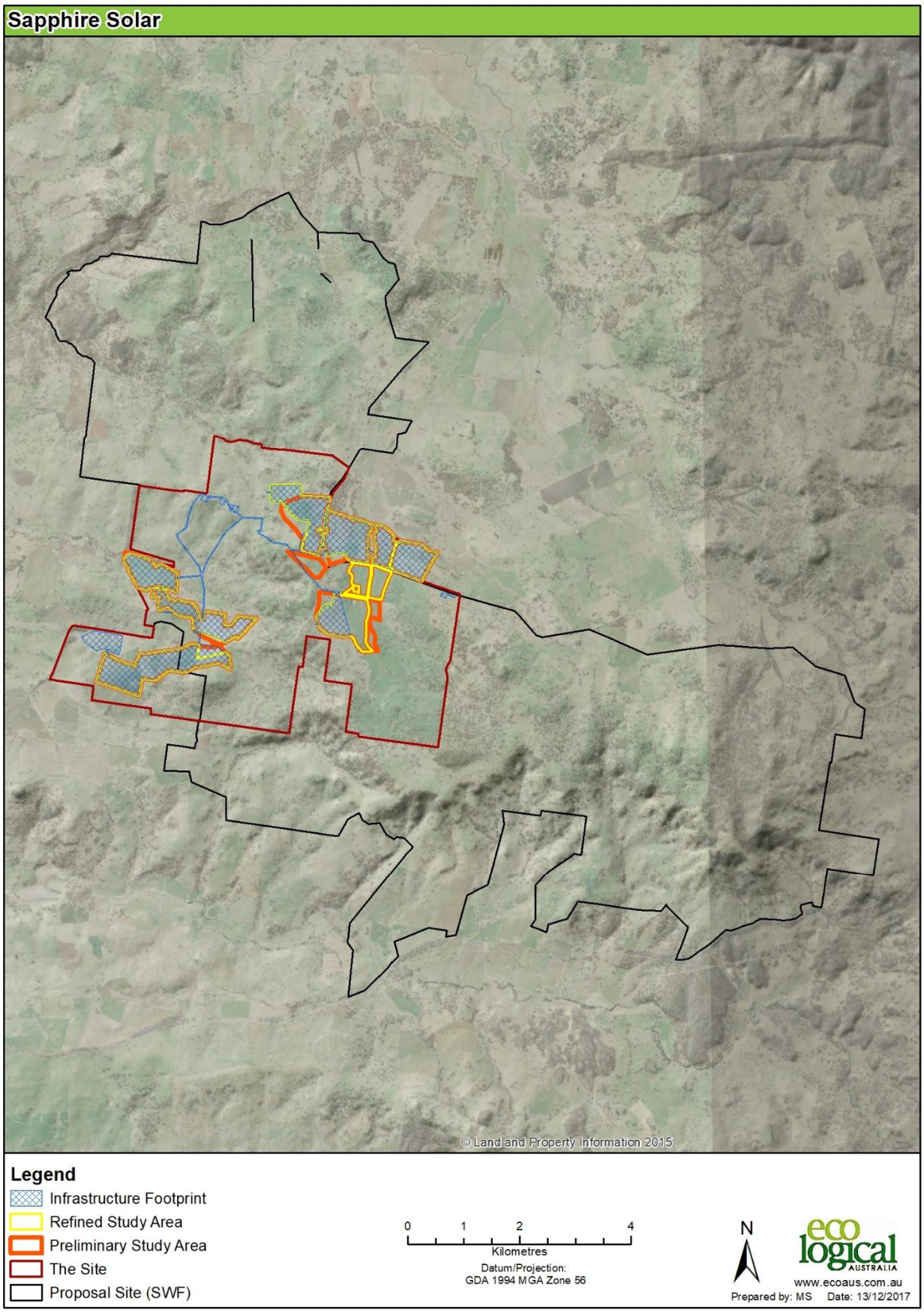

Figure 2-2: Evolution of the Site

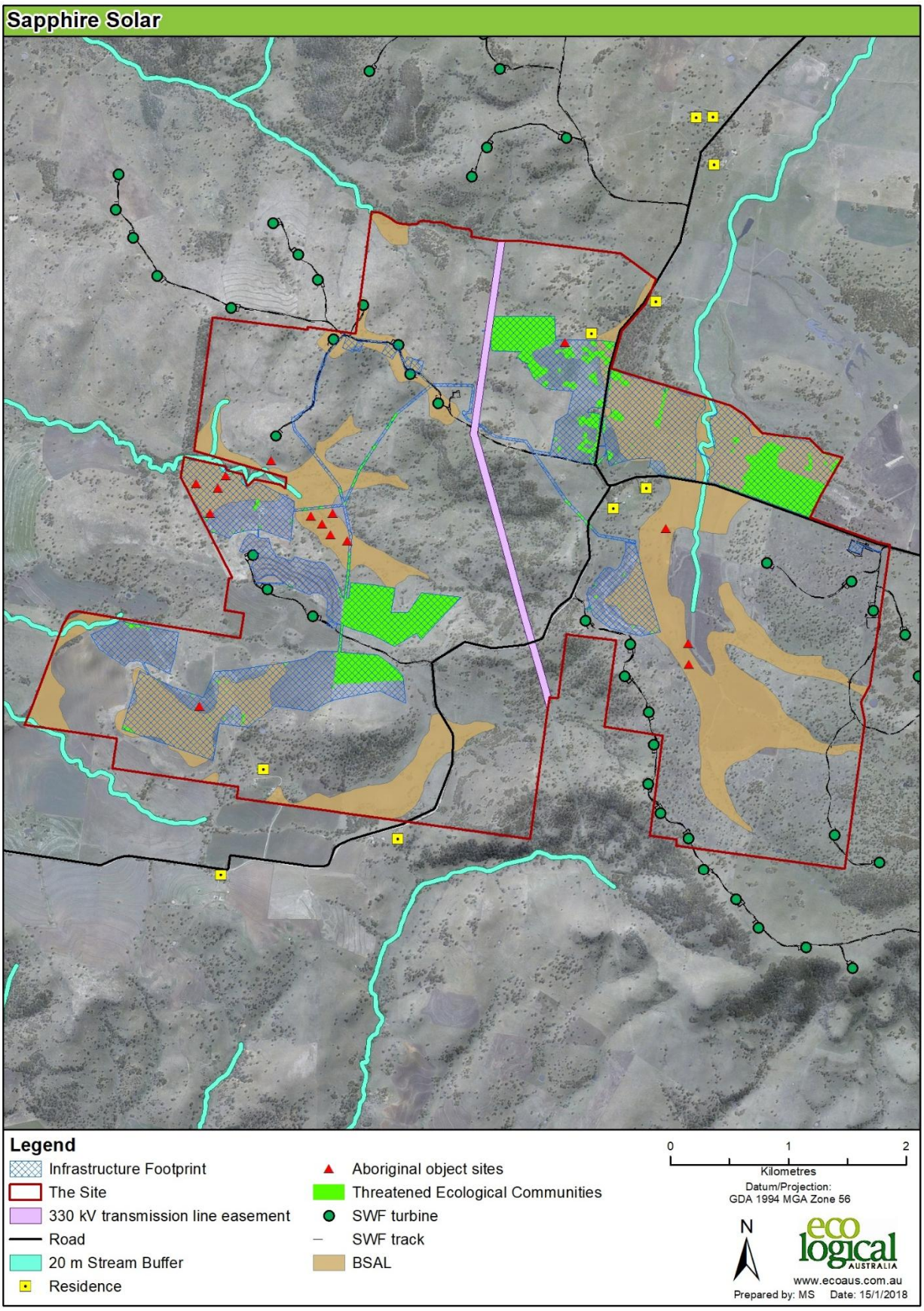

Figure 2-3: Constraints Layer

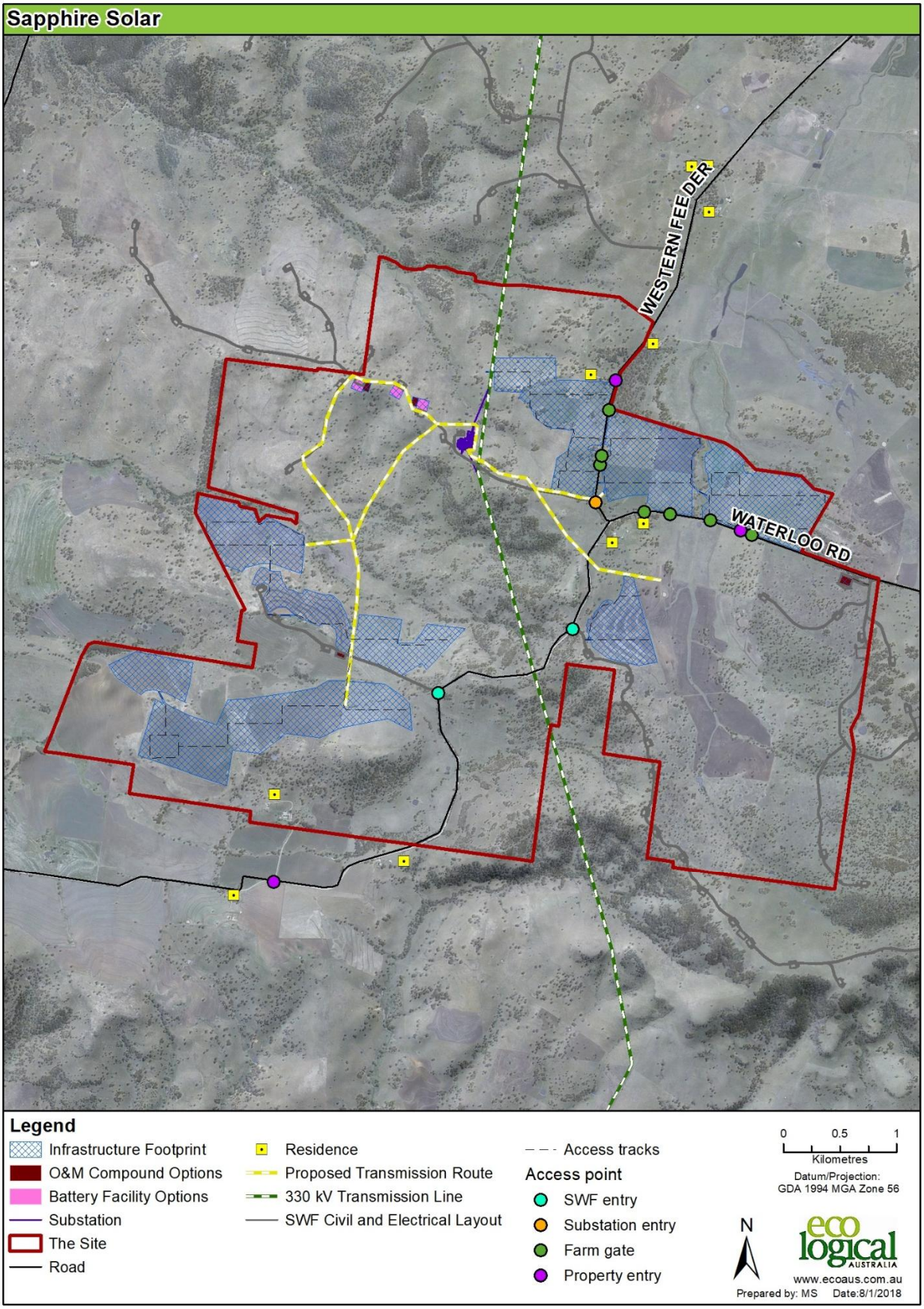

Figure 2-4: Sapphire Solar Farm Site Plan

3 The Proposal

3.1 Proposal Description

3.1.1 Site Description

The Proposed Development is a 180 MW_{AC} utility scale electricity generation works comprised of solar PV modules, steel racking and piled supports, battery-based storage facilities, electrical power conversion units, underground and/or above ground electrical cabling, telecommunications equipment, amenities and storage facilities, vehicular access and parking areas, along with security fencing and gates.

The Proposed Development is located on land within the Inverell Shire Local Government Area (LGA) 30 km east of Inverell in northern NSW, of which some includes the same parcels as the SWF project. General access to the Site is from either the Gwydir Highway or Kings Plains Road with immediate access to the study area via Woodstock Road, Waterloo Road, Western Feeder Road (Figure 3-1).

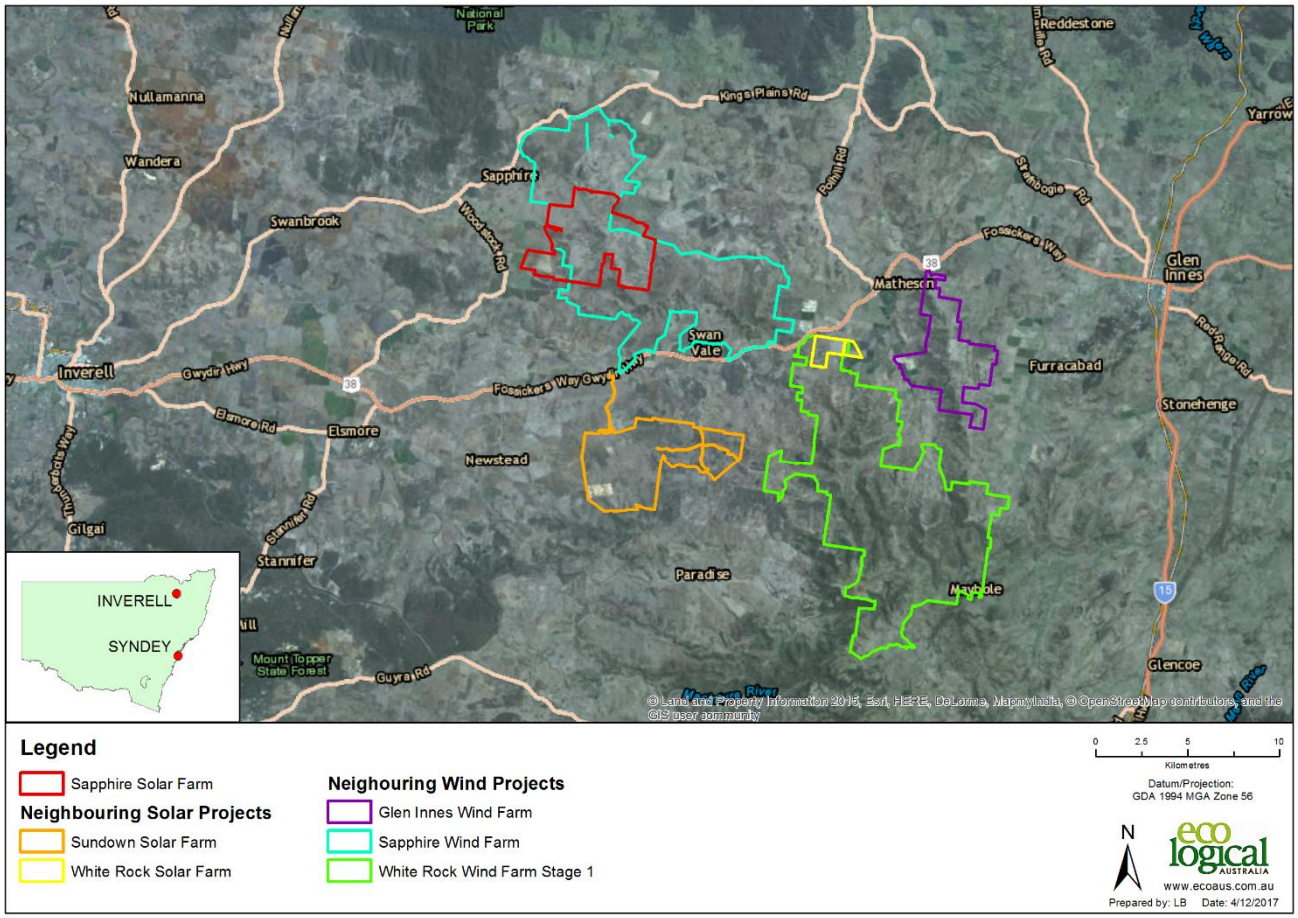

Figure 3-1: Local Context

The existence and proximity of SWF provides the opportunity to co-locate certain facilities and share the same point of connection to the TransGrid 330 kV network through the SWF substation. This connection option will minimise the overall impact of the Proposed Development, maximises the use of an existing connection asset

and is consistent with the proposal for a Renewable Energy Hub evaluated by TransGrid, the Australian Renewable Energy Agency (ARENA) and the NSW Government.

The Site is currently used for grazing and/or cultivation. Discrete areas within the site are mapped as Biophysical Strategic Agricultural Land (BSAL) and Bushfire Prone Land, with small areas of floodplain considered to be Flood Prone Land. Some portions have previously been subject to open-cut sapphire mining and quarrying. In these areas remediation activity to restore top soil over the mined areas has either concluded or is currently underway.

Surrounding land is primarily agricultural in use, with associated dwellings comprising a mix of involved and non-involved residences, totalling eight within a 2 km radius of the study area. Of note, all eight residences are associated with SWF either through a host or neighbour agreement with SWF, with three (R15, R17 and R19) not associated (non-involved) with SSF. Consultation with all eight owners for the purposes of the Proposed Development has been ongoing from inception of the proposed solar development. Where appropriate, visual screening and/or agreements with affected non-involved residents has been considered and addressed within Section 7.6.

The Site will occur on freehold land owned by five separate landholders comprising an area of up to 4243 ha (Figure 3-2). Table 3-1 provides details of freehold landholdings comprising the Development Footprint and current land-use.

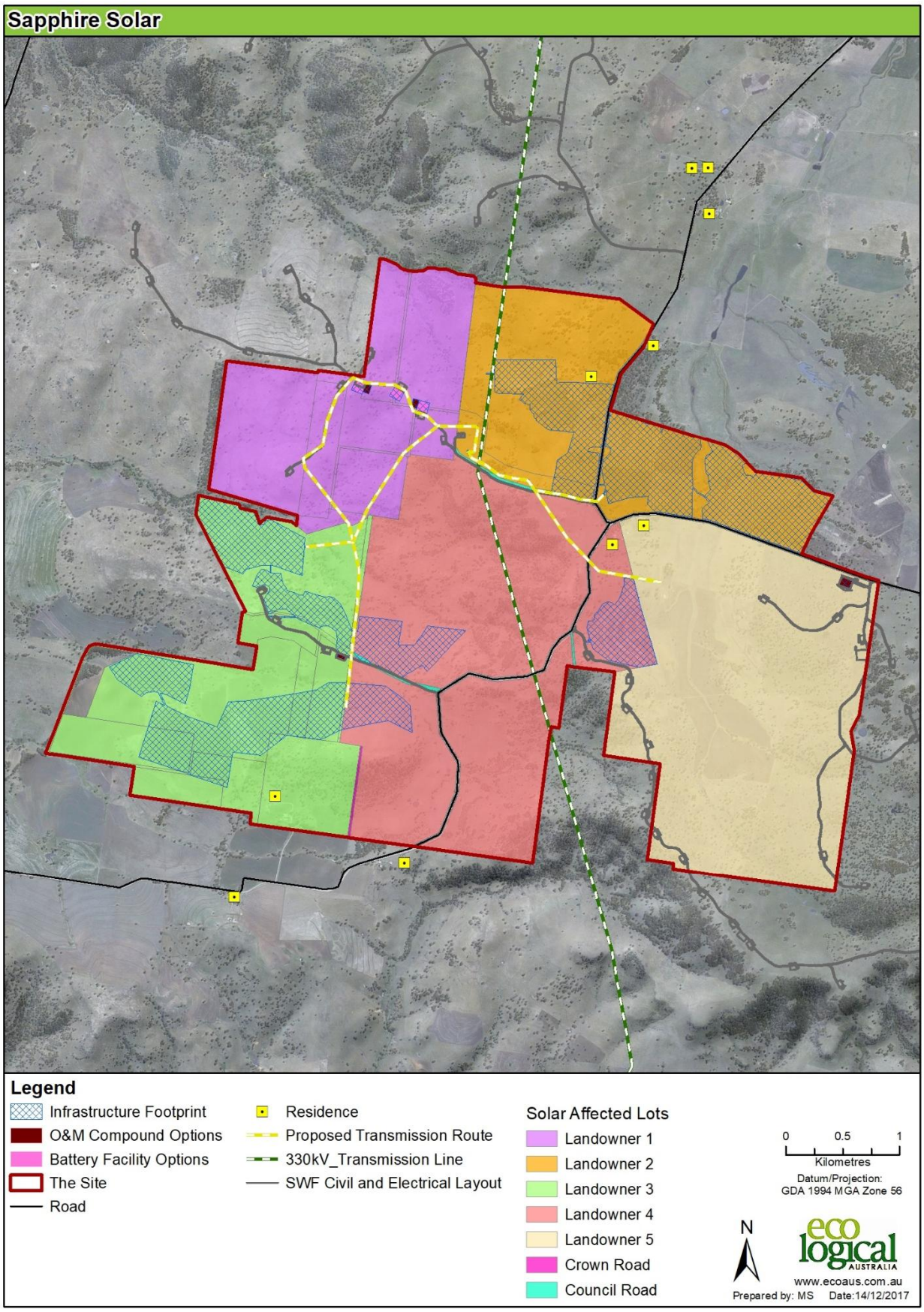

Figure 3-2: Land Tenure

Table 3-1: Project landholdings and characteristics

Landowner	Lot	DP	Total Area of Affected Lots (ha)	Infrastructure Footprint within Lot (ha)	Land use
Landowner 1	1	435844	326.9	11.2	▪ Grazing ▪ Cultivation ▪ SWF road network and wind turbine generator host ▪ Quarry operation
	209	750121			
	18	750121			
	16	750121			
	13	750121			
	139	750121			
	17	750121			
	2	1200772			
Landowner 2[2]	202	1227324	365.6	181.5	▪ Grazing ▪ Cultivation ▪ Open-cut sapphire mining and remediation ▪ SWF / TransGrid road network ▪ TransGrid Substation host
	201	1227324			
Landowner 3	1	1140309	446.1	169.9	▪ Grazing ▪ Cultivation ▪ SWF road network and wind turbine generator host
	133	753316			
	103	651984			
	81	753316			
	48	753316			
	57	753316			
	49	753316			
	99	753316			
	79	753316			
	1	128314			
Landowner 4	265	750076	646.2	79.0	▪ Grazing ▪ Cultivation ▪ SWF road network and wind turbine generator host ▪ Abandoned quarry
Landowner 5	266	750076	580.7	1.0	▪ Grazing ▪ Cultivation ▪ Open-cut sapphire mining and remediation

[2] Note, Lots 201 and 202 of DP 1227324 are the result of a recent subdivision. Previous reference was Lot 281 in DP 750076.

Landowner	Lot	DP	Total Area of Affected Lots (ha)	Infrastructure Footprint within Lot (ha)	Land use
					▪ SWF construction compound, road network and wind turbine generator host

3.1.2 Subdivision

The Proposed Development includes the subdivision of land for lease purposes to define the project area, which coincides with the leasing boundaries. This is because a lease of 5 years or more cannot be registered over part of a lot. Figure 3-3 shows the proposed lots to be created as part of the subdivision for leasing purposes.

Easements for access tracks will also be created so that rights will exist to cross over land between lots containing solar infrastructure. Similar easements will also be created for transmission lines and power cabling.

Some lots created as part of the Sapphire Wind Farm will be used as part of the Proposed Development and as such, additional subdivision of these lots is not required.

Indicative lot sizes are described in Table 3-2 below. These lots will be subject to final survey. Minor variations to lot boundaries may need to be made once the final layout of the Proposed Development has been determined and micrositing during detailed design has occurred. Development consent is therefore sought for the indicative subdivision layout in Figure 3-3 inclusive of minor lot boundary variations should adjustment be required at the detailed design stage.

Table 3-2 Proposed lots to be created for leasing purposes

Existing Lot	Existing DP	Current Lot Area (ha)	Proposed Lot No.	Type	Proposed Indicative Area (ha)
1	128314	111.58	1	PV Inclusion Area	20.60
1	128314		2	PV Inclusion Area	39.72
1	128314		3	Residual	51.26
1	435844	84.44	1	Battery (option)	0.62
1	435844		2	Battery (option)	0.37
1	435844		3	Battery (option)	0.43
1	435844		4	O&M/Compound Facility (option)	0.26
1	435844		5	O&M/Compound Facility (option)	0.00
1	435844		6	Residual	82.77
103	651984	15.60	1	PV Inclusion Area	0.09
103	651984		2	Residual	15.51

Existing Lot	Existing DP	Current Lot Area (ha)	Proposed Lot No.	Type	Proposed Indicative Area (ha)
265	750076	646.18	1	PV Inclusion Area	18.73
265	750076		2	PV Inclusion Area	29.31
265	750076		3	PV Inclusion Area	0.09
265	750076		4	PV Inclusion Area	28.34
265	750076		5	Residual	569.71
266	750076	580.68	1	O&M/Compound Facility (option)	0.83
266	750076		2	Residual	579.85
13	750121	33.41	1	Battery (option)	0.16
13	750121		2	Battery (option)	0.17
13	750121		3	O&M/Compound Facility (option)	0.38
13	750121		4	Residual	32.71
139	750121	31.87	1	Battery (option)	0.84
139	750121		2	O&M/Compound Facility (option)	0.00
139	750121		3	Residual	31.02
48	753316	20.37	1	PV Inclusion Area	0.78
48	753316		2	Residual	19.59
49	753316	22.66	1	PV Inclusion Area	7.19
49	753316		2	Residual	15.47
57	753316	11.64	1	PV Inclusion Area	6.05
57	753316		2	Residual	5.59
79	753316	41.31	1	PV Inclusion Area	13.61
79	753316		2	Residual	27.70
81	753316	127.42	1	PV Inclusion Area	39.41
81	753316		2	PV Inclusion Area	20.37
81	753316		3	Residual	67.64
99	753316	24.45	1	PV Inclusion Area	13.42
99	753316		2	PV Inclusion Area	0.31
99	753316		3	O&M/Compound Facility (option)	0.33
99	753316		4	Residual	10.39
133	753316	65.23	1	PV Inclusion Area	1.13
133	753316		2	Residual	64.11
1	1140309	9.35	1	PV Inclusion Area	0.38
1	1140309		2	PV Inclusion Area	0.08
1	1140309		3	PV Inclusion Area	0.79

Existing Lot	Existing DP	Current Lot Area (ha)	Proposed Lot No.	Type	Proposed Indicative Area (ha)
1	1140309		4	PV Inclusion Area	1.36
1	1140309		5	PV Inclusion Area	0.47
1	1140309		6	Residual	6.26
2	1200772	6.76	1	Battery (option)	0.22
2	1200772		2	Battery (option)	0.00
2	1200772		3	Battery (option)	0.20
2	1200772		4	O&M/Compound Facility (option)	0.11
2	1200772		5	Residual	6.23
201	1227324	342.71	1	PV Inclusion Area	56.38
201	1227324		2	PV Inclusion Area	57.02
201	1227324		3	PV Inclusion Area	60.70
201	1227324		4	Residual	168.60
202	1227324	22.85	1	PV Inclusion Area	4.59
202	1227324		2	Residual	18.26

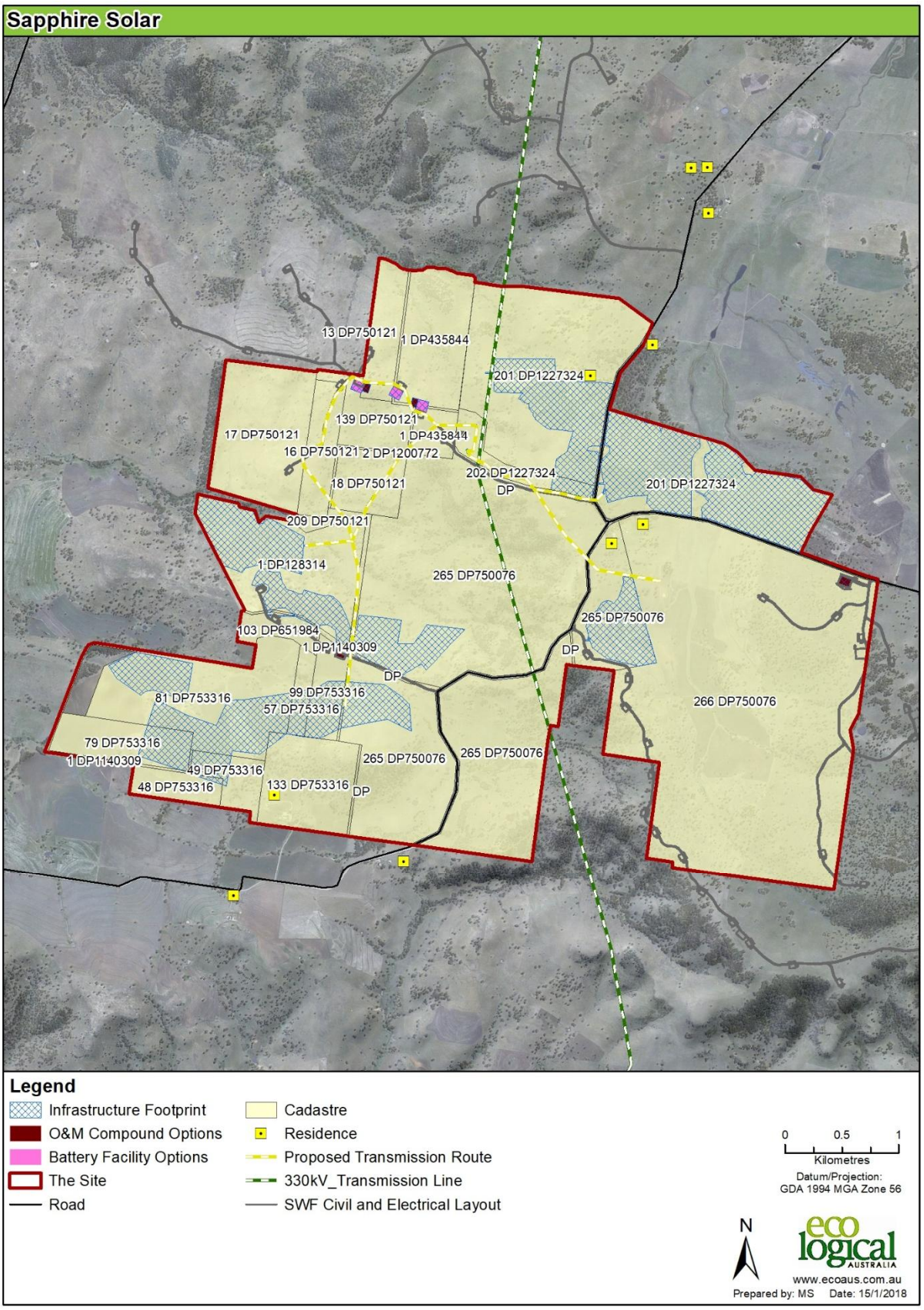

Figure 3-3 Subdivision by Cadastre

3.1.3 Key Components of the Proposed Development

The Proposed Development involves the installation of solar PV panels and battery-based storage facilities with a generation capacity of approximately 180 MW_{AC}. An indicative layout for the Proposed Development is provided in Figure 2-4. The Proposed Development would include, but not necessarily be limited to, the following elements:

- Solar arrays: solar panels supported by a mounting system[3] installed on piles driven, screwed, drilled and concreted or ballasted to the ground;
- Battery-based storage facilities;
- Power Conversion Units (PCU's) inclusive of Inverters/Rectifiers, Ring Main Units, LV/MV step-up Transformers located throughout the Proposed Development;
- Collector systems: above and/or below ground onsite cabling and electrical connections between the existing Substation and the respective PCU's;
- Operation and maintenance (O&M) building including workshop, warehouse, offices, ablutions, and carpark;
- Site access and onsite access tracks;
- Fencing and security system;
- Meteorological stations;
- Vegetation buffers (if required) for visual screening; and
- Firebreaks.

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

The construction compound would include:

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

The compound will be located to ensure native vegetation is not cleared beyond that already assessed for the Proposed Development, noise thresholds are achieved and consistent with NSW statutory guidelines, cultural heritage sensitivity is protected, and at least 100 m separates the compound from perennial waterways or significant water bodies.

[3] The mounting system will either be fixed-tilt or a single axis tracker (SAT) or a combination of both. Fixed tilt systems hold the modules in a fixed orientation in relation to the sun and have no moving parts. A SAT system tracks the daily movement of the sun and motorised linkages rotate the modules from the east in the morning to the west in the afternoon, constantly aligning towards the sun to maximise energy output performance. The modules are laid out in rows, typically referred to as arrays, approximately 4 to 7 m apart depending on the technology used. The choice of fixed-tilt or SAT will determine the arrangement of the racking system: east-west (fixed-tilt) or north-south (SAT). The racking system will be supported by steel piles, typically comprised of hollow section or I-section component which are driven into the ground or otherwise placed in bored holes and concreted in place.

Consideration has been given to utilising the temporary construction compound currently in use for construction of SWF.

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

3.1.4 Scale of Development

The 180 MW_{AC} layout for the Proposed Development in this EIS is 'indicative'. The reasons for this are twofold:

- The market for solar panels is dynamic with technology changing quickly and it is the intention of the applicant to take advantage of any advances to ensure that the benefits of the Proposed Development are maximised; and
- While the topography of the site has been assessed as suitable for solar development, detailed geotechnical studies will be required to determine the most suitable location for each of the project components.

These aspects cannot be resolved until after consent when detailed procurement and onsite pre-construction surveys are conducted. As such, the proponent has identified a Development Footprint within which all components of the Proposed Development would be accommodated. This application has been designed to assess the entire potential Development Footprint which provides a degree of flexibility in which the final design can be optimised to utilise best in class technology, while ensuring that environmental impacts are minimised to acceptable levels. By adopting this approach, the assessment represents a worst-case scenario in line with Environmental Impact Assessment (EIA) principles and reduces the likelihood of needing to seek modification approvals for minor layout changes.

The final scale and capacity of the Proposed Development will be optimised within the Development Footprint during post-consent studies based on a combination of the most suitable technology at the time of procurement along with detailed geotechnical and grid connection studies. For this EIS the applicant has assumed a 180 MW_{AC} design based on environmental constraints identified. A solar farm of this scale would result in a final output of approximately 370 GWh based on the solar resource at the Site, with an estimated capacity factor of 24 %.

Accordingly, this application seeks a flexible consent which will enable this optimisation to occur within the approved Development Footprint.

3.1.5 Indicative Timeline

It is anticipated that the Proposed Development would take approximately 18 months to construct. This time to construct could be reduced should the Proposed Development be granted approval for an out of hours works protocol. The Proposed Development would be operational over an initial term for approximately 25 years. Further, it is anticipated that the Proposed Development could extend for a further term should market and commercial circumstances dictate. It is expected that upgrading or repowering of the PV modules and ancillary equipment may be required throughout or to extend the operational life of the Proposed Development. This will be a commercial decision at the time based on the relative economics of solar PV

generation and battery-based storage compared to alternatives. Decommissioning and restoration would occur at the end of the operational life of the Proposed Development. As such, planning consent for the Proposed Development is sought for 55 years to cover two full terms of operation and associated construction, upgrading and decommissioning periods. Details of each project phase are provided below in Table 3-3

Table 3-3: Indicative timeframe for project phases

Phase	Indicative Start	Indicative Period
Construction	Mid 2018	18 months
Operation / Repowering	Mid/Late 2019	53 years
Decommissioning	c. 2070	6 months

3.1.6 Description of Solar Farm Key Components

Solar array

The solar array refers to the solar farm and would comprise of approximately 660,000 individual solar panels with a combined generation capacity of approximately 180 MW_{AC}. The solar panels would be fitted to either or a combination of:

- Fix tilt frames which would be orientated so the panels face upwards at approximately 300 through 25 degrees in a north, north west or north easterly direction; or
- A single-axis tracking system which would track the sun from east to west as it moves throughout the day.

The solar array will be supported by approximately 90,000 piles which would be mechanically driven, screwed into, drilled and concreted or ballasted to the ground. Figure 3-4 and Figure 3-5 below show examples of solar farms during construction. Figure 3-7 and Figure 3-6 illustrate an operational fixed array solar farm and an operational tracking solar farm respectively.

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

Figure 3-5: Fixed array assembled before PV panels added (image source Infinergy UK)

Figure 3-6: Fully assembled fixed array solar far (image source Infinergy UK)

Figure 3-7: Fully assembled tracking array solar farm showing inverter housing (image courtesy Nextracker Australia, actual tracking system may differ)

The solar array would be wired in 'blocks' that would be connected to Power Conversion Units (likely to be approximately 2.5 MW to 6 MW each) located throughout the Proposed Development. Blocks would not necessarily appear as discrete entities but would appear as a series of continuous rows. In the case of a fixed tilt mounting system the rows would run typically west to east, while the single-axis tracking system would be installed in rows that are oriented typically north to south. The solar array would connect to the Substation through a series of 33 kV lines that would be above or below ground depending on local ground conditions. Waterloo and Western Feeder roads will be impacted by this aspect of the Proposed Development.

Power Conversion Units (PCUs)

PV panels produce Direct Current (DC) electricity which would be converted to Alternating Current (AC) at the many central PCUs. The PCUs will be approximately 2.5 MW to 10 MW each, though subject to procurement processes. PCUs are typically housed in containers, or located on platforms, either singularly the size of a 20ft container, measuring approximately 6.1 m *(l)* x 2.9 m *(h)* x 2.5 m *(w)*, or doubly the size of a 40 ft container measuring approximately 12.2 m *(l)* x 2.9 m *(h)* x 2.5 m *(w)*. Each PCU would also have:

- A 33 kV Medium Voltage (MV) transformer;
- Circuit breakers; and
- Communication equipment.

PCUs will be transported to site readymade and require little in the way of foundations, either attached to steel or concrete pilings approximately 1.6 m deep depending on ground conditions. Figure 3-8 and Figure 3-9 below illustrate a double and single PCUs respectively.

Figure 3-8: Double PCU container (image courtesy of SMA)

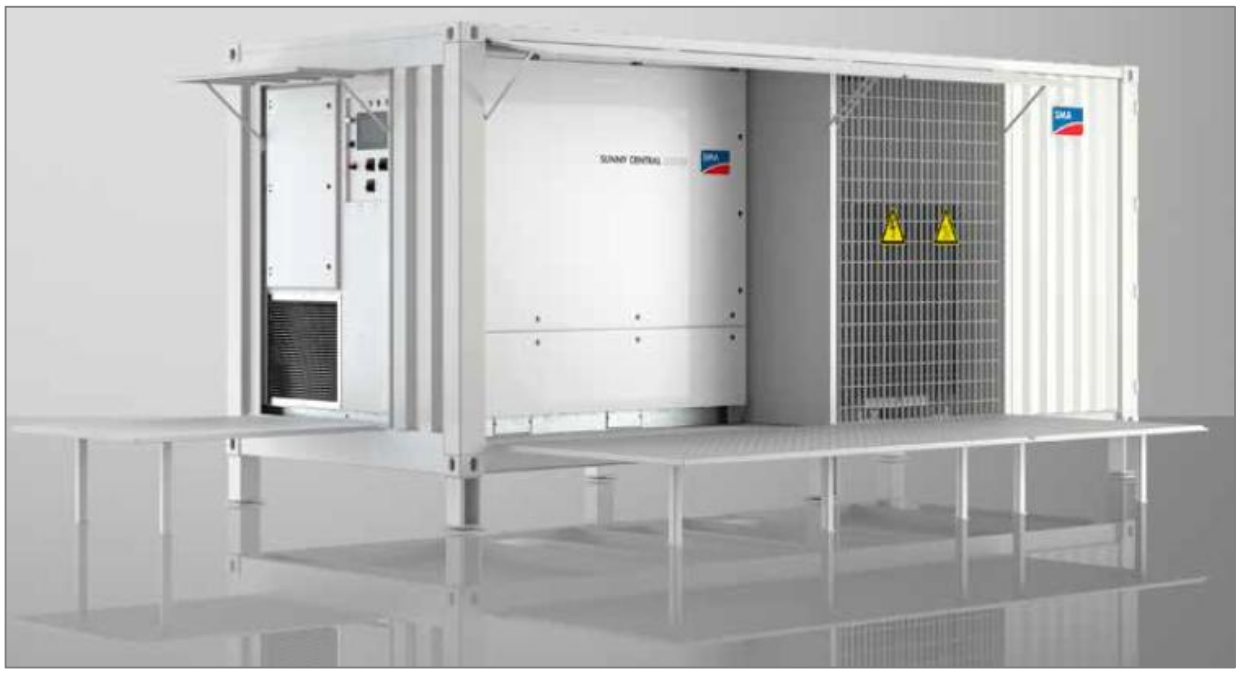

Figure 3-9: Single PCU container (image courtesy of SMA)

Battery-based Storage

The Proposed Development will include an energy storage system which would consist of batteries that are generally housed in enclosures approximately the size of a shipping container. Battery storage can add significant benefits to solar generation because it allows for the dispatch of energy in accordance with market demand and overcomes potential issues associated with intermittency of output.

The battery assemblies would be mounted on pad foundations and, depending on the selected technology, may include bunded containment. Underground or overhead cables would connect the battery assemblies to the Proposed Development and Substation equipment. The quantity and type of battery technology to be used will be subject to procurement processes, however a range of technologies have been considered, including lithium-ion, lead acid, sodium sulphur, sodium or nickel hydride and electrochemical technology. Subsequent hazard assessment undertaken as part of this EIS, shortlisted potential battery options to lithium-ion (certified to UN 34.80), wet lead acid and vanadium flow (Appendix K). Based on the outcomes of the hazard assessment process, lithium-ion was found to be currently the most suitable battery technology for the proposed development and forms the basis for this EIS.

Proposed stand-alone locations of battery storage facilities have been identified and assessed within this EIS. One or more of these locations may be utilised for optimal construction and operation of the Proposed Development. Section 7.10 includes an assessment of hazards and risks associated with the Proposed Development, within which an assessment of the battery component of this project is considered. Accepted industry practice will be observed for handling the respective battery components during installation, maintenance, replacement and recycling. Moreover, a 20 m asset protection zone (APZ) will be incorporated into the final design layout of the battery-based storage facility locations.

Collector Systems

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

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

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

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

Where possible, trenches will be located alongside/underneath internal access tracks (including those constructed for SWF) to minimise ground disturbance (Figure 3-10). MV/HV cables may be either laid underground or constructed overhead to connect sections of the Proposed Development to the Substation.

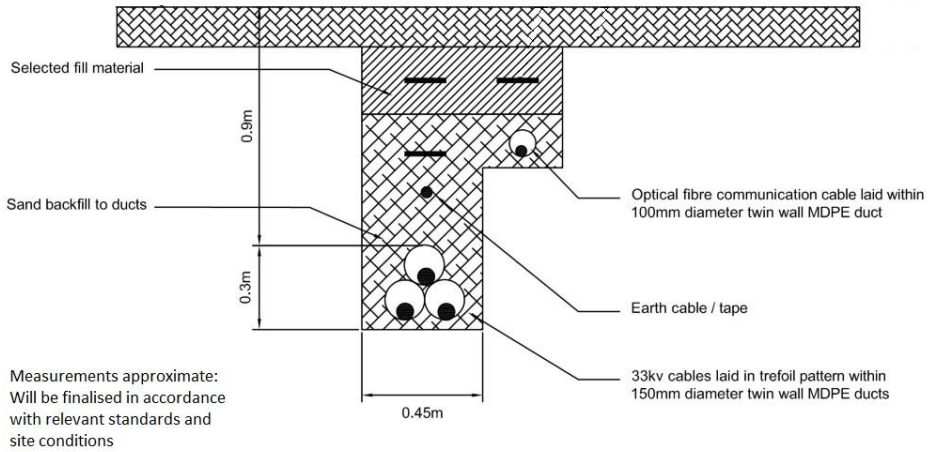

Figure 3-10: Indicative 33 kV cable trench design[4]

[4] Indicative design only. Cables may be direct buried rather than trenched. Cables will be buried to a depth >500 mm in land with a cropping history or land with a capability of cropping.

Operations and Maintenance Facility

A permanent Operations and Maintenance (O&M) facility will be provided to meet the ongoing operational needs of the Proposed Development. A typical arrangement is shown in Figure 3-11. Building fit-out will include power, lighting, air-conditioning, security, fire detection, and communication systems as required.

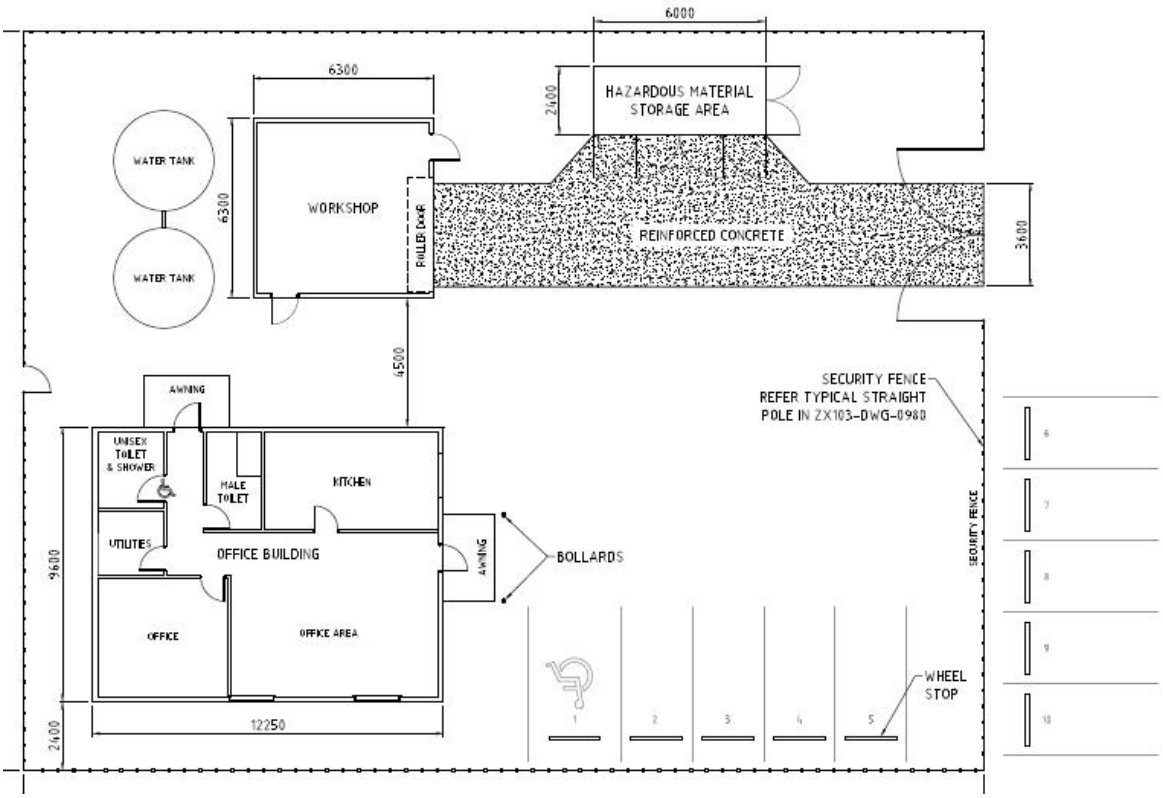

Figure 3-11: Typical O&M Facility

The Operations and Maintenance facility including associated parking would occupy an area of approximately 50 m by 50 m or 0.25 ha and may include the following:

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

Onsite support buildings will comply with all relevant Australian building standards and regulations. They will be designed to accommodate the maximum number of staff that will be required during the operational life of the Proposed Development. Water for the support buildings will be supplied to site by commercial

contractors and stored in onsite water tanks. In addition, there will be a requirement for a 20,000-litre water tank solely for the purposes of fire protection.

Site Access and Onsite Access Tracks

The Site will be accessed directly off Waterloo and Western Feeder roads. Permanent access locations are illustrated in Section 7.8, however during construction access may be required through existing gate entrances to the Site to accommodate an efficient workflow.

Waterloo Road joins the Gwydir Highway, a Roads and Maritime Services (RMS) Classified State Road southeast of the project boundary. The intersection between the Gwydir Highway and Waterloo Road has been upgraded to accommodate over-dimensional equipment for SWF, and it is not expected that further upgrades would be required for the Proposed Development.

Waterloo and Western Feeder roads are unsealed local roads that will require maintenance to support delivery vehicles during the construction phase. Maintenance and dust suppression activities will ensure the road is suitable for equipment delivery.

Internal tracks will be constructed of compacted gravel to an approximate depth of 150 mm depending on soil conditions (Figure 3-12). Internal access tracks would be approximately 4 m wide with intermittent wider stretches for passing, parking, and at corners. Small culverts over identified stream crossings would also be constructed. Culverts (where required) will be designed in line with the following guidance:

- *Policy and Guidelines for Fish Friendly Waterway Crossings* (NSW DPI, 2004); and
- *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003).

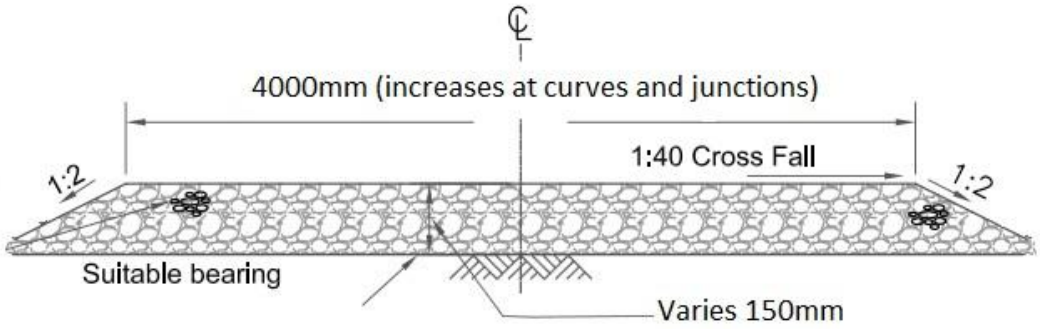

Figure 3-12: Typical track cross section

Fencing and Security System

To ensure safety and security at the site, a perimeter fence up to 2.5 m will be installed around the perimeter of the Proposed Development in accordance with the Proponent's requirements to ensure entry into the site is controlled. Once operational, all access points will be gated. The security system may include a CCTV security system.

Meteorological Station

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

Vegetation Screen

The Site has been selected to minimise impacts to surrounding residences through a combination of consultation, consideration of existing vegetation and proximity to the Proposed Development. If required, additional vegetation screening post construction may be planted in other areas of the Site or adjoining land (subject to landowner consent).

Firebreak

Where required, firebreaks will be established or maintained around the solar array (and associated infrastructure where appropriate) inside the Development Footprint. The firebreak will be ploughed, mown or grazed, and maintained in accordance with the NSW Rural Fire Service (RFS) standards (RFS, 2006). The firebreak is to ensure, as far as possible, that a fire that originates within the Site does not escape into the wider landscape or conversely the firebreak should reduce the potential of a fire that originates offsite encroaching onto the Site. Firebreaks will be approximately 5 m wide.

Grid Connection

The Substation and control building constructed for SWF provides additional 33 kV space to accommodate the connection of all or part of the Proposed Development. Augmentation within the Substation may include but not limited to the inclusion of an additional control building, limited high voltage infrastructure works and necessary interface connections. The extent of additional external works required at the Substation will be determined through detailed design in consultation with TransGrid, however are expected to be contained within the perimeter of the recently constructed Substation and associated temporary disturbance areas. Augmentation works may include expanded civil works (earthwork, earthing, conduits, concrete foundations, driveway crossover and culverts) to allow for integration with the existing Substation.

For the avoidance of doubt, additional works associated with the Proposed Development within (the inclusion of a new switch room and associated connection arrangement) and external to the Substation are included within this EIS.

4 Typical Works Program

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

4.1 Site Preparation

The site will require minimal preparation in advance of installing the PV modules as it is generally flat or of consistent slope, and largely clear of trees and dense vegetation. Site entrances will be opened and Site gates secured in position. Fencing will be upgraded or installed around the Site perimeter as required to match progress on work fronts. The Site will be cleared of internal fences, timber or rock debris as required. Trees within the development footprint where clearing has been approved will be removed or chipped.

It is possible that Essential Energy 11 kV distribution lines crossing the Site will need to be relocated to avoid impacting the layout. Any relocation will be undertaken in close cooperation with Essential Energy and residents supplied by these connections.

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

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

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

4.2 Installation

Following Site preparation, the supporting structures and the solar modules will be installed. The Site will be surveyed and locations of all the equipment will be pegged. Top soil will be left intact wherever possible. Circular hollow sections, flanged sectioned or ballasted steel piles which support the racking system will be driven into the ground pneumatically, screwed or alternatively ballasted in position. Where pneumatic piling is to occur, a 100 m exclusion zone will be in place whereby hearing protection will be mandatory.

Piles may be cut off to height and the steel racking assembly will be attached in accordance with the manufacturer's proprietary system. Solar PV modules are then installed on the racking and secured in position to withstand wind loading. Once the modules have been installed the DC collection cables are laid on the

structure and terminated to the modules. If a tracking system is being used, the rotating mechanism and servo motors will be installed on the support structure.

This phase will require the use of equipment including pile drivers, augers, forklifts, welders, oxy acetylene, trenchers, excavators, pickup trucks, water trucks, flatbed trucks and cranes.

4.3 PCU Assemblies and Electrical Collection System

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

4.4 Commissioning

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

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

4.5 Restoration

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

4.6 Operation

The Proposed Development will operate independently and no permanent employees will be stationed on-site. The SSF will be monitored remotely from an off-site location and apart from a routine maintenance program, operators will only visit the SSF when responding to any performance issues (i.e. where actual output measured by the monitoring system deviates from generation forecasts and other key performance metrics).

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

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

4.7 Maintenance

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

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

Following installation and commissioning, a minimal amount of preventative maintenance will be required on the battery-based storage facilities to ensure safe and continued operation. Scheduled and preventative maintenance tasks may include:

- Battery: Verify power connection torque, isolation check, ground measurement, battery performance check (full charge / discharge cycle);
- Fire suppression system: Check and maintenance; and,
- Air conditioning: Clean filters.

4.8 Upgrading, Repowering and/or Decommissioning

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

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

If the decision at the time is to decommission the SSF the procedure would be to initially disconnect the solar farm from the TransGrid network. The interconnecting cable would be removed and disposed of off-site, reusing and recycling wherever possible. Foundations would be broken up and removed off site.

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

5 Statutory Framework

5.1 Permissibility

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

As an activity that is permitted with consent, the Proposed Development will be assessed under Division 4.1 of the EP&A Act.

5.2 Commonwealth Legislation

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

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

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

MNES have been assessed in Section 5.2 and Section 7.2 of this EIS. The Proposed Development will potentially have a significant impact on a Critically Endangered Ecological Community (CEEC). A referral was made to the Australian Government Environment Minister on 15th December 2017 and was determined on 5th January 2018 as being a 'Controlled Action' (that is, approval is required for the action under the EPBC Act). The Bilateral Agreement made under section 45 of the EP&A Act, between the Commonwealth and NSW Governments mandates that where an action is determined as a Controlled Action, the assessment responsibilities are vested in the NSW Major Projects assessment process with the provision of Commonwealth Assessment Requirements by the Commonwealth DotEE to the NSW DP&E. The bilateral is for the assessment process, but not for the approval process. That is, approval is still required from the Australian Government Environment Minister.

The Proposed Development does not impact on other MNES' including World Heritage properties, National heritage places, Ramsar wetlands, threatened species, migratory species, a Commonwealth marine area or the Great Barrier Reef Marine Park. The Proposed Development is not a nuclear action, nor is it a coal seam gas development or large coal mine that has the potential to impact water resources.

5.2.2 Native Title Act 1993

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

The Site is located within the area covered by a Native Title Claim made by the Gomeroi People in 2012. However, the Proposed Development is located on freehold land and former Crown roads that have since transferred to Inverell Shire Council and is therefore not subject to Native Title claims.

5.2.3 Renewable Energy (Electricity) Act 2000

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

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

The objects of the RE Act are achieved through the issuing of certificates for the generation of electricity using eligible renewable energy sources. This requires certain purchasers (called liable entities) to surrender a specified number of certificates for the electricity that they acquire during a year. Under section 17 of the RE Act, solar energy is a renewable energy source eligible under the Commonwealth government's Renewable Energy Target (RET). The Proposed Development will need to be accredited as a Renewable Energy Generator to create Renewable Energy Certificates.

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

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

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

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

5.3 State Legislation

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

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

The Site will be leased for the purposes of the Proposed Development. Since the lease will extend for a term greater than five years, the Proposed Development will be deemed 'subdivision' of land pursuant to Section 4B(1)(b) of the EP&A Act.

It is noted that this is not an actual subdivision of the land which creates a new allotment and deposited plan, DPE advise (email dated 15 November 2017) that a formal request for a subdivision certificate compliant with the requirements of clause 157 of the EP&A Reg is not required. Therefore, to avoid any doubt, this deemed 'subdivision' forms part of this project application.

As an activity that is permitted with consent, the Proposed Development shall be assessed under Division 4.1 of the EP&A Act.

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

Clause 20 of Schedule 1 states that "*development for the purpose of electricity generating works or heat or their co-generation (using any energy source, including gas, coal, biofuel, distillate, waste, hydro, wave, solar or wind power) that have a capital investment value of more than $30 million*" shall be classified as "State Significant Development" (SSD) under Division 4.1 of the EP&A Act.

The Proposed Development has a capital investment value estimated to be approximately $280 million, therefore is classified as a SSD. A formal quantity surveyor's report confirming the capital investment value of the Proposed Development is included as part of the development application.

The Minister for Planning is the consent authority for SSD applications. SSD applications are assessed by the Department of Planning and Environment (DPE), and in some cases the Minister may delegate decision making to Department staff. However, the Minister may also delegate the consent authority function to the Planning and Assessment Commission (PAC) if the application is not supported by Council or the Department has received more than 25 public objections.

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

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

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

5.3.4 State Environmental Planning Policy (Rural Lands) 2008

The aims of this Policy are as follows:

(a) *to facilitate the orderly and economic use and development of rural lands for rural and related purposes;*
(b) *to identify the Rural Planning Principles and the Rural Subdivision Principles so as 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;*
(c) *to implement measures designed to reduce land use conflicts;*
(d) *to identify State significant agricultural land for the purpose of ensuring the ongoing viability of agriculture on that land, having regard to social, economic and environmental considerations; and*

(e) to amend provisions of other environmental planning instruments relating to concessional lots in rural subdivisions.

Pursuant to clause 13, land identified as being State significant agricultural land is listed in Schedule 2. Currently, Schedule 2 does not list any State significant agricultural land. Therefore, the Proposed Development does not compromise any of the above objectives or impact any State significant agricultural land.

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

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

Inverell Shire Council is listed as one of the Councils in which SEPP 44 applies. Councils are encouraged to prepare LGA-wide Koala plans of management, and once agreed to by the NSW Department of Planning, they may be used by developers to address Koala issues and individual plans of management would no longer be required. Currently, potential and core koala habitat has not been surveyed in the Inverell Shire Council LGA, or included as a special provision in the Inverell LEP, or the *Inverell Development Control Plan 2013*.

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

The potential impact of the Proposed Development on Koalas and whether the potential Koala habitat identified meets the definition of core Koala habitat is assessed in Section 7.2. No core Koala habitat was identified within the Site.

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

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

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

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

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

A preliminary hazard analysis (PHA) is required for development proposals classified as 'potentially hazardous industry' to determine the risks to people, property and the environment. Appendix 3 of the *Applying SEPP 33* guidelines list the industries that are considered to fall within SEPP 33. Solar farms and energy storage facilities are not listed in Appendix 3, however an assessment of hazardous activities associated with the Proposed Development is provided in Section 7.10.

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

SEPP 55 aims to promote remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment.
Under clause 7, a consent authority must not consent to the carrying out of any development on land unless:

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

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

A review of premises currently regulated by an Environmental Protection Licence (EPL) under the POEO Act and premises that are no longer required to be licensed under the POEO Act revealed five EPLs within the Site. Four of these are associated with the SWF, while one is held by Eastern Feeder Holdings Pty Ltd for the purpose of mining minerals at 'Yarrandoo'.

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

5.3.8 Biodiversity Conservation Act 2016 (BC Act)

The purpose of the BC Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development. The BC Act contains provision relating to threatened species and ecological communities listings and assessment, section 5A of the EP&A Act and repealing the *Threatened Species Conservation Act*

1995 (TSC Act) . The BC Act also provides for a biodiversity offsets scheme, a single biodiversity assessment methodology (BAM), calculation and retirement of biodiversity credits and biodiversity assessment and approvals. The BC Act also contains measures for flora and fauna protection, repealing parts of the *National Parks and Wildlife Act 1974.* The *Biodiversity Conservation Regulation 2017* supports the Act.
The BC Act commenced on 25 August 2017. Under clause 28 of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* (Transitional Regulation) the former assessment and planning framework applies to SSD development applications if the environmental assessment requirements were issued prior to the commencement of the BC Act and the application is made within 18 months after the commencement of the BC Act. SEARs for the Proposed Development were issued on 23 August 2017, hence the Proposed Development is being assessed under the former provisions of the TSC Act (see below).

5.3.9 Threatened Species Conservation Act 1995 (TSC Act)

The TSC Act lists and protects threatened species, populations and ecological communities that are under threat of extinction in NSW. NSW Office of Environment and Heritage (OEH) is responsible for administering the TSC Act.

The TSC Act establishes a system for biodiversity certification, and establishes the Biodiversity Banking and Offsets Scheme. All major projects require that impacts to biodiversity are assessed in accordance with the Framework for Biodiversity Assessment (FBA) (Section 7.2; Appendix B).

5.3.10 Fisheries Management Act 1994 (FM Act)

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

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

Pursuant to section 89J of the EP&A Act, a section 201 permit will not be required for the Proposed Development for any dredging or reclamation works due to the Proposed Development being classified as SSD. Nevertheless, best practice methods for vehicular and cable crossings (as detailed in Section 7.9) will be implemented to reduce impacts to all creeks identified as containing KFH.

The Proposed Development will not harm marine vegetation or block fish passage, therefore, permits under sections 205 or 219 of the FM Act are not required by virtue of section 89J of the EP&A Act.

5.3.11 Water Management Act 2000 (WM Act)

The WM Act regulates controlled activities on waterfront land in NSW. Waterfront land is defined as the bed of any river, together with any land lying between the bed of the river and a line parallel to, and the prescribed

distance (being 40 m) inland of, the highest bank of the river. Cables and vehicular crossings will cross Kings Plains Creek, a 3rd order stream.

A controlled activity, within the meaning of the WM Act, includes the deposition or removal of material (whether or not by extractive material) or vegetation from land, or the carrying out of any other activity that affects the quality or flow of water in a water source. Whilst vehicular crossings and the installation of cables are controlled activities undertaken on waterfront land, a permit under section 91 of the WM Act is not required by virtue of section 89J of the EP&A Act.

5.3.12 Native Vegetation Act 2003 (NV Act)

The NV Act and the *Native Vegetation Regulation 2013* were repealed by the *Local Land Services Amendment Act 2016* on 25 August 2017. The BC Act and the *Local Land Services Act 2013* (LLS Act) regulate clearing of native vegetation (although not for SSD, see below).

5.3.13 Local Land Services Act 2013 (LLS Act)

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

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

The Proposed Development, including vegetation clearing, is being assessed under Part 4 of the EP&A Act, hence clearing of vegetation for the purpose of SSF is authorised, and does not require approval under Division 6 of Part 5A of the LLS Act.

5.3.14 National Parks and Wildlife Act 1974 (NPW Act)

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

An initial 'due diligence' assessment has indicated that there is a low risk that Aboriginal objects and/or sites may occur within the Site. An Aboriginal Cultural Heritage Assessment is provided in Section 7.3 and Appendix C. Pursuant to section 89J of the EP&A Act, an Aboriginal Heritage Impact Permit (AHIP) under section 90 of the NPW Act is not required for SDD.

5.3.15 Heritage Act 1977

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

Under section 139 of the Heritage Act, a person must not disturb or excavate any land knowing or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being

discovered, exposed, moved, damage or destroyed unless the disturbance or excavation is carried out in accordance with an excavation permit. A relic is any deposit, artefact, object or material that relates to the settlement of the area that comprises NSW, not being Aboriginal settlement, and is of State or local heritage significance. Section 139 does not apply to a relic that is subject to an interim heritage order made by the Minister or a listing on the State Heritage Order.

The potential impacts on historic heritage are addressed in Section 7.4 of this EIS. No heritage items or places have been identified on the Site. The Proposed Development would not have any direct or indirect impacts on any items of historic heritage significance and a section 139 permit is not required pursuant to section 89J of the EP&A Act.

5.3.16 Crown Lands Act 1989

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

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

Former Crown roads within the Site have transferred to Inverell Shire Council. Therefore, the Proposed Development will not impact on any Crown Land or Crown roads.

The *Crown Land Management Act 2016* and the *Crown Land Legislation Amendment Act 2017* will repeal and consolidate seven pieces of legislation, including the Crown Lands Act. It is anticipated the new legislation will commence in early 2018.

5.3.17 Conveyancing Act 1919

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

As such, because each lease required to secure the land for the Proposed Development will exceed 5 years, the Registrar-General will not register the leases unless development consent is obtained for the subdivision of the land for leasing purposes. An indicative subdivision plan is shown in Figure 3-3 and described in Section 3.1.2 of this EIS.

The *Inverell Local Environmental Plan 2012* (Inverell LEP) provides that land may be subdivided with development consent (clause 2.6) but any resulting lot must not be less than the identified minimum lot size (clause 4.1(3)).

The applicable minimum lot size for the area of the Proposed Development is 200 hectares. Therefore, the creation of a lot for lease purposes which is less than 200 hectares is prohibited under the Inverell LEP. This prohibition applies to all Proposed Lots.

Despite this prohibition, section 89E(3) of the EP&A Act allows the consent authority to grant development consent to a State Significant Development which is partly prohibited. Accordingly, development consent may be granted, inclusive of this subdivision.

5.3.18 Roads Act 1993

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

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

The Proposed Development will be accessed via either the Gwydir Highway or Kings Plains Road, with immediate access to the Site via Woodstock Road, Waterloo Road and Western Feeder Road. These are existing public roads. Activities that change the structure of the Gwydir Highway and its intersection with the Waterloo Road, upgrades to Waterloo Road and new access from Waterloo Road and Western Feeder Road have been undertaken as part of the SWF project. Access to Waterloo Road and Western Feeder Road will be via existing gates and these roads are unclassified roads. Therefore, approval to connect to a public road under section 138 is not required.

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

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

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

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

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

Waste minimisation and management is discussed in Section 7.11 .

5.3.20 Biosecurity Act 2015 (Biosecurity Act)

The Biosecurity Act repealed the *Noxious Weeds Act 1993* and provides a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

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

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

Weed management is discussed in Sections 7.2and 7.5.

5.3.21 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 infrastructure and environment, economic, cultural, agricultural and community assets from damage arising from fire.

The Site contains Bushfire Prone Land. However, the Proposed Development is not a subdivision for residential or rural residential purposes nor is it for a special fire protection purpose, hence issue of a bush fire safety authority under section 100B of the Rural Fires Act is not required. Furthermore, a section 100B authority is not required pursuant to section 89J of the EP&A Act. Fire risk is discussed in Section 7.10.

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

The *Waste Avoidance and Resource Recovery Act 2001* (WARR Act) introduces a scheme to promote extended producer responsibility for the life-cycle of a product. The objectives of the WARR Act are:

- *(a) to encourage the most efficient use of resources and to reduce environmental harm in accordance with the principles of ecologically sustainable development,*
- *(b) to ensure that resource management options are considered against a hierarchy of the following order:*
  - *(i) avoidance of unnecessary resource consumption,*
  - *(ii) resource recovery (including reuse, reprocessing, recycling and energy recovery),*

(iii) disposal,

(c) to provide for the continual reduction in waste generation,

(d) to minimise the consumption of natural resources and the final disposal of waste by encouraging the avoidance of waste and the reuse and recycling of waste,

(e) to ensure that industry shares with the community the responsibility for reducing and dealing with waste,

(f) to ensure the efficient funding of waste and resource management planning, programs and service delivery,

(g) to achieve integrated waste and resource management planning, programs and service delivery on a State-wide basis,

(h) to assist in the achievement of the objectives of the Protection of the Environment Operations Act 1997.

Waste minimisation and management is discussed in Section 7.11.

5.3.23 Mining Act 1992

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

Two Mining Lease (ML) and two Exploration Licence (EL) areas exist within the Site. ML1687, ML1374 and EL8536 are held by Eastern Feeder Holdings Pty Ltd, and EL8230 by Bond Resources Pty Ltd. CWP, in consultation with the NSW Department of Industry – Resources and Energy (DRE), Eastern Feeder Holdings and Bond Resources have established that the Proposed Development can 'co-exist' with the exploration and mining leases that are held over the Site (further detail is provided in Section 7.5.)

5.4 Other Relevant Policies and Plans

5.4.1 Ecologically Sustainable Development

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

The Proposed Development is assessed against each of the principles of ESD in Section 0.

5.4.2 New England North West Strategic Regional Land Use Plan

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

Two categories of strategic agricultural land have been identified:

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

There are no critical industry clusters within the New England North West; however, the Proposed Development does contain 527 ha of land mapped as BSAL (see Section 7.5).

All State significant mining and CSG projects on BSAL will be referred to the Commonwealth's Independent Expert Scientific Committee as part of the Gateway process. Due to the nature of the Proposed Development, it is unlikely to have many large or permanent detrimental impacts on the land. This EIS considers potential impact to land resources in Section 7.5.

5.5 Summary of Licences and Approvals Required

No approvals or licences are required for the Proposed Development, due to its nature and being SSD.

6 Stakeholder and Community Consultation

6.1 Consultation

Effective and broad community and stakeholder consultation provides communities and stakeholders with a clear understanding of a development proposal as well as opportunities to provide feedback to identify issues important to them and, as such, it is an essential part of the EIA process. CWP has carried out extensive consultation with the local community, stakeholders from the wider area and relevant Government Agencies in order to understand and respond to community concerns during the design and assessment process leading to this Development Application (DA).

6.1.1 Consultation Objectives

Table 6-1 below outlines how the consultation objectives for the Proposed Development were established. These objectives will continue to be developed and deployed through a plan which addresses community engagement issues post consent for the construction and operational phases of the project.

Table 6-1: Development of Consultation Objectives

Question	Considerations	Objectives
Who are the community stakeholders for the proposal?	Community stakeholders may come from groups within a range of geographical scales, for example: ▪ Local residents; ▪ Nearby villages or towns; ▪ The broader regional council area; ▪ The wider State level; and ▪ The National level.	▪ Consultation needs to ensure that all geographical scales are considered in the development of stakeholder and community understanding; ▪ Ensure those community groups that are potentially most affected by the Proposed Development are engaged with as a priority; and ▪ Utilise the SEARs responses as an additional tool to identify stakeholders.
What could be the main issues associated with each group, and how can these issues be clarified?	▪ Issues may be positive or negative depending on stakeholder perspective, and the potential impacts of the Proposed Development; and ▪ Open and regular dialogue with interested and potentially impacted stakeholders allow an understanding of stakeholder perspectives to be built over time.	▪ Following the identification of stakeholders, address using appropriate communication tools at a level that correlates to stakeholder interest; ▪ Ensure that consultation with stakeholders is developed in a timely manner (at appropriate geographical scales) so that feedback can be incorporated into assessment and design; and ▪ Ensure that project information is transparent and easy to understand.
What tools could be used to provide and receive information for each stakeholder group and what would be an effective communication strategy for each group?	▪ Different stakeholder groups will favour different communication methods; and ▪ All stakeholder groups will not necessarily be known at the beginning of the project lifecycle.	▪ Use a wide variety of communication tools in order to ensure that all interested stakeholder groups can participate in the consultation process; ▪ Invest in wide range of mediums to facilitate ease of communication with the project team; and ▪ Communication and consultation strategies must be adaptive to ensure they remain relevant as the Proposed Development develops.

Question	Considerations	Objectives
How will consultation requirements change over time?	▪ Stakeholders requirements will be different at different stages of the proposal; and ▪ Consultation strategies will need to be engaged over the course of all project timescales.	▪ Ensure that communication about project timelines is communicated effectively; ▪ Ensure that the changing needs for communication of potentially affected stakeholders, particularly at the local level, or those that are deemed to have a high sensitivity to the Proposed Development are understood; and ▪ Commit to maintaining effective communication through different project stages.

6.1.2 Consultation to Date

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

Activities that have taken place are listed below in Table 6-2 and then expanded in the text that follows.

Table 6-2: Consultation activities timeline

Date	Stakeholder(s)	Activities
March 2016	SWF host landholders	Concept discussion
April 2016	TransGrid	Concept discussion
August 2016	SWF CCC	Concept discussion
February 2017	Potential host consultations	Land use suitability and interest
March 2017	Community	Community meeting and feedback
June 2017	Potential host consultations	Land use suitability and interest
	Mining lease/licence holder	Discussion and feedback
July 2017	Community	Revised footprint
	All stakeholders	PEA submission
August 2017	All stakeholders	Media coverage
	Individual neighbours	One-to-one consultation
	Council	Discussion in relation to transport and waste
	Community	CCC participation
		Community meeting and feedback
September 2017	Registered Aboriginal Parties	Participation in on-site surveys
October 2017	Mining lease/licence holder	Agreement of the Proposed Development
	SWF CCC	Presentation and feedback

Date	Stakeholder(s)	Activities
November 2017	Host consultations	Refined project footprint
	Community	Updated layout
	Potentially affected residences	Potential mitigation measures
	Waterloo Road residences	Potential impacts and concerns
December 2017	DPE	Issue draft EIS
January 2018	All stakeholders	Website update
		Public Exhibition of EIS

6.2 Consultation

6.2.1 Consultation – Concept Discussions

The concept of co-locating a solar development on land within and adjacent to SWF was first proposed in March 2016 with the group of 13 host landowners associated with SWF. This occurred during one of many SWF host landowner group meetings and was largely an open discussion relating to the reasoning behind the combined approach and the preferable land type / areas that would be most suitable. The opportunity was left for the group to consider.

In parallel with early concept discussions with SWF host landowners, the proposal was also discussed with TransGrid in April 2016 in relation to design considerations associated with the substation proposed for SWF.

Further, the concept to co-locate solar and battery-based storage at the wind farm was presented to the SWF Community Consultative Committee (CCC) in August 2016. Attendees included representatives of Inverell Shire Council (ISC), SWF host landowners, SWF neighbouring landowners, community representatives and representation from NSW OEH. Apologies at this meeting included representation from Glen Innes Severn Council (GISC) and Church Communities Australia (neighbouring landholder), however follow-up discussions were held with the two absent CCC members over the period that immediately followed.

General interest to the proposal was received during this concept period, with the understanding that further discussions relating to the Proposed Development would ensue following financial close of the SWF which occurred in December 2016.

6.2.2 Consultation – Community and Potential Hosts

In February 2017, land suitability assessments were undertaken with a view to identifying preferable areas to host a development. The assessment involved evaluating topographic information such as contours and vegetation, with a land ownership overlay. This cursory evaluation provided the basis for consultations with the wider community.

Primary areas of interest included flat, clear land located close to the substation. In general, these criteria resulted in a focus towards the Kings Plains valley, which is an area generally bordered by Waterloo Road, and the Eastern and Western Feeder roads (Figure 6-1).

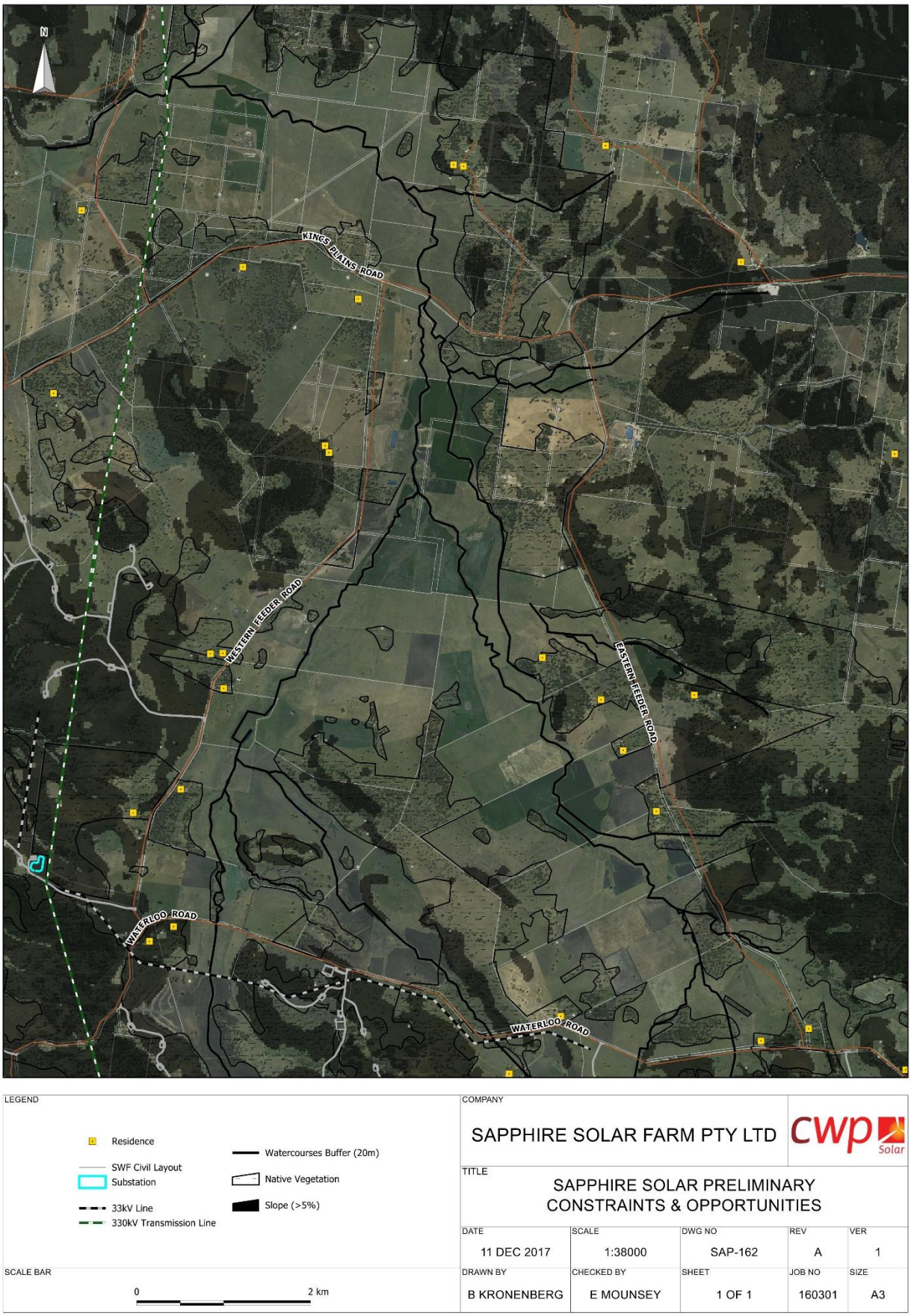

Figure 6-1 Preliminary Constraints and Opportunities

Initial targeted landowner discussions were held, which expanded to community-wide correspondence through email, aimed at drawing feedback from the wider community.

In March 2017 a community fire shed meeting was held to discuss the proposal. The meeting was attended by approximately 30 landowners from the locality and provided the opportunity for CWP Solar to outline the concept and areas of interest. Feedback received during this meeting identified concerns relating to visual impacts to neighbouring properties, the potential for property devaluation, impacts on agricultural use of the land, and the proposed commercial terms of hosting the project.

Note: All non-involved property owners with dwellings within 2 km of the current Proposed Development were in attendance at this meeting – R15, R17, R19 – and have remain included in all email correspondence to the community throughout the development phase.

6.2.3 Consultation – Design Refinement

Between March and July 2017, the project footprint was refined to address feedback received during the March fire shed meeting. The design focus shifted away from the main Kings Plains valley towards land surrounding the substation (generally in line with the current Proposed Development).

This process included continued discussions with those landowners who maintained an interest as potential hosts, and upon rationalising the design, continued correspondence with the wider community of the change to the proposed footprint. Correspondence with the wider community included emails sharing the revised footprint, in addition to targeted phone calls and/or meetings with those community members that raised concerns either during the March fire shed meeting, or generally throughout the period of consultation. This included residences R4, R17, R19, R21, R30, and R78, in addition to property owners located beyond 5 km of the Proposed Development.

Feedback on the revised footprint concluded that the design had addressed the concerns that had been raised, with a high level of acceptance towards the project location.

During this period, consultation with affected mining lease/licence holders was undertaken. The conclusion of these consultations is documented within the Proposal Description (Section 3.1).

6.2.4 Consultation –Environmental Assessment Requirements

In July 2017 the SSF PEA was lodged with the NSW Department of Planning and Environment (DPE), requesting that Secretary's Environmental Assessment Requirements (SEARs) to be issued. The project footprint outlined in the PEA (Figure 6-2) had been guided by preceding consultations (as outlined above).

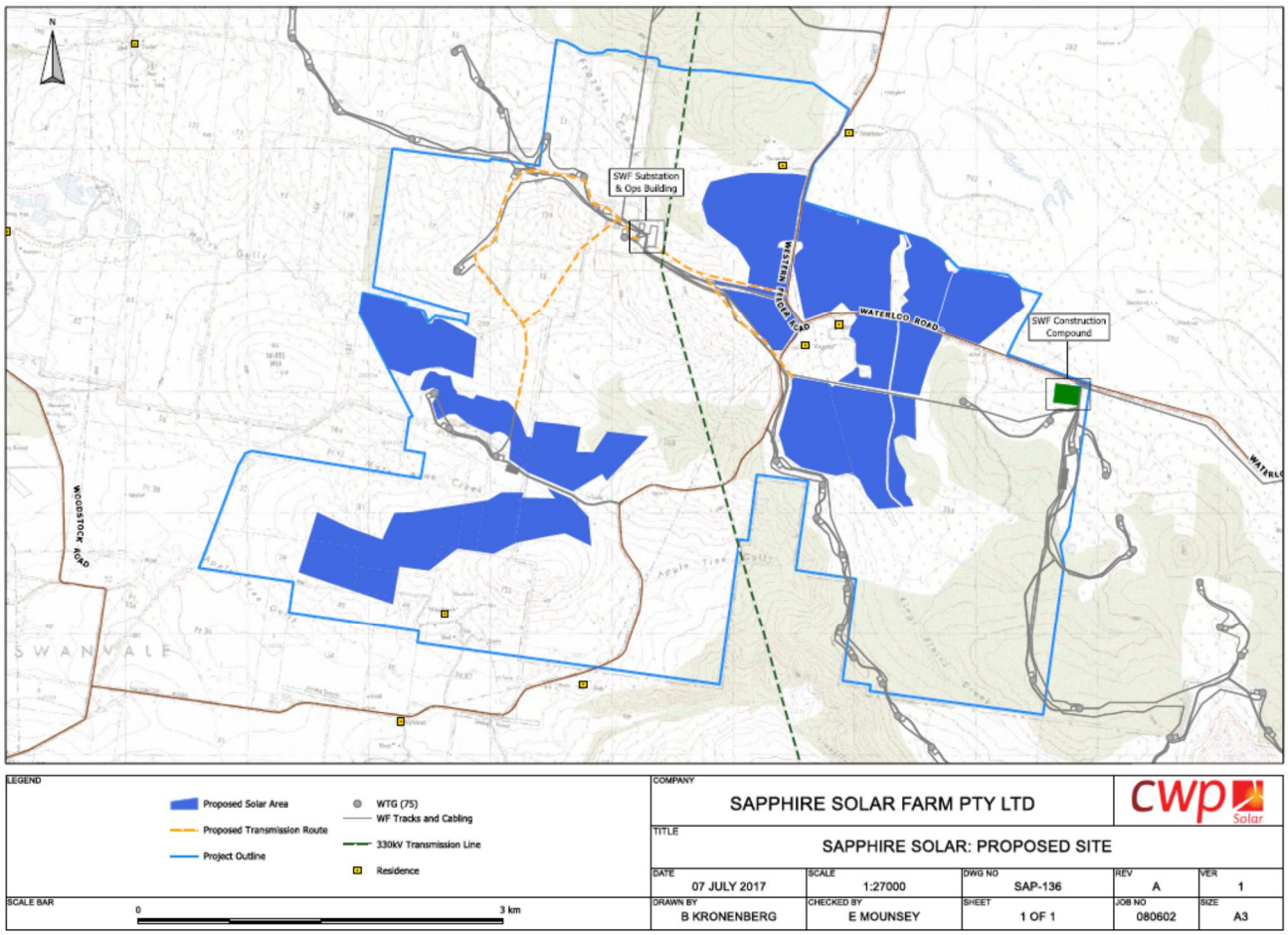

Figure 6-2: Sapphire Solar Farm proposed site map from PEA

Alongside other information, the PEA included a Zone of Theoretical Visual (ZTV) impact assessment which provides a theoretical indication of from where the proposed SSF may be viewed. This assessment indicated that of the three dwellings located within 2 km of the current Proposed Development, only R17 and R19 were within the potential viewshed of SSF. However, when considering the setting of both of these dwellings within the actual local context, it could be seen that R17 has a large stand of trees immediately to the south and west of the dwelling, providing natural screening, and R19 (located further from the project boundary) is similarly screened but through a combination of existing large stands and scattered trees across the viewing angle. A comprehensive visual impact assessment of the Proposed Development is included in Section 7.6.

The SEARs were provided by DPE on the 23rd of August 2016. The SEARs are intended to guide the structure and content of the EIS and reflect the responsibilities and concerns of NSW government agencies in relation to the environmental assessment of the Proposed Development.

During the preparation of the EIS according to the SEARs, it was identified that approval was likely required from the Australian Government Environment Minister due to impact significance on MNES, and the Proposed Development was referred to the Minister for consideration. The Minister determined the action as a Controlled Action (i.e. that approval was required under the EPBC Act) on 5th January 2018 (Appendix A). The Bilateral Agreement under section 45 of the EP&A Act, between the Commonwealth and NSW Governments

mandates that where an action is determined as a Controlled Action, the assessment responsibilities are vested in the NSW Major Projects assessment process with the provision of Commonwealth Assessment Requirements by the Commonwealth DotEE to the NSW DP&E. Those assessment requirements were provided to the NSW DP&E who incorporated them into revised SEARs which were issued on 10th January 2018.

A summary of key issues raised in the SEARs and the section of the EIS where they are addressed is provided in Table 6-3. In addition to the SEARs, additional issues raised by statutory agencies through formal correspondence attached to the SEARs are summarised in Table 6-4, together with the relevant section which addresses that issue in the EIS.

Table 6-3: Secretary's Environmental Assessment Requirements

Issue	Requirement	Section in EIS
General Requirements	▪ A stand-alone executive summary	Executive Summary
	▪ A full description of the development, including: o Details of construction, operation, upgrading and decommissioning; and o A site plan showing all infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process); o Detailed constraints map identifying the key environmental and other land use constraints that have informed the final design of the development.	Section 3 Figure 2.3 Figure 2.4
	▪ A strategic justification of the development focusing on site selection and the suitability of the proposed site.	Section 2
	▪ An assessment of the likely impacts of the development on the environment, focusing on the specific issues identified below, including: o A description of the existing environment likely to be affected by the development; o 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; o Consideration of the cumulative impacts of other developments (where relevant); o A description of the measures that would be implemented to avoid, mitigate and/or offset the impacts of the development (including draft management plans for specific issues as identified below); and o A description of the measures that would be implemented to monitor and report on the environmental performance of the development.	Section 7
	▪ A consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; and	Section 8

Issue	Requirement	Section in EIS
	▪ The reasons why the development should be approved having regard to: o Relevant matters for consideration under the EP&A Act, including the objects of the Act and how the principles of ecologically sustainable development have been incorporated into the design, construction and ongoing operations of the development; o The suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses; and o Feasible alternatives to the development (and its key components), including the consequences of not carrying out the development.	Section 9
Key Issues	Biodiversity	
	▪ An assessment of the likely biodiversity impacts of the development (including but not limited to the impacts on Box Gum Woodland and Derived Native Grassland and Ribbon Gum Mountain Gum Snow Gum Grassy Open Forest / Woodland Endangered Ecological Communities) having regard to having regard to the *NSW Biodiversity Offsets Policy for Major Projects*, and in accordance with the *Framework for Biodiversity Assessment*, unless otherwise agreed by the Department. ▪ An assessment of the likely impacts on aquatic ecology of waterways (including but not limited to Kings Plains Creek, Mary Anne Creek, Frazers Creek, Horse Gully and Apple Tree Gully).	Section 7.2 Section 7.9 Appendix B
	Heritage	
	▪ An assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development, including adequate consultation with the local Aboriginal community.	Section 7.3 and 7.4 Appendix C
	Land	
	▪ An assessment of the impact of the development on agricultural land, flood prone land, a soil survey to consider the potential for erosion to occur, and paying particular attention the compatibility of the development with the existing land uses on the site and adjacent land (e.g. operating mines, extractive industries, mineral or petroleum resources, exploration activities, aerial spraying, dust generation, and risk of weed and pest infestation) during operation and after decommissioning, with reference to the zoning provisions applying to the land.	Section 7.5 Section 7.9 Appendix D Appendix J
	Visual	
	▪ An assessment of the likely visual impacts of the development (including any glare, reflectivity and night lighting) on surrounding residences, scenic or significant vistas, air traffic and road corridors in the public domain, including a draft landscaping plan for on-site perimeter planting, with evidence to demonstrate it has been developed in consultation with affected landowners.	Section 7.6 Appendix E Appendix F
	Noise	
	▪ An assessment of the construction noise impacts of the development in accordance with the *Interim Construction Noise Guideline* (ICNG) and operational noise impacts in accordance with the *NSW Industrial Noise Policy* (INP), and a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria.	Section 7.7 Appendix G

Issue	Requirement	Section in EIS
	Transport	
	▪ An assessment of the site access route, the site access point off and likely transport impacts (including peak and average traffic generation) of the development on the capacity and condition of roads (including on any Crown land), a description of the measures that would be implemented to mitigate any impacts during construction, and a description of any proposed road upgrades developed in consultation with the relevant road authorities (if required).	Section 7.8 Appendix H
	Water	
	▪ An assessment of the likely impacts of the development (including flooding) on surface water (including Kings Plains Creek, Mary Anne Creek, Frazers Creek, Horse Gully and Apple Tree Gully and riparian land) and groundwater resources, wetlands, riparian land, groundwater dependent ecosystems, aquatic ecology, and acid sulfate soils), related infrastructure, adjacent licensed water users and basic landholder rights, and measures proposed to monitor, reduce and mitigate these impacts; ▪ Details of water requirements and supply arrangements for construction and operation; and ▪ A description of the erosion and sediment control measures that would be implemented in accordance with *Managing Urban Stormwater: Soils & Construction* (Landcom, 2004).	Section 7.9 Appendix I Appendix J
	Hazards and Risks	
	▪ A preliminary risk screening in accordance with the *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development* and *Applying SEPP 33* (DoP, 2011), and if the preliminary risk screening indicates the development is "potentially hazardous", a Preliminary Hazard Analysis (PHA) must be prepared in accordance with *Hazard Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis* (DoP, 2011) and *Multi-Level Risk Assessment* (DoP, 2011); and ▪ An assessment of all potential hazards and risks including but not limited to bushfires, spontaneous ignition, electromagnetic fields or the proposed grid connection infrastructure.	Section 7.10 Appendix K
	Socio-Economic	
	▪ An assessment of the likely impacts on the local community and a consideration of the construction workforce accommodation.	Section 7.12
	Cumulative Impacts	
	▪ An assessment of the cumulative impacts with the Sapphire Wind Farm, White Rock Wind Farm, White Rock Solar Farm and Glen Innes Wind Farm.	Section 7.13
Consultation	In preparing the EIS for the development, you should consult with relevant local, State or Commonwealth Government authorities, infrastructure and service providers, community groups and affected landowners. In particular, you must undertake detailed consultation with affected landowners surrounding the development, and Armidale Regional Council. The EIS must describe the consultation that was carried out, identify the issues raised during this consultation, and explain how these issues have been addressed in the EIS.	Section 6

Table 6-4: Key issues raised by statutory agencies

Agency	Issues raised	Section in EIS
NSW Department of Planning (Resources and Geoscience)	Identification of the current and applied for Mining Leases (MLs) and Exploration Licenses (ELs).	Section 7.5.2
	Consultation with the titleholders to determine their level of interest.	Section 1.3 Section 5.3.22 Section 7.5.2
	Clarify the sequence of land use, particularly within ML1687. Timeframes for mining activities, rehabilitation and solar farm construction works should be clearly described and demonstrated through evidenced consultation with the titleholder.	Section 7.5.2
	Review and updated for new mineral and energy titles that may be granted in the vicinity of the subject site during all decision making stages of the project.	Section 7.5
NSW Department of Primary Industries	The EIS should specifically address impacts on the aquatic ecology of waterways such as Kings Plains Creek, Mary Anne Creek, Frazers Creek, Horse Gully and Apple Tree Gully and controls to be established for access tracks, cabling, transmission lines or road upgrades in Key Fish Habitats. The aquatic ecology environmental assessment should include: ▪ A recent aerial photograph (preferably colour) of the locality (or reproduction of such a photograph); ▪ Area which may be affected either by the development or activity should be identified and shown on an appropriately scaled map (and aerial photographs); ▪ Waterways within the area of development are to be identified; ▪ The extent of aquatic habitat removal and riparian vegetation removal or modification which may result from the proposed development; ▪ Details of the location and design of proposed tracks or road upgrades crossing Key Fish Habitat; and ▪ Details of the methodology (e.g. trenching, boring) for any underground cabling or transmission lines that pass through Key Fish Habitat.	Section 7.9
	The EIS should specifically address: ▪ Outline the proposed management of ground cover to protect soil from erosion, including: o Appropriate expertise to be sought; o Pasture composition to be maintained; o Alternatives to be used to protect the soil if pasture establishment is not successful; and o Management of beneficial grazing to maintain ground cover.	Section 7.5

Agency	Issues raised	Section in EIS
	▪ Outline the rehabilitation objectives and strategies including indicators to be used to guide the return of the land back to agricultural production. Detailed location identification of any subsurface infrastructure that is to remain is required. ▪ Trenching through sodic soils during construction must include soil amendment. ▪ Identify placement of transmission lines and solar panels within the site in relation to Crown road reserves to allow for further assessment on the impact of access over the roads. The proponent will also be required to provide information in relation to formed access tracks to determine the impacts of the on Crown rods within the proposal area. This information should be provided in shapefile format at the time of the EIS exhibition.	
NSW Environment Protection Authority	The EIS should incorporate options and strategies for waste minimisation, reuse and recycling.	Section 7.11
	Impacts from dust generated during the construction phase should be identified and appropriate mitigation measures should be defined and implemented.	Section 7.5
	The EIS should ensure that adequate control measures are implemented to ensure the risk of spills to the environment are minimised.	Section 7.5.4
NSW Heritage Council	In areas identified as having potential archaeological significance, undertake comprehensive archaeological assessment in accordance with Heritage Council guidelines. This includes a methodology and research design to assess the impact of the works on potential archaeological resource to guide physical archaeological test excavations and include the results of these excavations	Section 7.3 Appendix C
	Consolation with the local Aboriginal Community should follow the OEH Aboriginal Cultural Heritage Consultation Requirements for Proponents. Consultation with the Local Aboriginal Land Council should begin at the planning stage of any assessment of the impacts of the Proposed Development on Aboriginal heritage values.	Section 6.2.6 Section 7.3 Appendix C
Roads & Maritime Services	That the Traffic Impact Assessment include: ▪ The total impact of existing and Proposed Development on the road network with consideration for a 10 year horizon; ▪ The volume and distribution of traffic generated by the proposed development; ▪ Intersection sight distances at key intersection/s along the nominated access route to the site; ▪ Existing and proposed site access standards; ▪ Details of proposed improvements to affected intersections, in particular assessment of impacts on	Section 7.8 Appendix H

Agency	Issues raised	Section in EIS
	safety and efficiency of junctions with the classified road network; ▪ Details of servicing and parking arrangements; ▪ Impact on public transport (public and school bus routes) and consideration for alternative transport modes such as walking and cycling; ▪ Impacts of road traffic noise and dust generated along the primary access route/s; ▪ Consideration of potential glare/reflectivity generated from on-site infrastructure towards public roads; and ▪ Details of a Transport Management Plan (TMP) to identify and manage impacts of construction and operational traffic on the safety and efficiency of the affected road network. The TMP may include temporary measures such as Traffic Control Plans to address construction related traffic at specific locations. The TMP should include a Driver Code of Conduct, which may include, but not be limited to the following: o A map of the primary access route/s highlighting critical locations; o Safety initiatives for transport through residential areas and/or school zones; o Consideration for coordination of construction traffic with seasonal agricultural haulage; o An induction process for vehicle operators & regular toolbox meetings; o A complaint resolution and disciplinary procedure; and o Any community consultation measures for the peak construction period.	It is concluded through the Traffic Assessment that a Driver's Code of Conduct should be conditioned as part of the Consent.
	Where road safety concerns are identified at a specific location along the identified access route/s the TIA may be accompanied by a targeted Road Safety Audit to address any road safety concerns.	Appendix H
Office of Environment & Heritage	Biodiversity	
	Biodiversity impacts related to the proposed project can be assessed and documented in accordance with the *Framework for Biodiversity Assessment*, unless otherwise agreed by OEH, by a person accredited in accordance with s142B(1)(c) of the *Threatened Species Conservation Act 1995.*	Section 7.2 Appendix B
	The EIS must identify and map woodland endangered ecological communities listed under the TSC Act, in accordance with the *OEH North East Branch Guidance Material – Crown Density Parameters for Mapping the Extent of Woodland Endangered Ecological Communities.*	Figure 7-2
	Aboriginal cultural heritage	

Agency	Issues raised	Section in EIS
	The EIS must identify and describe the Aboriginal cultural heritage values that exist across the whole area that will be affected by the project and document these in the EIS. This may include the need for surface survey and test excavation. The identification of cultural heritage values should be guided by the *Guide to investigation, assessing and reporting on Aboriginal Cultural Heritage in NSW* (DECCW 2011) and consultation with OEH regional officers.	Section 7.3 Appendix C
	Where Aboriginal cultural heritage values are identified, consultation with Aboriginal people must be undertaken and documented in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW). The significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be documented in the EIS.	Section 6.2.6 Section 7.3 Appendix C
	Impacts on Aboriginal cultural heritage values are to be assessed and document in the EIS. The EIS must demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcomes. Where impacts are unavoidable, the EIS must outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented and notified to OEH.	Section 7.3 Appendix C
	The assessment of cultural heritage values must include a surface survey undertaken by a qualified archaeologist in areas with potential for subsurface Aboriginal deposits. The result of the surface survey is to inform the need for targeted test excavation to better assess the integrity, extent, distribution, nature and overall significance of the archaeological record. The results of the surface survey and test excavations are to be documented in the EIS.	Section 7.3 Appendix C
	The EIS must outline the procedures to be followed if Aboriginal objects are found at any stage of the life of the development to formulate appropriate measures to manage unforeseen impacts.	Section 7.3.4 Appendix C
	Historic Heritage	
	The EIS must provide a heritage assessment including but not limited to an assessment of impacts to *State and local heritage* including conservation areas, natural heritage areas, places of Aboriginal heritage value, buildings, works, relics, gardens, landscapes, views, trees should be assessed. Where impacts to State or locally significant heritage items are identified, the assessment shall: ▪ Outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) generally consistent with the *NSW Heritage Manual* (1996); ▪ Be undertaken by a suitably qualified heritage consultant(s) (note: where archaeological excavations	Section 7.4 No Impacts to State or locally significant heritage items were identified. Therefore further assessment of impacts were not undertaken.

Agency	Issues raised	Section in EIS
	are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria); ▪ Include a statement of heritage impact for all heritage items (including significance assessment); ▪ Consider impacts including, but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, landscape and vistas, and architectural noise treatment (as relevant); and ▪ Where potential archaeological impacts have been identified develop an appropriate archaeological assessment methodology, including research design, to guide physical archaeological test excavations (terrestrial and maritime as relevant) and include the results of these test excavations.	
	Water and soils	
	The EIS must map the following features relevant to water and soils including: ▪ Acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Planning Map); ▪ Rivers, streams, wetlands, estuaries ; ▪ Groundwater; ▪ Groundwater dependent ecosystems; and ▪ Proposed intake and discharge locations.	Figure 7-9 and Appendix J Figure 7-20 and Figure 7-21 Figure 7-22 Figure 7-22 Appendix J
	The EIS must describe background conditions for any water resource likely to be affected by the project, including: ▪ Existing surface and groundwater; ▪ Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations; ▪ Water Quality Objectives (as endorsed by the NSW Government) including groundwater as appropriate that represent the community's uses and values for receiving waters; and ▪ Indicators and trigger values/criteria for the environmental values identified at (c) in accordance with the ANZECC (2000) Guidelines for Fresh and Marine Water Quality and/or local objectives, criteria or targets endorsed by the NSW Government.	Section 7.9.2 Appendix J
	The EIS must assess the impacts of the project on water quality, including: ▪ The nature and degree of impact on receiving waters for both surface and groundwater. Demonstrating how the project protects the Water Quality Objectives where they are currently being achieved, and contributes towards achievement of the Water Quality Objectives over time where they are not currently	Section 7.9.3

Agency	Issues raised	Section in EIS
	being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction; and ▪ Identification of proposed monitoring of water quality.	Appendix J
	The EIS must assess the impact of the project on hydrology, including: ▪ Water balance including quantity, quality and source; ▪ Effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas; ▪ Effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems; ▪ Impacts to natural processes and functions within rivers, wetlands, estuaries and floodplain that affect river system and landscape health such as nutrient flow, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches); ▪ Changes to environmental water availability, both regulated/licensed and unregulated/rules-based sources of such water; ▪ Mitigating effects of proposed stormwater and wastewater management during and after construction on hydrological attributes such as volumes, flow rates, management methods and re-use options; and ▪ Identification of proposed monitoring of hydrological attributes.	Appendix I Section 7.9.3 Section 7.9.3 Section 7.9.3 Section 7.9.3 Section 7.9.3 Section 7.9.4 Appendix J
	Flooding and coastal erosion	
	The EIS must map the following features relevant to flooding as described in the Floodplain Development Manual 2005: ▪ Flood prone land; ▪ Flood planning area, the area below the flood planning level; and ▪ Hydraulic categorisation (floodways and flood storage areas).	Section 7.9.3 Appendix I Section 7.9.32 Appendix J Appendix J
	The EIS must describe flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 1 in 10, 1 in 100 year flood levels and the probable maximum flood, or an equivalent extreme event.	Section 7.9.3 Appendix I
	The EIS must model the effect of the proposed project (including fill) on the flood behaviour under the following scenarios: ▪ Current flood behaviour for a range of design events as identified above. The 1 in 200 and 1 in 500 year flood events as proxies for assessing sensitivity to an	Section 7.9.3 Appendix I

Agency	Issues raised	Section in EIS
	increase in rainfall intensity of flood producing rainfall events due to climate change.	
	Modelling in the EIS must consider and document: ▪ The impact on existing flood behaviour for a full range of flood events including up to the maximum probable maximum flood; ▪ Impacts of the development on flood behaviour resulting in detrimental changes in potential flood affection of other developments or land. This may include redirection of flow, flow velocities, flood levels, hazards and hydraulic categories; and ▪ Relevant provisions of the NSW Floodplain Development Manual 2005.	Section 7.9.3 Appendix I
	The EIS must assess the impacts on the proposed project on flood behaviour, including: ▪ Whether there will be detrimental increases in the potential flood affection of other properties, assets and infrastructure; ▪ Consistency with Council floodplain risk management plans; ▪ Compatibility with the flood hazard of the land; ▪ Compatibility with the hydraulic functions to flow conveyance in floodway's and storage in flood storage areas of the land; ▪ Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site; ▪ Whether there will be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses; ▪ Any impacts the development may have upon existing community emergency management arrangements for flooding. These matters are to be discussed with the SES and Council; ▪ Whether the proposal incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the SES and Council; ▪ Emergency management, evacuation and access, and contingency measures for the development considering the full range or flood risk (based upon the probable maximum flood or an equivalent extreme flood event). These matters are to be discussed with and have the support of Council and SES; and ▪ Any impacts the development may have on the social and economic costs to the community as consequences of flooding.	Section 7.9 Appendix I Appendix J Appendix J Appendix J Section 7.9.3 Section 7.9.3 Section 7.9.3. Appendix J Appendix J Section 7.9.3

Agency	Issues raised	Section in EIS
Commonwealth Department of the Environment and Energy	General Requirements	
	Project Description ▪ The title of the action, background to the development and current status. ▪ The precise location and description of all works to be undertaken (including associated offsite works and infrastructure), structures to be built or elements of the action that may have impacts on matters of national environmental significance (MNES). ▪ How the action relates to any other actions that have been, or are being taken, in the region affected by the action. ▪ How the works are to be undertaken and design parameters for those aspects of the structures or elements of the action that may have relevant impacts on MNES.	Section 1,2 and 3 Section 1,2,3,and 4 Section 7.13 Section 7.2 and Appendix B
	Impacts The Environmental Assessment (EA) must include an assessment of the relevant impacts1 of the action on threatened species and communities; including ▪ a description and detailed assessment of the nature and extent of the likely direct, indirect and consequential impacts, including short term and long term relevant impacts; ▪ a statement whether any relevant impacts are likely to be known, unpredictable or irreversible; analysis of the significance of the relevant impacts; ▪ any technical data and other information used or needed to make a detailed assessment of the relevant impacts; and ▪ a comparative description of the impacts of alternatives, if any, on the threatened species and communities.	Section 7.2.3 and Appendix B
	Avoidance, mitigation and offsetting For each of the relevant matters protected that are likely to be significantly impacted by the development, the EA must provide information on proposed avoidance and mitigation measures to deal with the relevant impacts of the action, including: ▪ a description and an assessment of the expected or predicted effectiveness of the mitigation measures; ▪ any statutory policy basis for the mitigation measures; ▪ the cost of the mitigation measures; ▪ a description of the outcomes that the avoidance and mitigation measures will achieve; ▪ an outline of an environmental management plan that sets out the framework for continuing management,	Section 7.2.4 and Appendix B Avoidance – Table 7-4 – 7-7 Mitigation – Table 7-8 and 7-9 Offsets – Section 7.2.4 & Table 7-10

Agency	Issues raised	Section in EIS
	mitigation and monitoring programs for the relevant impacts of the action; ▪ the name of any agency responsible for endorsing or approving a mitigation measure or monitoring program; and ▪ a description of the offsets proposed to address the residual adverse significant impacts and how these offsets will be established.	
	Where a significant residual adverse impact to a threatened species or community is considered likely, the EA must provide information on the proposed offset strategy, including discussion of the conservation benefit associated with the proposed offset strategy.	Section 7.2.4 & Table 7-10
	Key Issue - Biodiversity	
	The EA must address the following issues in relation to Biodiversity including separate: ▪ identification of each EPBC Act listed threatened species and community likely to be impacted by the development. Provide evidence why other EPBC Act listed threatened species and communities likely to be located in the project area or in the vicinity will not be impacted.	Appendix B (Section 5.3.2 & Likelihood of Occurrence (Table 14))
	For each of the relevant EPBC Act listed threatened species and communities likely to be impacted by the development the EA must provide a separate: ▪ description of the habitat and habits (including identification and mapping of suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advice, conservation advice and recovery plans, threat abatement plans and wildlife conservation plans; ▪ details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Australian Government guidelines and policy statements; and ▪ description of the impacts of the action having regard to the full national extent of the species or community's range.	Appendix B Appendix B (Section 4, Figures 6 and 7) Appendix B (Section 4 – FBA methods) Appendix B (Section 7, Table 23)
	For each of the relevant EPBC Act listed threatened species and communities likely to be significantly impacted by the development the EA must provide a separate:	Appendix B (Section 8 and Section 9)

Agency	Issues raised	Section in EIS
	▪ identification of significant residual adverse impacts likely to occur after the proposed activities to avoid and mitigate all impacts are taken into account; ▪ details of how the current published NSW Framework for Biodiversity Assessment (FBA) has been applied in accordance with the objects of the EPBC Act to offset significant residual adverse impacts; and ▪ details of the offset package to compensate for significant residual impacts including details of the credit profiles required to offset the development in accordance with the FBA and/or mapping and descriptions of the extent and condition of the relevant habitat and/or threatened communities occurring on proposed offset sites.	
	Any significant residual impacts not addressed by the FBA may need to be addressed in accordance with the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offset Policy. http://www.environment.gov.au/epbc/publications/epbc-actenvironmental-offsets-policy.	Appendix B (Section 8 and Section 9)
	For each threatened species and community likely to be significantly impacted by the development, the EA must provide reference to, and consideration of, relevant approved conservation advice or recovery plan for the species or community.	Appendix B (Section 8 and Section 9)
	Environmental Record	
	Information in relation to the environmental record of a person proposing to take action must include details as prescribed in Schedule 4 Clause 6 of the EPBC Regulations 2000.	Section 1.4 and Appendix B
	Information sources	
	For information given in the EA, the EA must state the source of the information, how recent the information is, how the reliability of the information was tested; and what uncertainties (if any) are in the information.	Section 11 and Appendix B

In the period following submission of the PEA, a media release detailing the project was issued to the local newspapers and radio stations. This was picked up by both Inverell and Glen Innes print media and a radio interview was held with ABC Tamworth, which extends throughout the New England region of NSW.

Further, to accompany the lodgement of the PEA, CWP requested of the DPE via the remit of the SWF CCC Chairperson, that the operating SWF CCC could be expanded to incorporate the Proposed Development. Feedback from the DPE indicated that while a CCC was not a requirement for the Proposed Development, it would be a welcomed initiative. Consequently, an invitation to participate in the CCC with regard to SSF was extended to the wider community through the group email.

Further, in August 2017 a second fire shed meeting was arranged to hear community-wide feedback to the PEA. The meeting was attended by three proposed host landowners and one member of the community. As a consequence of this low attendance, one-to-one phone calls and meetings were undertaken, focussing on those members of the wider-community that had raise initial concerns in March 2017, to gather feedback on the submitted proposal. These discussions reaffirmed a general consensus towards the revised project location and included conversations with the owners of R17 and R19.

6.2.5 Consultation – Council

Ongoing consultation with Council occurred during August 2017, with a focus on areas for consideration within the EIS. These consultations with ISC and GISC highlighted impacts to local roads and management of waste streams arising from project construction and operation. In this regard, information relating to vehicle type, volume and movement profiles and materials associated with the construction and operation of the Proposed Development were shared with both Councils. Feedback received has been considered within Traffic and Transport and Waste Section 7.8 and 7.11, respectively.

6.2.6 Consultation – Registered Aboriginal Parties

Consultation with the Aboriginal community was conducted by NSW Archaeology Pty Ltd in accordance with guidance set out in the DECCW (2010a) document *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*. A summary of the consultation is provided in the draft Aboriginal Cultural Heritage Assessment (ACHA) provided in Appendix C. Registered Aboriginal Parties (RAPs) have had the opportunity to provide feedback on the draft ACHA prior to its finalisation and submission to OEH.

The ACHA identifies ongoing consultation commitments and recommends the development of a Cultural Heritage Management Plan (CHMP) to guide this process.

6.2.7 Consultation – SWF CCC

In October 2017, CWP presented the status of the project to the SWF CCC. The presentation included an outline of the consultation process (discussed above), maps of the project footprint, a discussion about the combining the generation from SWF with generation and storage from the Proposed Development to provide firm and dispatchable power, and the process going forward. The presentation was followed by a general question and answer session, generally focussed around the technology and combined energy generation offering.

Additionally, it was offered and accepted that the SWF CCC members were to be included in all future email correspondence direct towards the wider community in relation to the Proposed Development.

6.2.8 Consultation – Host landowner and Community

In November 2017, changes to development were made to accommodate host landowner requirements. This resulted in solar array areas being relocated from Landowner 5, to areas within Landowners 3 and 4. These changes were shared with the wider community via email and the provision of an updated map in November 2017.

Phone discussions and email exchanges were undertaken following the visual impact assessment which identified some potentially affected residences. Responses were positive, with R19 and R30 advising that while generally unconcerned, they would be happy in principal with visual screening if required, and they were happy to decide on the need for that following construction.

In addition, during the month, phone correspondence, face-to-face meetings and letters describing the project were sent to all owners of residences fronting Waterloo Road. Discussions and subsequent letter correspondence addressed the Proposed Development in light of construction traffic impacts arising from the use of Waterloo Road.

6.2.9 Ongoing Stakeholder Consultation

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

7 Environmental Assessment

7.1 Assessment methodology

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

Issues	Section
Biodiversity	7.2
Aboriginal cultural heritage	7.3
Historic heritage	7.4
Land use and soils	7.5
Visual impact	7.6
Noise	7.7
Traffic and access (Transport)	7.8
Water resources	7.9
Hazards and Risks (Battery Storage, Bushfire and electrical fire, Electromagnetic interference)	7.10
Waste and resource use	7.11
Socio-Economic factors	7.12
Cumulative Impacts	7.13

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

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

Mitigation measures are proposed to effectively manage all potential environmental impacts. These may include design considerations, monitoring strategies, construction safeguards, consultation, training and awareness programs, modified work practices, management plans or other relevant management strategies. A full list of mitigation and environmental management strategies and commitments is provided in Environmental Management (Section 8).

The Project Justification (Section 9) provides triple-bottom-line (environmental/social/economic) evaluation of the Proposed Development in order to fully describe potential benefits and impacts to the environment and the local, regional and NSW community.

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

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

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

The Conclusion (Section 10) integrates the relevant Statutory and Planning Framework (Section 5) and commitments made through the Stakeholder and Community Consultation process (Section 6) with the findings of the Environmental Assessment to provide a concise statement regarding the suitability of the Proposed Development and outlines any key points for consideration as part of the development approval process.

7.2 Biodiversity

7.2.1 Introduction

As the Proposed Development is SSD, the impacts must be assessed under the Framework for Biodiversity Assessment (FBA; OEH 2014) and a Biodiversity Assessment Report (BAR) must be prepared. The purpose of this BAR is to assess the impacts to biodiversity, propose mitigating and ameliorating options, as well as calculate offsets for unavoidable residual impacts.

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

- Co-locates services, access, infrastructure, and construction facilities with existing disturbance areas of the SWF;
- Locates panel arrays within areas of cultivation;
- Provides for a facility that compliments the existing SWF development; and
- As far as practicable avoids drainage lines, high quality vegetation, and known threatened species records.

Given the Controlled Action decision for MNES which has invoked the bilateral assessment process, this biodiversity assessment meets the Commonwealth DotEE assessment requirements by applying the FBA (and other additional methods as required).

The biodiversity assessment was undertaken using a combination of desktop and field surveys. Field surveys were undertaken during the period 27 November 2017 to 1 December 2017.

7.2.2 Existing Environment

Biophysical

The Proposed Development is located within the Kings Plains district of the New England Tablelands. The landscape is a basin with undulating tertiary basalt hills as well as alluvial plains within drainage lines. The Site is in the Mitchell Landscape 'Glen Innes – Guyra Basalts'.

Australian Soil Classification mapping indicates Ferrosols and Dermosols are found on upper slopes, with Vertosols within valleys and major drainage lines. Native vegetation within the locality is considerably degraded from ongoing agricultural impacts. The majority of native vegetation present is in the form of open woodland separating cropland and improved pastures.

The hydrology of the Site is typified by ephemeral first order streams. Several of these streams intersect each other across the Site to form Frazers Creek and Mary Anne Creek which are classed as second order streams (Strahler, 1952), as well as Kings Plains Creek which is a third order stream, and Horse Gully which is a fourth order stream beyond the Site. All streams were not flowing at the time of field surveys.

Land Uses

The primary land use locally is agriculture including sheep and cattle grazing, as well as extensive cropping. The majority of the locality is occupied by improved pastures and there are very few areas remaining that do not have any nutrient enrichment. The primary extractive industry locally included sapphire mining and quarrying for local aggregates.

The development site is currently used for agricultural purposes as well as a wind farm, and has been substantially cultivated. 76% of the infrastructure footprint is considered cleared land, with only 7% of the infrastructure footprint occupied by poor condition woodland vegetation. The SWF is currently under construction within the same landownership as the proposed SSF. There are several other renewable energy projects locally including the White Rock wind and solar farms and Glen Innes Wind Farm.

Native Vegetation

The Infrastructure Footprint is 445 ha in size which includes 104.1 ha of native vegetation and 341 ha of cleared land. The extent of native vegetation was determined through aerial imagery, in conjunction with field assessments.

The majority of paddocks within the Infrastructure Footprint had been sown with pasture fodder such as *Paspalum dilatatum* (Paspalum), *Trifolium* sp. (Clover), and *Phalaris aquatica* (Phalaris) within recent years leading up to the field survey. Paddocks that had not been recently ploughed, still showed evidence of ploughing and pasture improvement from previous years and had a species assemblage similar to that of currently ploughed paddocks. Nineteen full floristic plots and plot transects were undertaken across the Infrastructure Footprint, which included eleven plots within grassland areas to determine whether or not the paddocks should be incorporated as a plant community type (PCT) in the form of a derived native grassland (DNG). All grassland within the Infrastructure Footprint was in poor condition with varying abundances of native perennial groundcover, with native species generally confined to localised occurrences of species, at a ground cover of generally less than 50%. All cropland has been excluded from the biodiversity assessment and is mapped as cleared land.

Given the extensive history of pastoral disturbance within the Infrastructure Footprint, native woody vegetation extent has predominately been mapped as the canopy cover of paddock trees. Trees where the canopy extent is closer than 50 m to each other have been joined to form a single polygon, recognising the potential connective biodiversity values of adjacent paddock trees, as well as the guidance material provided by OEH in the SEARs.

Areas where native perennial groundcover was visibly more abundant were mapped as DNG of adjacent woodland PCTs, and assessed accordingly. Three PCTs were identified within the Infrastructure Footprint (Figure 7-1), all of which occur as woodland and DNG forms:

- PCT510 (BR272): Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion;
- PCT921 (BR153): Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tableland Bioregion and NSW North Coast Bioregion; and
- PCT1383 (BR240): White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion.

All PCTs are heavily impacted by the current agricultural practices used within the Infrastructure Footprint. The mid-storey has been removed from all PCTs and the ground layer has been extensively modified from ploughing, nutrient enrichment, and sowing of pasture grasses, as well as current grazing by sheep, cattle, and infrequent impacts by feral animals such as *Lepus europaeus* (Brown Hare) and *Sus scrofa* (Feral Pig) which were both observed during field surveys.

All vegetation within the Infrastructure Footprint was stratified into vegetation zones (different areas of PCTs in the same broad condition). As the Proposed Development occurs within an area of homogenous vegetation, only one vegetation patch has been identified within the Infrastructure Footprint. A summary of vegetation zones occurring within the Infrastructure Footprint is shown in Table 7-1.

Table 7-1: Summary of Vegetation Zones within Site

Zone	PCT	Condition	Area (ha)	Site Value Score
1	PCT1383: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion	Poor	3.89	20.83
2	PCT1383: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion	DNG	41.2	16.67
3	PCT510: Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion	Poor	10.58	17.19
4	PCT510: Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion	DNG	19.75	14.06
5	PCT921: Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tableland Bioregion and NSW North Coast Bioregion	Poor	15.83	31.08
6	PCT921: Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tableland Bioregion and NSW North Coast Bioregion	DNG	12.85	9.90

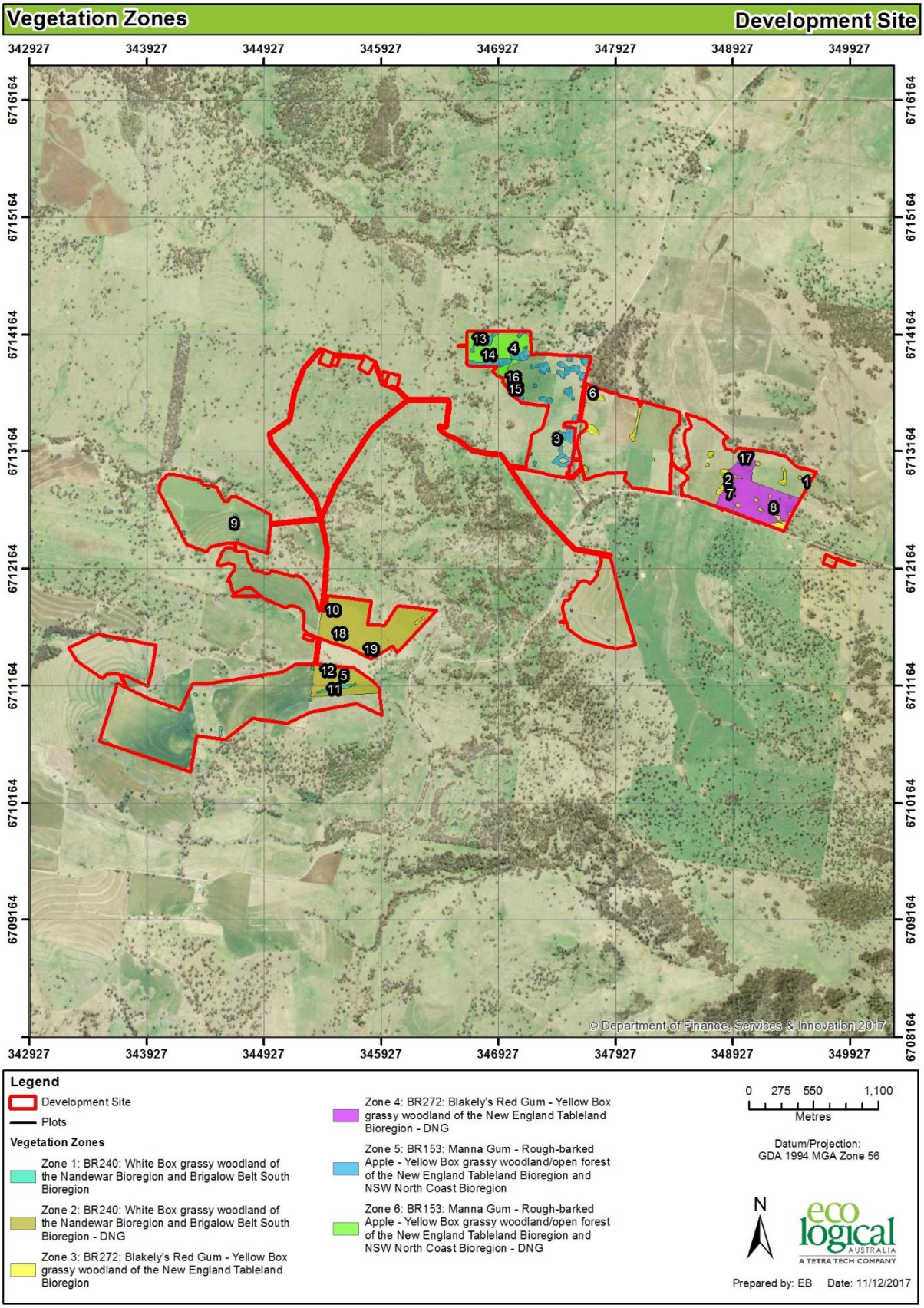

Figure 7-1 Vegetation Zones

Habitat within the Infrastructure Footprint is highly modified due to persistent and extensive impacts of agriculture. The Proposed Development has been intentionally located within areas of agricultural disturbance, to reduce the potential ecological impacts of the Proposed Development.

Canopy species within the Infrastructure Footprint have been retained as scattered paddock trees with limited habitat complexity to provide fauna habitat potential. The mid-storey is absent and the groundcover is almost exclusively exotic pasture grasses. There is no accumulated leaf litter or rocky outcrops present. There are however many hollow-bearing trees within the Infrastructure Footprint.

The following habitat features of relevance to the FBA are present within the Infrastructure Footprint:

- Coastal headlands, grassland, grassy open forest or woodland on fertile or moderately fertile soils;
- Land within 40 m of watercourses, containing hollow-bearing trees, loose bark and/or fallen timber;
- Grassy forest or woodland on fertile or moderately fertile soils;
- Seeding native grasses within 100 m of water courses;
- Shallow or infertile soils; and
- Land within 100 m of stream or creek banks.

Threatened species and populations

Targeted surveys for threatened flora have been carried out on 27 November to 1 December 2017, and subsequent surveys were carried out between 18 and 20 December 2017. Targeted surveys for *D. setosum* and *T. australe* were undertaken across the development site in areas of suitable habitat. *Picris evae, E. nichollii* and *Polygala linariifolia* were also considered during surveys although less likely to occur given the disturbance history at the site. Local reference sites for *D. setosum* and *T. australe* were initially inspected to assess adequacy of survey timing.

Potential occurrences of *D. setosum* were detected at 62 locations. The majority of detections were in areas that were either protected from ploughing by a physical structure such as a fence line, rocky outcrop, or steep topography. Samples have been sent to the National Herbarium of NSW for confirmation of the species occurrence. Sample locations can be seen in (Figure 7-2). *T. australe* was positively identified outside the development site. No other threatened flora were observed within the development site.

Survey results for threatened fauna detected only common species. *Eucalyptus blakelyi* were in profuse flower at the time of surveys. Woodland birds recorded within the development site included *Cracticus tibicen* (Australian Magpie), *Glossopsitta concinna* (Musk Lorikeet), as well as *Platycercus eximius* (Eastern Rosella).

No Regent Honeyeaters were detected during the surveys. Whilst the vegetation within the development site may provide foraging habitat for the species on occasion, it is highly unlikely that the species utilises the development site for breeding.

Spotlighting surveys identified *Ninox boobook* (Southern Boobook), *Podargus strigoides* (Tawny Frogmouth), and *Trichosurus vulpecula* (Brush-tailed Possum).

The BioBanking Credit Calculator Version 4.0 (BBCC) generates a list of predicted species known as 'ecosystem species'. A complete list of all predicted ecosystem species is provided in Appendix B.

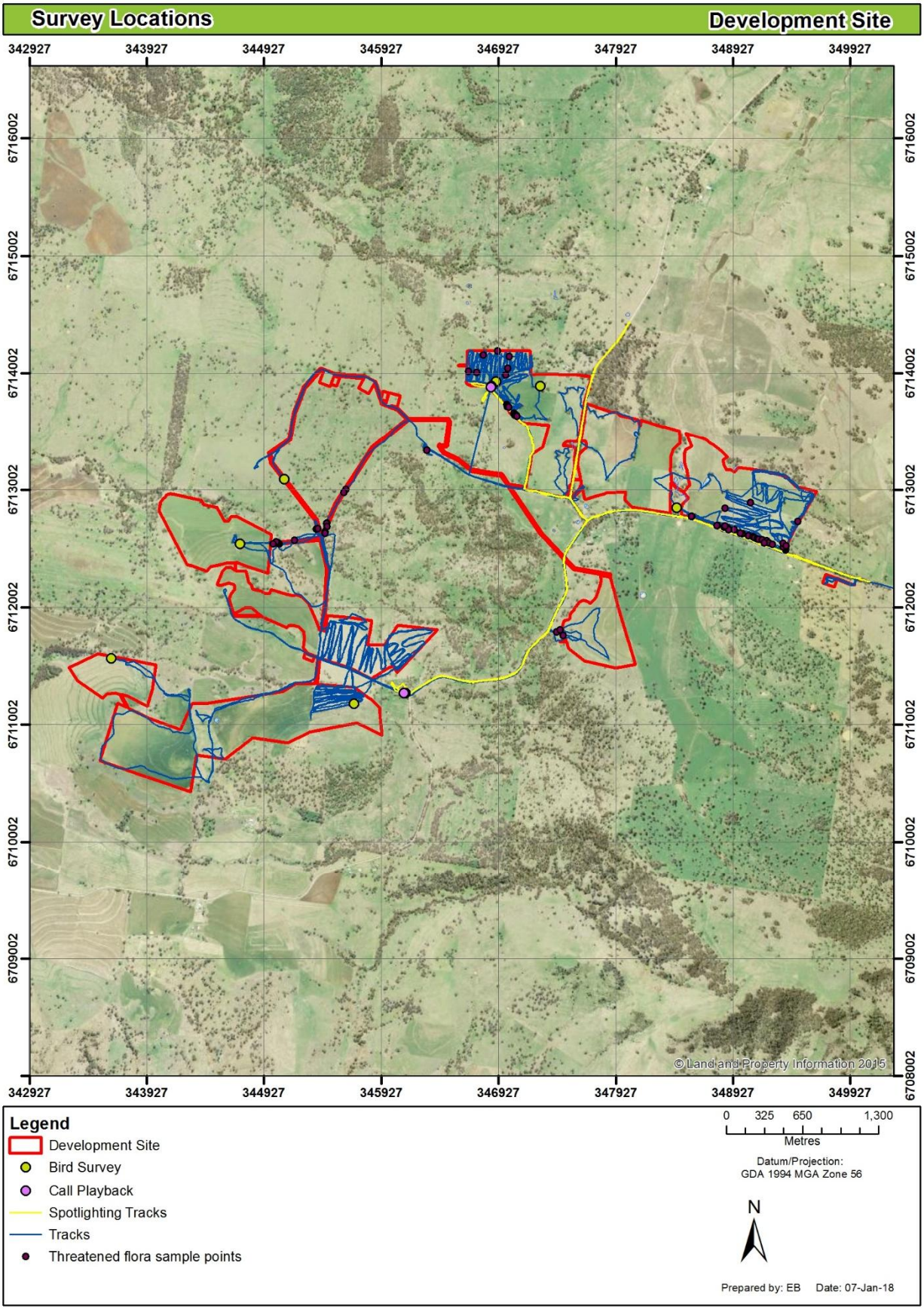

Figure 7-2: Flora and fauna survey location and effort

Threatened ecological communities

An assessment of the potential threatened ecological communities (TECs) under both the BC Act and EPBC Act has been undertaken to determine whether any of the PCTs present within the study area are consistent with the descriptions for these TECs. A map of the TECs within the Infrastructure Footprint is shown in Figure 7-3.

One TEC listed under the BC Act was identified as occurring within the Infrastructure Footprint:

- White Box Yellow Box Blakely's Red Gum Woodland.

One TEC listed under the EPBC Act was identified as occurring within the Infrastructure Footprint:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

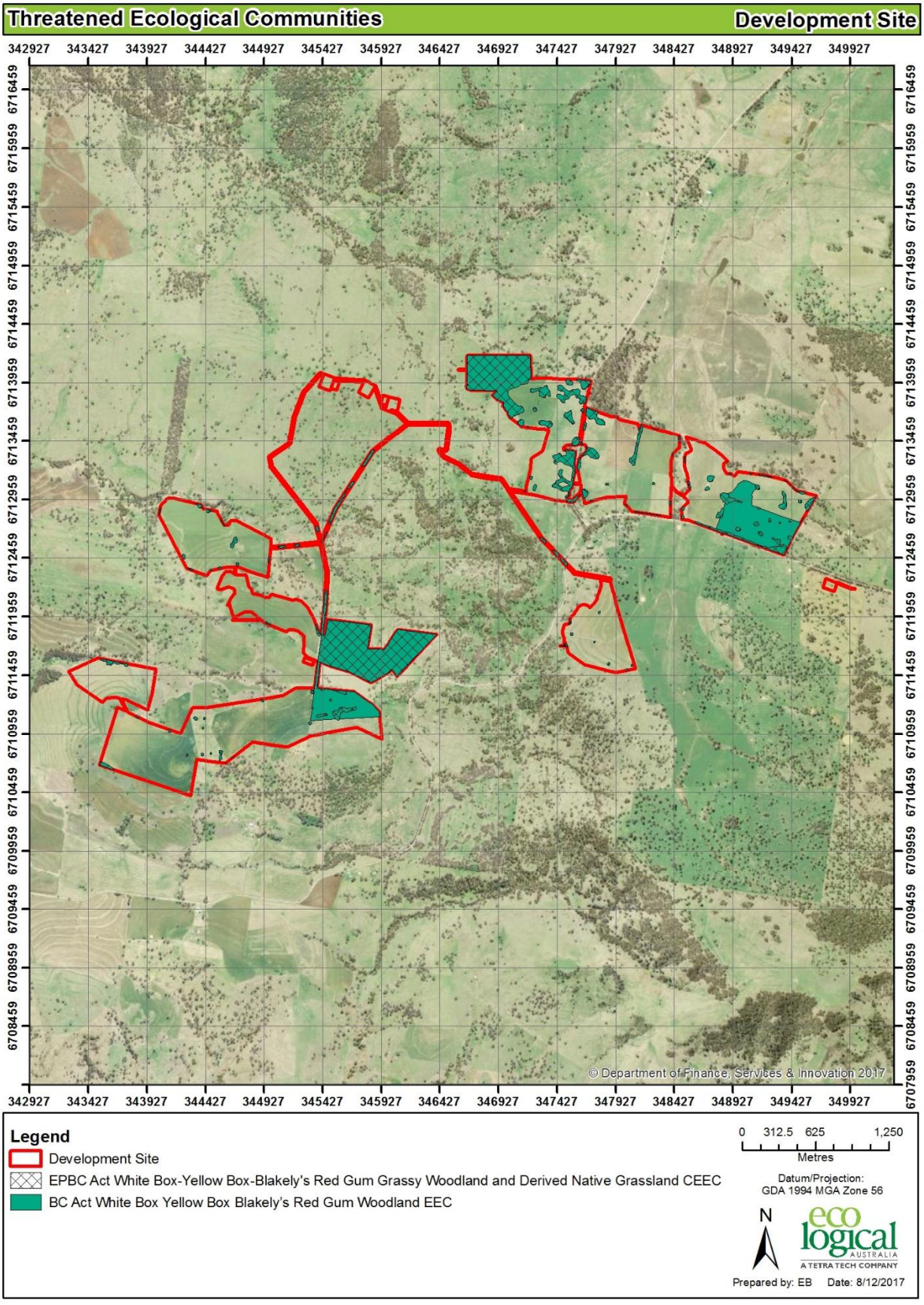

Figure 7-3: Threatened ecological communities within the Infrastructure Footprint

Table 7-2: Assessment of EPBC Box Gum Woodland

Zone	Plant Community Type	Plot	Native perennial cover (%)	Exotic perennial (%)	% total perennial cover native	BC Act (ha)	EPBC Act (ha)
1	PCT1383: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion	Plot 09	53.5	16.4	77%	3.89	1.08. Patches of the community are not connected and do not contain the sufficient assemblage of native non-grass species
		Plot 11	14.8	95.7	13%		
2	PCT1383: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - DNG	Plot 05	25.7	53	33%	41.2	30.01. Areas within the paddock containing plots 05, 10, and 12 do not contain native ground layer
		Plot 10	9.9	101.5	9%		
		Plot 12	16.3	79.1	17%		
		Plot 18	55.1	37.7	59%		
		Plot 19	63	22	74%		
3	PCT510: Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion	Plot 01	7	55.9	11%	10.58	7.86 Patches of the community are not connected and do not contain the sufficient assemblage of native perennial species
		Plot 02	21.1	50.6	29%		
		Plot 06	15.4	38.9	28%		
4		Plot 07	12.2	52.6	19%	19.75	

Zone	Plant Community Type	Plot	Native perennial cover (%)	Exotic perennial (%)	% total perennial cover native	BC Act (ha)	EPBC Act (ha)
	PCT510: Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion - DNG	Plot 08	5.1	66.3	7%		0. The ground layer is not predominately native
		Plot 17	38.8	42.8	48%		
5	PCT921: Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tableland Bioregion and NSW North Coast Bioregion	Plot 03	3.9	84	4%	15.83	14.75 Patches of the community are not connected and do not contain the sufficient assemblage of native perennial species
		Plot 04	22.4	55	29%		
		Plot 15	5.1	37.5	12%		
6	PCT921: Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tableland Bioregion and NSW North Coast Bioregion - DNG	Plot 13	55.3	26.8	67%	12.85	12.85
		Plot 14	41.4	32.5	56%		
		Plot 16	71.9	7.4	91%		

7.2.3 Potential Impacts

The Proposed Development will unavoidably impact up to 104.1 ha of native vegetation, which includes vegetation communities listed under the BC Act and EPBC Act. Noteworthy is that this area calculation includes an overestimation of the actual vegetation to be cleared because it uses the entire solar PV inclusion area as a 'block' of vegetation which will be completely cleared whereas the solar panel arrangement is panels in rows separated by approximately 4-7m between which current vegetation will mostly remain (refer to Sections 2 and 3 for a description of the Proposed Development). The same is true for the transmission line route which is taken as a complete area of clearance however during operation a grassland with low trees/shrubs can be maintained within operational limits. A summary of the vegetation zone areas to be directly impacted by the Proposed Development is shown in Table 7-3.

Table 7-3: Direct loss of native vegetation

Zone	PCT name	BC Act	EPBC Act	Area to be removed (ha)
1	PCT1383: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion	White Box Yellow Box Blakely's Red Gum Woodland EEC	Portions of the community are White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC	3.89
2	PCT1383: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - DNG	White Box Yellow Box Blakely's Red Gum Woodland EEC	Portions of the community are White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC	41.2
3	PCT510: Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion	White Box Yellow Box Blakely's Red Gum Woodland EEC	Portions of the community are White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC	10.58
4	PCT510: Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion – DNG	White Box Yellow Box Blakely's Red Gum Woodland EEC	-	19.75
5	PCT921: Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tableland Bioregion and NSW North Coast Bioregion	White Box Yellow Box Blakely's Red Gum Woodland EEC	Portions of the community are White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC	15.83
6	PCT921: Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tableland Bioregion and NSW North Coast Bioregion – DNG	White Box Yellow Box Blakely's Red Gum Woodland EEC	White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC	12.85
Total				104.1

7.2.4 Mitigation Measures

Under the FBA the proponent must design the Proposed Development to minimise impacts to biodiversity. Specifically, the FBA requires proponents to identify and avoid direct impacts to:

- Threatened Ecological Communities;
- PCTs that contain threatened species habitat;
- Threatened species that cannot be predicted by vegetation type;
- Declared critical habitat; and
- Regional and state significant biodiversity links.

A summary of the impact avoidance methods of the Proposed Development are provided below (Table 7-4).

Table 7-4: Avoidance of Direct Impacts

Direct Impact to be Avoided	Method to Avoid Impact
Impacts to EECs and CEECs	The Infrastructure Footprint is located so as to minimise impacts upon EECs identified. Impacts to EECs have been minimised by locating the proposed development on land that is currently developed. The EECs that will be impacted by the proposal are currently of low native species integrity (i.e. in cleared farmland) or within existing easements of the SWF.
Impacts to PCTs that contain threatened species habitat	All PCTs within the Infrastructure Footprint are identified as potential foraging habitat for highly mobile fauna species. There are no caves, and no rocky outcrops. The vegetation within the Infrastructure Footprint will be intermittently used by mobile fauna species, however will not be used as breeding or refuge habitat for threatened species.
Impacts to areas that contain habitat for Vulnerable, Endangered, or Critically Endangered threatened species or populations in accordance with Step 5 in Section 6.5 of the FBA	*D. setosum* is potentially identified within the Infrastructure footprint. Areas where positively identified shall be mapped and avoided through the design and construction phases of the project.
Impacts to areas of land that the Minister for Environment has declared as critical habitat in accordance with s47 of the TSC Act	Critical habitat has not been identified within the Infrastructure Footprint.
Impacts to riparian areas of 4th order or higher streams and rivers, important wetlands and estuaries	The Infrastructure Footprint will not impact on riparian areas of rivers, wetlands, estuaries, or 4th order (or higher) streams
Impacts to state significant biodiversity links	No state significant biodiversity links have been identified within the Infrastructure Footprint

Site selection was undertaken considering the extent of known biodiversity values, as well as the extent of current disturbance within the Infrastructure Footprint. A summary of considerations during the selection of the Infrastructure Footprint is shown in Table 7-5.

Table 7-5: Avoidance and minimisation of direct impacts through site selection

Site selection criteria	Method to avoid impact
Selecting a suitable development site for a Major Project or a route for linear projects, should be informed by knowledge of biodiversity values. An initial desktop assessment of biodiversity values would assist in identifying areas of native vegetation cover, EECs or CEECs, and potential habitat for threatened species	The broader study area has been subject to multiple NSW and Commonwealth assessments as part of the SWF. For the SSF, a desktop and field assessment was conducted within the development site in 2017 by Environmental Property Services Pty Ltd (EPS) to determine the areas of native vegetation cover, EECs or CEECs, and potential habitat for threatened species.
Stage 1 of the FBA will provide the preliminary information necessary to inform project planning. Early consideration of biodiversity values is recommended in site selection, or route selection for linear projects, and the planning phase.	Biodiversity values were identified within the development site by ELA from 2008, identifying areas of key biodiversity significance within the SWF boundary. Previous assessments were reviewed when planning the development footprint. The Infrastructure Footprint has undergone several iterations including a significant reduction since preparation of the PEA, with the final footprint avoiding as much EEC as possible. Areas of native grassland previously identified within the PEA have been avoided where practicable, and areas with known threatened species have been avoided.
The site/route selection process should include consideration and analysis of the biodiversity constraints of the site and consider the suitability of the Major Project based on the types of biodiversity values present on the site	As identified above, previous assessments as well as the PEA were conducted to determine areas of biodiversity constraints by ELA since 2008 as well as a PEA by EPS in 2016. The current development footprint reflects the retention, where possible, of existing biodiversity within the Infrastructure Footprint.
When considering and analysing the biodiversity constraints for the purpose of selecting a site, the following matters should be addressed: (a) whether there are alternative sites within the property on which the Proposed Development is located where siting the proposed Major Project would avoid and minimise impacts on biodiversity values (b) how the development site can be selected to avoid and minimise impacts on biodiversity values as far as practicable (c) whether an alternative development site to the site, which would avoid adversely impacting on biodiversity values, might be feasible.	Given the nature of the proposed development, the development footprint is largely situated within cleared agricultural land, or areas of lower biodiversity value due to past agricultural use. As described above there was a process of refining the project footprint. The Infrastructure Footprint is located on cleared land, or areas disturbed by past agricultural use which minimising impacts on biodiversity values. The Infrastructure Footprint has been selected to integrate with the previous wind farm development, and thus an alternative Infrastructure Footprint is not feasible.
For linear projects, the route selection process must include consideration and an analysis of the biodiversity constraints of the various route options. In selecting a preferred option, loss of biodiversity values must be weighed up and justified against social and economic costs and benefits.	The Proposed Development is not a linear project

Planning was considered during the selection of the Infrastructure Footprint. A summary of criteria utilised is shown in Table 7-6.

Table 7-6: Avoidance and Minimisation of Direct Impacts through Planning

Planning criteria	Method to avoid impact
Siting of the Proposed Development – the Major Project should be located in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower site value score) or which avoid an EEC or CEEC	The siting of the project is largely within cleared agricultural land. Where native vegetation is present it is disturbed by past agricultural use.
Minimise the amount of clearing or habitat loss – the Major Project (and associated construction infrastructure) should be located in areas that do not have native vegetation, or in areas that require the least amount of vegetation to be cleared (i.e. the development footprint is minimised, and/or in areas where other impacts to biodiversity will be the lowest	The Proposed Development is located primarily within cleared agricultural land to minimise vegetation clearing. Some impacts to vegetation will be required during construction, however some biodiversity values can be retained in adjacent areas. *D. setosum* is potentially identified within the Infrastructure footprint. Areas where positively identified shall be mapped and avoided through the design and construction phases of the project.
Loss of connectivity – some developments can impact on the connectivity and movement of species through areas of adjacent habitat. Minimisation measures may include providing structures that allow movement of species across barriers or hostile gaps	Connectivity within the Infrastructure Footprint is unlikely to be reduced as part of the Proposed Development. The biodiversity corridor that currently exists throughout the landscape is already highly modified.

The Proponent will implement measures to minimise the impacts of the Proposed Development during both the construction and operational phase. A biodiversity management plan will be prepared following approval of the Proposed Development, which will aim to put in place mechanisms for reduction of impacts. The biodiversity management plan will address impacts to flora and fauna such as delineation of clearing boundaries and minimising harm to fauna, whereas the construction environmental management plan will minimise other environmental impacts such as sediment control, dust, noise, lighting, and protection of waterways. The biodiversity management plan will include operational measures to reduce impacts of the Proposed Development such as:

- Pre-clearance surveys and clearance supervision; and
- Vegetation management including weed control, soil stabilisation and rehabilitation

It is anticipated that the SSF biodiversity management plan will largely mimic that which is in the SWF management plans, given the concurrent siting and ownership of each project. Details of measures to minimise impacts during the construction and operational phase are described below (Table 7-7).

Table 7-7: Minimisation of impacts through during the construction phase

Matter considered to minimise impacts	Adopted matters within Infrastructure Footprint
Method of clearing – using a method of clearing during the construction phase that avoids damage to retained native vegetation and reduces soil disturbance. For example, removal of native vegetation by chain-saw,	To avoid any additional impacts of the project, vegetation removal will use chain-saws rather than heavy machinery in areas with adjacent vegetation.

Matter considered to minimise impacts	Adopted matters within Infrastructure Footprint
rather than heavy machinery, is preferable in situations where partial clearing is proposed	
Clearing operations – minimising direct harm to native fauna during actual construction operations through onsite measures such as undertaking pre-clearing surveys, daily fauna surveys and the presence of a trained ecologist during clearing events	Clearing of vegetation will be undertaken via a two stage clearing process. Clearing will not be undertaken until a pre-clearance assessment is conducted and the results communicated by qualified environmental officers. An ecologist and/or suitably trained environmental officers will be present for all vegetation clearing. Stage 1 of the clearing process will involve marking of habitat features, and removal of all vegetation except habitat features. Stage 2 will involve removal of habitat features under the supervision of ecologists to relocate resident fauna. A detailed methodology of the two stage clearing process will be included within the BMP. All clearing staff will be briefed about the two stage clearing process, and their responsibilities to minimise impacts to biodiversity.
Timing of construction – identifying reasonable measures that minimise the impacts on biodiversity. For example, timing construction activities for when migratory species are absent from the site, or when particular species known to or likely to use the habitat on the site are not breeding or nesting, can minimise the impacts of construction activities on biodiversity	Timing of construction will not mitigate any impacts to biodiversity. The Infrastructure Footprint is occupied by limited fauna species and as such there is no specific timing constraints of the project.
Other measures that minimise inadvertent impacts of the Major Project on the biodiversity values – measures such as installing temporary fencing to protect significant environmental features such as riparian zones, promoting the hygiene of construction vehicles to minimise spread of weeds or pathogens, appropriately training and inducting project staff and contractors so that they can implement all measures that minimise inadvertent adverse impacts of the Major Project on biodiversity values.	Other measures to minimise the impacts of the project on biodiversity will be detailed within the appropriate construction environmental management plan. These measures will include at a minimum: • Temporary fencing (i.e. star pickets with flagged rope) to delineate clearing boundaries • Marking of trees for retention within open space areas • Cleaning of mobile plant prior to works to prevent the spread of weeds and pathogens • Sediment controls adjacent to waterways to prevent impacts downstream • Signage within the works area to advise contractors of responsibilities

In addition to the controls identified above the following management actions will be undertaken to minimise indirect impacts during construction (Table 7-8) and operation (Table 7-9).

Table 7-8: Minimisation of indirect impacts

Indirect impact	Method to avoid indirect impact
Sedimentation and run-off – sediment barriers or sedimentation ponds to minimise impacts of the Major Project on biodiversity values on land that is adjoining the site, and waterways downstream of the site	Installation of sediment barriers, sediment ponds, stormwater management systems, delineation of works zones

Indirect impact	Method to avoid indirect impact
Noise, dust or light spill – adopting onsite measures that can minimise the impacts on biodiversity values from noise, dust or light spill during the construction phase. For example, only undertake construction during daylight hours to avoid impacts from light spill where this may be detrimental to species habitat on adjoining lands	Construction works are to occur during standard construction hours to maximise daylight hours. Any request for an out of hours works protocol should address this indirect impact.
Inadvertent impacts on adjacent habitat or vegetation – considering measures such as retaining vegetation on the site as a buffer to protect significant environmental features (e.g. riparian zones, likely or known threatened species habitat)	Temporary fencing to be installed prior to works, to delineate boundaries and protect retained vegetation
Feral pest, weed and/or pathogen encroachment into vegetation on land adjoining the site – one example is using protocols for hygiene that minimise the likelihood of construction vehicles spreading weeds or pathogens from the site into native vegetation on land adjoining the site	A weed management plan will be included within the biodiversity management plan for the Infrastructure Footprint which will include cleaning and inspection of light vehicles and mobile plant
Impacts that are infrequent, cumulative or difficult to measure – where there are likely to be indirect impacts on biodiversity that are infrequent, cumulative or difficult to measure over time, consideration should be given to how an operational monitoring program can be used to assess the timing and/or extent of these impacts. A proposal for an operational monitoring program should be set out in the BAR. Development of a monitoring program may involve determining the base-line information that will be necessary to measure the impact over time. It should also consider how the results of the monitoring program could be used to inform ongoing operations in order to reduce the extent of indirect impacts	Monitoring programs are unlikely to provide any additional management requirements for the project, given the static nature of solar farm developments.
Impacts during the operational phase – measures to avoid or minimise the indirect impacts on threatened species and threatened species habitat on land adjoining the site, migratory species or flight pathways as a result of the operation of the development. Such measures may include those adopted to avoid and minimise: (i) trampling of threatened flora species (ii) rubbish dumping (iii) noise (iv) light spill (v) weed encroachment (vi) nutrient run-off (vii) increased risk of fire, and (viii) pest animals.	Areas of threatened flora that are identified will be partitioned off during the construction phase to prevent impacts to these species. Fences will be placed around key biodiversity areas to prevent rubbish dumping. Appropriate security measures will also be in place to reduce illegal dumping Noise impacts will not be increased from the current levels experienced by the Infrastructure Footprint and adjacent land Light spill will be managed according to the relevant approval. Weed encroachment, and nutrient run off will be managed by a weed management plan within the biodiversity management plan, and sediment and stormwater controls within the construction environmental management plan.

Table 7-9: Minimisation of impacts through during the operational phase

Operational phase impact	Method to avoid impact

Seasonal impacts – whether there are likely to be any impacts that occur during specific seasons. Minimisation measures may include amending operational times to minimise impacts on biodiversity during periods when seasonal events such as breeding or species migration occur	There are unlikely to be any additional seasonal impacts during operation of the solar farm.
Artificial habitats – using 'artificial habitats' for fauna where they may be effective in minimising impacts on such fauna. These include nest boxes, glider-crossings or habitat bridges.	Nest boxes can be installed to minimise impacts to arboreal mammals. Nest boxes will be considered as a measure to minimise impacts to arboreal or avian species. The necessary, number and locations will be resolved during the CEMP process.

Offset Strategy

Up to 104.1 ha of native vegetation requiring offsetting will be removed as part of the construction and operation phase of the Proposed Development. The offsetting requirement has been calculated using the BBCC. A summary of the vegetation zones, loss in landscape value, loss in site value, and ecosystem credits required to offset the impacts of the Proposed Development are shown in Table 7-10.

Table 7-10: Offsetting requirements of the Proposed Development

Zone	PCT	Loss in landscape value	Loss in site value	Required ecosystem credits
1	PCT1383: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion	12.6	20.83	73
2	PCT1383: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - DNG	12.6	16.67	0
3	PCT510: Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion	12.6	17.19	170
4	PCT510: Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion – DNG	12.6	14.06	0
5	PCT921: Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tableland Bioregion and NSW North Coast Bioregion	12.6	31.08	419
6	PCT921: Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tableland Bioregion and NSW North Coast Bioregion – DNG	12.6	9.90	0
Total				662

The proposed offset measures of the Proposed Development are to acquire and retire the full quantum of ecosystem credits required by the impacts of the Proposed Development as calculated within the BBCC. Ecosystem credits can either be purchased from credit holders as identified on a public register, or by establishment of a Stewardship site. All credits will be formally retired prior to construction of the Proposed

Development. Retirement of credits will be made prior to issue of the Construction Certificate for the Infrastructure Footprint.

CWP has submitted a BioBanking Agreement Application to OEH for the registration of a biobank site at Windemere at 3840 Kings Plains Road, Kings Plains NSW. The registration of the Windemere biobank site will generate 3,124 ecosystem credits, of which 2,401 credits will be retired for the SWF approvals. The residual 723 credits are for BR272: Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion, which is listed as an EEC under the BC Act and CEEC under the EPBC Act. By proposing to offset the impacts of the Proposed Development using credits at Windemere, the Proponent provides a clear path to completion of the offset requirement

The surplus credits from Windemere are viable credits to be used at the Infrastructure Footprint for BR272 and BR153. Both of these PCTs can be fully offset using the credits at Windemere. BR240 cannot be offset with BR272 as it has a higher percent cleared value, even though it is the same (C)EEC under the BC Act and EPBC Act. The residual credit requirement for BR240 will be offset from other local vendors. Should the credits not be available, the proponent will seek to offset these credits using alternative methods as approved under the FBA, including supplementary measures and/or payment to the fund.

A summary of the credit requirement and offset strategy is provided in Table 7-11.

Table 7-11. Proposed offset measures

PCT	Credits required	Credits available at Windemere	Residual
PCT1383: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion	73	0	73 Source credits externally
PCT510: Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion	170	723	533
PCT921: Manna Gum - Rough-barked Apple - Yellow Box grassy woodland/open forest of the New England Tableland Bioregion and NSW North Coast Bioregion	419	0	Use BR272 at Windemere
Total	662	723	134 BR272 remaining

7.3 Aboriginal Cultural Heritage

7.3.1 Introduction

NSW Archaeology Pty Ltd undertook an Aboriginal Cultural Heritage Assessment (ACHA) for the Proposed Development. The assessment was undertaken to address the project SEARs. The draft assessment report is provided in Appendix C and summarised below.

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

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

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

7.3.2 Existing Environment

A search of the NSW OEH Aboriginal Heritage Management Information System (AHIMS) has been conducted for this project on 8 September 2017 (AHIMS Reference: #300555). The search area measured 432 km² and encompassed the area between eastings 339000 – 363000, and northings 6703000 – 6721000 (Figure 7-4). Twenty seven Aboriginal object sites are listed for the search area (Table 7-12), although three are duplicate recordings.

Table 7-12. Location of AHIMS sites within search area

Site ID	Site Name	Datum	Description
12-4-0003	Matheson	AGD	Rock engraving; carved kangaroo tracks on a flat rock near the Gwydir Highway
12-4-0023	PAD5 (GLEN INNES)	GDA	Potential Archaeological Deposit (PAD)
12-4-0024	PAD6 and PAD7 (GLEN INNES)	GDA	Potential Archaeological Deposit (PAD)
11-6-0090	PAD8(GLEN INNES)	GDA	Potential Archaeological Deposit (PAD)
11-6-0091	PAD9 (GLEN INNES)	GDA	Potential Archaeological Deposit (PAD)
11-6-0084	CG-OS-1 (Chinamans Gully Associated Pad 10 & Pad 11)	GDA	Artefact:4; Potential Archaeological Deposit (PAD)
11-6-0085	RC-OS-1 Redbank Creek (Associated with Pad 12)	GDA	Artefact:2; Potential Archaeological Deposit (PAD)
11-6-0092	PAD10 and PAD11 (GLEN INNES)	GDA	Potential Archaeological Deposit (PAD)

Site ID	Site Name	Datum	Description
11-6-0093	PAD12 (GLEN INNES)	GDA	Potential Archaeological Deposit (PAD)
12-4-0030	RPS WHITE ROCK02	GDA	Artefact
12-4-003	RPS WHITE ROCK03	GDA	Artefact
11-6-0097	SWF-SU19/L1	GDA	Artefact: 2
11-6-0098	SWF-SU14/L1	GDA	Artefact: 3
11-6-0099	SWF-SU21/L1	GDA	Artefact: 1
11-6-0101	Kings Plains L&H P1	GDA	Potential Archaeological Deposit (PAD)
11-6-0052	S30	AGD	1 Hornfels flake; on a flat; 25m east of a small creek
11-6-0054	S31	AGD	1 Quartzite flake; on a slightly raised area; 150m west of a small creek
12-4-0017	Gwydir Scar Tree	AGD	Carved tree; canoe/ shield tree; dead tree with scar adjacent to Gwydir Highway
11-6-0029	Ashgrove; Swan Pond	AGD	Site artefacts (flakes, cores, ground edge axes, grinding slabs); along "several" 100 "yards" of banks of Swan brook
11-6-0065	EL25	AGD	3 artefacts (1 x Quartzite flake/p; 2 x Quartzite flakes); raised knoll above a large ephemeral creek; site area 5 x 3m
11-6-0062	EL23	AGD	10 stone artefacts; raised knoll on a gently undulating hill; site area 10 x 6m
11-6-0063	EL24	AGD	6 stone artefacts; raised knoll; site area 12 x 3m

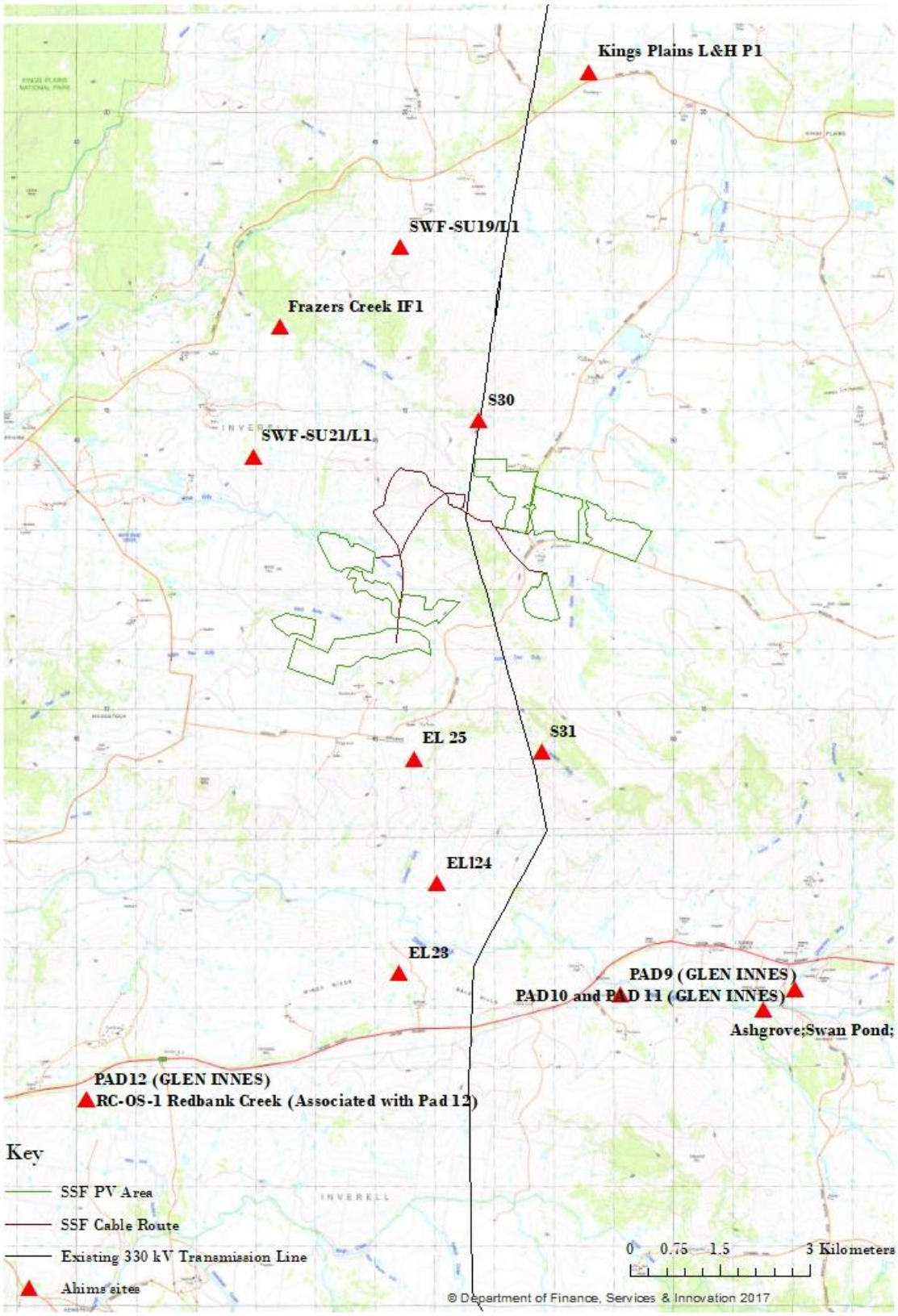

Figure 7-4. Location of AHIMS sites in relation to the Proposed Development (Grid references in AGD datum changed to GDA for mapping).

A field assessment has been conducted by Andrew Pearce and Tom Knight (NSW Archaeology Pty Ltd), and Vicki Duncan, Samantha Duncan and Diane Marlowe (*Edgerton Kwiembal*). The assessment was conducted on 6, 7, 8 and 9 November 2017. The field survey was aimed at locating Aboriginal objects. An assessment was also made of prior land disturbance, survey coverage variables (ground exposure and archaeological visibility) and the potential archaeological sensitivity of the land. Survey Units (SU) were established based on landform units. These are utilised as a framework of recording, analysis and the formulation of recommendations. The proposal area was found to contain discrete distributions of stone artefacts. For the purposes of defining the artefact distribution in space it has been labelled as a locale (eg. Survey Unit 1/Locale 1).

Certain areas of cabling have been surveyed previously during the assessment of the Sapphire Wind Farm (see Dibden 2012: Survey Unit 21). These have not been inspected during the current survey. The area encompassed by Survey Unit 15b was added to the project after the completion of fieldwork and has been assessed by recourse to predictive modelling.

The Aboriginal object sites recorded during the assessment are summarised in Table 7-13 below.

Table 7-13. A summary of Aboriginal object sites recorded during the assessment.

Survey Unit (SU)	Locale	Exposure	Context	Artefact Number	Predicted Density	Integrity
SU6	L1	Grassed area adjacent to ephemeral watercourse: area: 1 x 1m	On west side of ephemeral watercourse on simple slope; aspect: E; very gentle gradient	1	Very low	Moderately disturbed: ploughing, eroding
SU6	L2	Grassed area 150 m from ephemeral watercourse: area: 1 x 1 m	On west side of ephemeral watercourse on simple slope; aspect: E; very gentle gradient	1	Very low	Moderately disturbed: ploughing, eroding
SU6	Tree 1	-	-	-	-	-
SU8	L1	Pastured paddock: area: 1 x 1 m	On a crest; aspect: Open; very gentle gradient	1	Very low	Moderately disturbed: ploughing
SU12	L1	Ploughed area 20m from ephemeral watercourse: area: 100 x 40 m	On a flat, adjacent to an ephemeral watercourse, 200m from 2nd order watercourse; level gradient	3	Very low	Highly disturbed: ploughing, eroding
SU12	L2	Ploughed area: area: 10 x 10 m	On a flat, 180m from 2nd order watercourse; level gradient	1	Very low	Highly disturbed, ploughing, eroding

SU12	L3	Ploughed area: area: 10 x 10m	On a flat, adjacent to a 2nd order watercourse; level gradient	1	Very low	Highly disturbed: ploughing, eroding
SU13	L1	Ploughed area 20 m from ephemeral watercourse: area: 10 x 10m	Contour drainage swale on eastern side of ephemeral watercourse on simple slope; aspect: NW; very gentle gradient	2	Very low	Highly disturbed: Contour drainage swale construction, ploughing, eroding
SU13	L2	Ploughed area: area: 10 x 10m	Between contour drainage swales near top of simple slope; aspect: N; very gentle gradient	2	Very low	Highly disturbed: Contour drainage swale construction, ploughing, eroding
SU15	L1	Ploughed area sown to lucerne hay: area: 10 x 10m	Contour drainage swale on simple slope; aspect: NW; gentle gradient	1	Very low	Moderately disturbed: Contour drainage swale construction, ploughing, eroding
SU17	L1	Ploughed area with poisoned wheat stubble: area: 10 x 10m	On northern side of 2nd order watercourse on a flat; aspect: open; level gradient	1	Low	Highly disturbed: eroding and mechanical
SU17	L2	Ploughed area with poisoned wheat stubble: area: 10 x 10m	On northern side of 2nd order watercourse on a flat; aspect: open; level gradient	1	Low	Highly disturbed: eroding and mechanical
SU17	L3	Ploughed area with poisoned wheat stubble: area: 80 x 80m	On northern side of 2nd order watercourse on a flat; aspect: open; level gradient	4	Low	Highly disturbed: eroding and mechanical
SU17	L4	Ploughed area with poisoned wheat stubble: area: 100 x 50m	On northern side of 2nd order watercourse on a flat; aspect: open; level gradient	5	Low	Highly disturbed: eroding and mechanical
SU17	L5	Ploughed area with poisoned wheat stubble: area: 10 x 10m	On northern side of 2nd order watercourse on a flat; aspect: open; level gradient	2	Low	Highly disturbed: eroding and mechanical

The location of Aboriginal object sites are shown in Figure 7-5 and Figure 7-6.

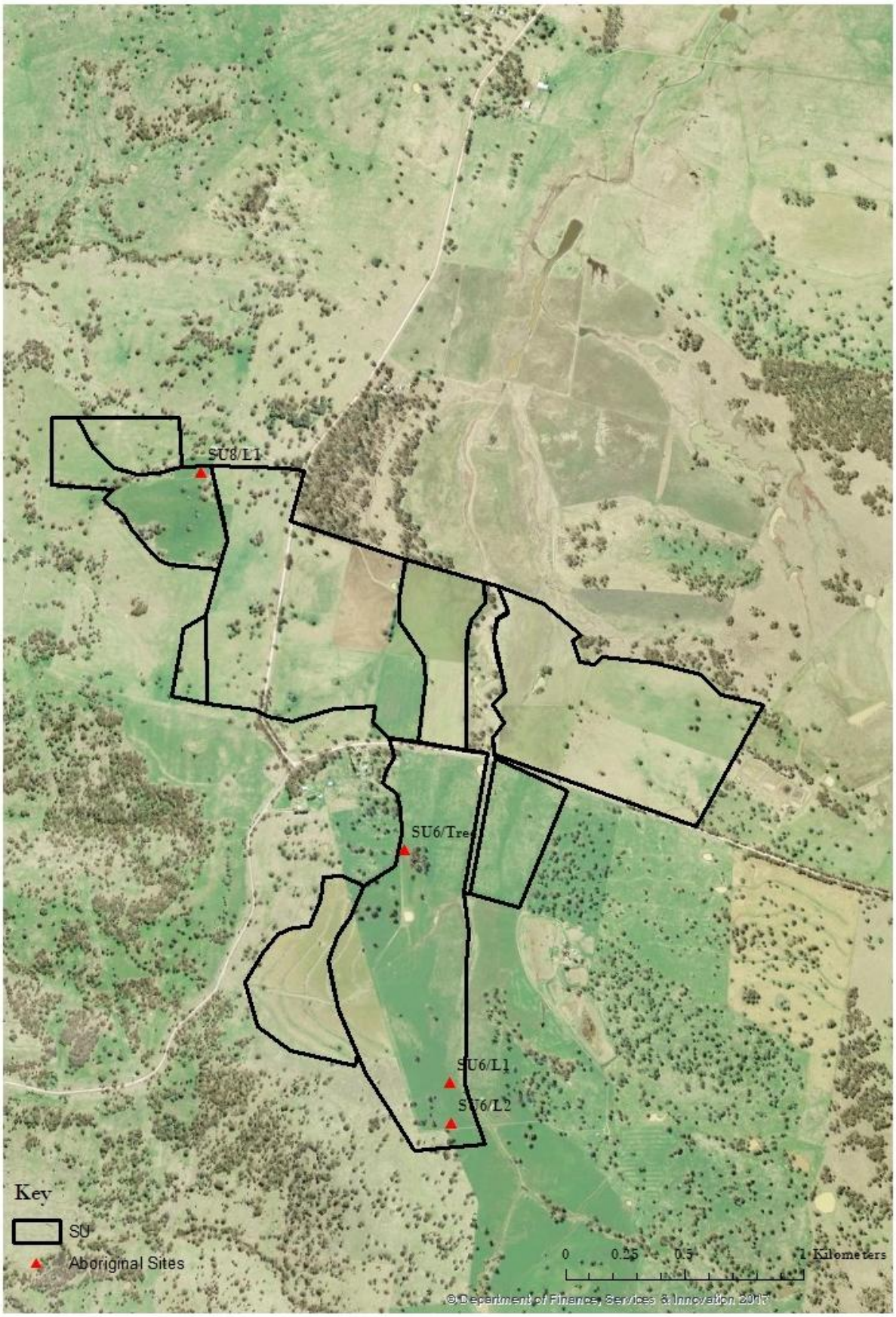

Figure 7-5. Location of Aboriginal object sites; east end.

Figure 7-6. Location of Aboriginal object sites; west end.

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

Table 7-14. Heritage significance

Site	Significance	Criteria
SU6/L1	Low/moderate local significance	Common site type; however, the top stone artefact is of some significance Low educational value Low aesthetic value Low research potential: disturbed; predicted very low density.
SU6/L2	Low local/moderate local significance	Common site type; however, the hammerstone artefact is of some significance Low educational value Low aesthetic value Low research potential: disturbed; predicted very low density.
SU6/Tree	Potentially moderate significance	Its status as an Aboriginal scarred tree is not confirmed
SU8/L1	Low local significance	Common site type Low educational value Low aesthetic value Low research potential: disturbed; predicted very low density.
SU12/L1	Low local significance	Common site type Low educational value Low aesthetic value Low research potential: disturbed; predicted very low density.
SU12/L2	Low local significance	Common site type Low educational value Low aesthetic value Low research potential: disturbed; predicted very low density.
SU12/L3	Low local significance	Common site type Low educational value Low aesthetic value Low research potential: disturbed; predicted very low density.
SU13/L1	Low/moderate local significance	Common site type; however, the bifacially flaked piece is of some significance Low educational value Low aesthetic value Low research potential: disturbed; predicted very low density.
SU13/L2	Low/moderate local significance	Common site type; however, the bifacially flaked piece is of some significance Low educational value Low aesthetic value Low research potential: disturbed; predicted very low density.

Site	Significance	Criteria
SU15/L1	Low local significance	Common site type Low educational value Low aesthetic value Low research potential: disturbed; predicted very low density.
SU17/L1	Low local significance	Common site type Low educational value Low aesthetic value Low research potential: disturbed; predicted low density.
SU17/L2	Low/moderate local significance	Common site type; however, the hammerstone is of some significance Low educational value Low aesthetic value Low research potential: disturbed; predicted low density.
SU17/L3	Low local significance	Common site type Low educational value Low aesthetic value Low research potential: disturbed; predicted low density.
SU17/L4	Low local significance	Common site type Low educational value Low aesthetic value Low research potential: disturbed; predicted low density.
SU17/L5	Low local significance	Common site type Low educational value Low aesthetic value Low research potential: disturbed; predicted low density.

7.3.3 Potential Impacts

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

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

An impact assessment is set out below in Table 7-15 below.

Table 7-15 Impact assessment of Aboriginal object locales within the proposal area.

Aboriginal object site	Significance	Type of harm	Degree of harm	Consequence of harm
SU6/L1 Layout has changed, and this site is outside impact area	Low/moderate local significance	nil	nil	nil
SU6/L2 Layout has changed, and this site is outside impact area	Low/moderate local significance	nil	nil	nil
SU6/Tree Layout has changed, and this site is outside impact area	Potentially moderate significance	nil	nil	nil
SU8/L1	Low local significance	direct	whole	Total loss of value
SU12/L1	Low local significance	direct	whole	Total loss of value
SU12/L2	Low local significance	direct	whole	Total loss of value
SU12/L3	Low local significance	direct	whole	Total loss of value
SU13/L1	Low/moderate local significance	direct	whole	Total loss of value
SU13/L2 Outside impact area	Low/moderate local significance	nil	nil	nil
SU15/L1	Low local significance	direct	whole	Total loss of value
SU17/L1 Nil impacts in accordance with current layout	Low local significance	nil	nil	nil
SU17/L2 Nil impacts in accordance with current layout	Low/moderate local significance	nil	nil	nil
SU17/L3 Nil impacts in accordance with current layout	Low local significance	nil	nil	nil
SU17/L4 Nil impacts in accordance with current layout	Low local significance	nil	nil	nil
SU17/L5 Nil impacts in accordance with current layout	Low local significance	nil	nil	nil

7.3.4 Mitigation Measures

The OEH aims to ensure impacts to Aboriginal objects and places are avoided or reduced and that where possible Aboriginal sites should be conserved. The guiding principle is that, wherever possible, avoidance should be the primary management option, but if avoidance is not feasible, measures shall be taken to mitigate against impacts to Aboriginal items and/or places. Management and mitigation measures are set out in Table 7-16 below.

Table 7-16 Management and mitigation.

Aboriginal object site	Significance	Impacts	Management
SU6/L1 Layout has changed, and this site is outside impact area	Low/moderate local significance	nil	If layout changes and impacts proposed, artefact should be salvaged
SU6/L2 Layout has changed, and this site is outside impact area	Low/moderate local significance	nil	If layout changes and impacts proposed, artefact should be salvaged
SU6/Tree Layout has changed, and this site is outside impact area	Potentially moderate significance	nil	If layout changes, site should be subject to active conservation
SU8/L1	Low local significance	direct	Unmitigated impact
SU12/L1	Low local significance	direct	Unmitigated impact
SU12/L2	Low local significance	direct	Unmitigated impact
SU12/L3	Low local significance	direct	Unmitigated impact
SU13/L1	Low/moderate local significance	direct	Salvage artefact (surface collection)
SU13/L2 Outside impact area	Low/moderate local significance	nil	If layout changes and impacts proposed, artefact should be salvaged
SU15/L1	Low local significance	direct	Unmitigated impact
SU17/L1 Nil impacts in accordance with current layout	Low local significance	nil	nil
SU17/L2 Nil impacts in accordance with current layout	Low/moderate local significance	nil	If layout changes and impacts proposed, artefact should be salvaged
SU17/L3 Nil impacts in accordance with current layout	Low local significance	nil	nil
SU17/L4 Nil impacts in accordance with current layout	Low local significance	nil	nil
SU17/L5 Nil impacts in accordance with current layout	Low local significance	nil	nil

ACHA recommendations

The following recommendations are made:

- No further archaeological investigations are required in respect of the proposal. No areas were identified that could be characterised as places with a high probability of possessing subsurface Aboriginal objects

with high potential conservation value. Accordingly, archaeological test excavation has not been undertaken in respect of the proposal as it could not be justified (DECCW 2010a).

- Management and mitigation strategies are set out in Section 7 of the ACHA. These should be used to formulate appropriate Statement of Commitments to condition Development Approval.
- It is recommended that additional archaeological assessment is conducted in any areas which are proposed for impacts that have not been surveyed during the current assessment. It is predicted that significant Aboriginal objects can occur anywhere in the landscape and, accordingly, they need to be identified and impact mitigation strategies implemented prior to impacts. The assessment may be conducted by predictive modelling, if appropriate (Note: Up to 100 m allowance for micro-siting has been allowed for in original survey. Additional surveys only necessary beyond this allowance).
- The proponent should develop a Cultural Heritage Management Plan for the appropriate management and mitigation of development impacts during any further planning and project construction. The development of an appropriate Cultural Heritage Management Plan should be undertaken in consultation with the project archaeologist, the registered Aboriginal parties and the NSW OEH.
- The Cultural Heritage Management Plan would be prepared to guide the process for management and mitigation of impacts to Aboriginal cultural heritage and to set out procedures relating to the conduct of additional archaeological assessment, if required, and the management of any further Aboriginal cultural heritage values which may be identified.
- Personnel involved in the construction and management phases of the project should be trained in procedures to implement recommendations relating to cultural heritage, as necessary.
- Cultural heritage should be included within any environmental audit of impacts proposed to be undertaken during the construction phase of the development.

7.4 Historic Heritage

7.4.1 Introduction

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

The primary objectives of the historical heritage assessment were:

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

This involved the following key tasks:

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

7.4.2 Existing environment

Australian Heritage Database

A search of this database revealed that there are no heritage items within the Site listed on the Australian Heritage Database. There is however one item listed within the Inverell LGA that is situated to the north of the subject area. Details of this item are provided in Table 7-17.

Table 7-17: Australian Heritage Database results within the Inverell LGA

LGA	Item	Address	Listing
INVERELL	Kings Plains Private Cemetery	Nullamanna-Wellingrove Rd Kings Plains	(Indicative Place) Register of the National Estate

State Heritage Inventory

A search of this database revealed that there are no items within the Proposed Development area that are currently listed on the State Heritage Inventory (SHI). There are however two previously identified items that are located nearby and details of these items are provided in Table 7-18.

Table 7-18: State Heritage Inventory results within the Inverell and Glen Innes Severn LGAs

LGA	Item Name	Suburb	Significance
Inverell	Kings Plains Castle	Kings Plains	LGOV
Glen Innes Severn	Presbyterian Church	Wellingrove	LGOV

The Kings Plains Castle was identified in the Inverell Heritage Study (RES 1986); it is listed in Volume 2 of that document as item RUR005. The abovementioned Kings Plains Private Cemetery, which is listed on the Register of the National Estate, is a component of the larger site complex at Kings Plains Castle.

National Trust of Australia (NSW) Register

A search of the National Trust of Australia (NSW) revealed that while there are various items listed within the Inverell LGA there are no heritage items currently listed in the Proposed Development area. The Kings Plains Private Cemetery, which is situated to the northwest is however listed on the Register Index for the Inverell LGA. This item is also listed on the Register of the National Estate.

Table 7-19: National Trust of Australia results within the Inverell LGA

LGA	Locality	Address	Item Name
INVERELL	Wellingrove	Kings Plain Property 30 km west of Glen Innes, past Wellingrove	Kings Plains Private Cemetery

Historic Survey Results

Survey Unit 6/H1 grid reference: Hand GPS (GDA): 348159e 6712802n

This recording is of an old telephone pole located adjacent to Waterloo Road in Survey Unit 6. The pole is still standing between the tall current electricity pole to the right, and the stand of eucalypts in the paddock. It is formed from an undressed tree trunk and has two glass insulators affixed to its upper section. The pole is well outside areas of proposed impacts and does not satisfy any criteria for heritage listing.

7.4.4 Potential Impacts

All identified registered heritage items are located more than 5 km from the Proposed Development, these are:

- Kings Plains Private Cemetery;
- Kings Plains Castle; and
- Presbyterian Church at Wellingrove.

As such, the Proposed Development will not have any direct impacts on known historic heritage items.

It is considered unlikely any items of historic significance remain unidentified within the Site. The proposed works are therefore unlikely to impact on any unknown items of historic significance.

7.4.5 Mitigation measures

The above historic heritage assessment indicates that no direct impacts to known heritage sites are anticipated as a result of the proposed development, and accordingly, mitigation strategies are not proposed.

The Interim Heritage Order provisions of the Heritage Act allow the minister or his delegates (local government may have delegated authority) to provide emergency protection to threatened places that have not been previously identified. In the event that unidentified potential historic heritage items are found during construction activities, works in that area shall cease until an assessment is made by an appropriately qualified archaeologist and OEH has been consulted. Contractors and staff working on Site will be advised of this requirement through Site induction and toolbox talks.

7.5 Land Resources

7.5.1 Introduction

In accordance with the requirements of the SEARs, this section establishes a baseline assessment of current land use, soils and land capability prior to the Proposed Development.

Potential impacts associated with the Proposed Development on agricultural land, sapphire resources and exploration activities in proximity to the Site are considered to ensure the compatibility of the development with existing land use on and adjacent to the Site both during operation and after decommissioning.

Site and surrounding land, is zoned RU1 Primary Production under the provisions of the Inverell LEP. Solar energy systems are prohibited in the RU1 Zone. However, a SSD for the purpose of a solar energy system may be carried out by any person with consent on any land (except land in a prescribed rural residential zone). Therefore, the Proposed Development is permissible with consent.

7.5.2 Existing Environment

The Site is located within an undulating landscape, where elevation ranges between 810 - 1000 m (AHD). The Site has been historically cleared and grazed for sheep and cattle production and is typical of farmland in the region. A number of stock dams have been developed across the Site. A considerable portion of the Site has been cultivated for improved pasture and other fodder crops. Surrounding land uses include:

- Agriculture;
- Sapphire exploration and mining; and
- Wind farm operation.

Land Use

The Site and surrounding land is zoned RU1 Primary Production. Under the provisions of the Inverell LEP 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; and
- To allow for non-agricultural land uses that will not restrict the use of other land in the locality for agricultural purposes.

Historically, agriculture has been a significant industry in the Inverell region and still plays an important role in both the social and economic wellbeing of the region today. The Proposed Development involves a temporary diversification in land use of up to 2368.9 ha for the duration of the project life (initial term estimated to be 25 years). This changed land use may temporarily reduce agricultural production. However, once constructed sheep grazing may continue within the Site to control vegetation beneath the solar array.

The Inverell – Tenterfield Statistical Area (Level 3) covers 3,056,628 ha, of which 1,905,461 ha is used for dryland and irrigated agricultural production (ABS, 2013). The Proposed Development will impact up to 2368.9 ha, representing 0.12% of land used for agricultural production. Therefore impacts of the Proposed Development on agricultural production at a regional and state level are not significant. At the conclusion of the life of the project, the Site would be decommissioned in order to permit the resumption of grazing activities or other agricultural uses. Therefore, the Proposed Development does not conflict with the objectives of the RU1 Zone as described by the Inverell LEP.

Sapphire Deposits

The Kings Plains deposit, part of the New England gem fields, is one of the richest single accumulation of gem quality sapphire mined in NSW. There is also the potential for further commercial deposits in the existing mining regions of the New England region. The Site sits within the Kings Plains deposit, with one now remediated sapphire mine ("Yarrandoo") located within the Site.

Two Mining Lease (ML) and two Exploration Licence (EL) areas exist within the Site (Figure 7-7). ML1687, ML1374 and EL8536 are held by Eastern Feeder Holdings Pty Ltd, and EL8230 by Bond Resources Pty Ltd. Consultation with Eastern Feeder Holdings Pty Ltd has resulted in agreement for SSF to progress with the proposal within ML1687, ML1374 and EL8536. To facilitate ongoing activities in the area by Eastern Feeder Holdings Pty Ltd, Coordination Deeds between the parties are in the process of being drafted. Consultation with Bond Resources Pty Ltd has confirmed their acceptance of SSF insofar as it impacts upon EL8230.

Consultations with both Eastern Feeder Holdings and Bond Resources has been provided to the DPE and the Department of Industry. This included correspondence relating to the sequence of mining and rehabilitation activity associated with ML 1687 in relation to the Proposed Development. In summary, the mining sequence and rehabilitation on ML1687 was undertaken in accordance with the approved Mining Operations Plan. Rehabilitation works were undertaken progressively, and when mining ceased in August 2017 the final physical rehabilitation was completed in October 2017 (Ecosite Solutions, 2017).

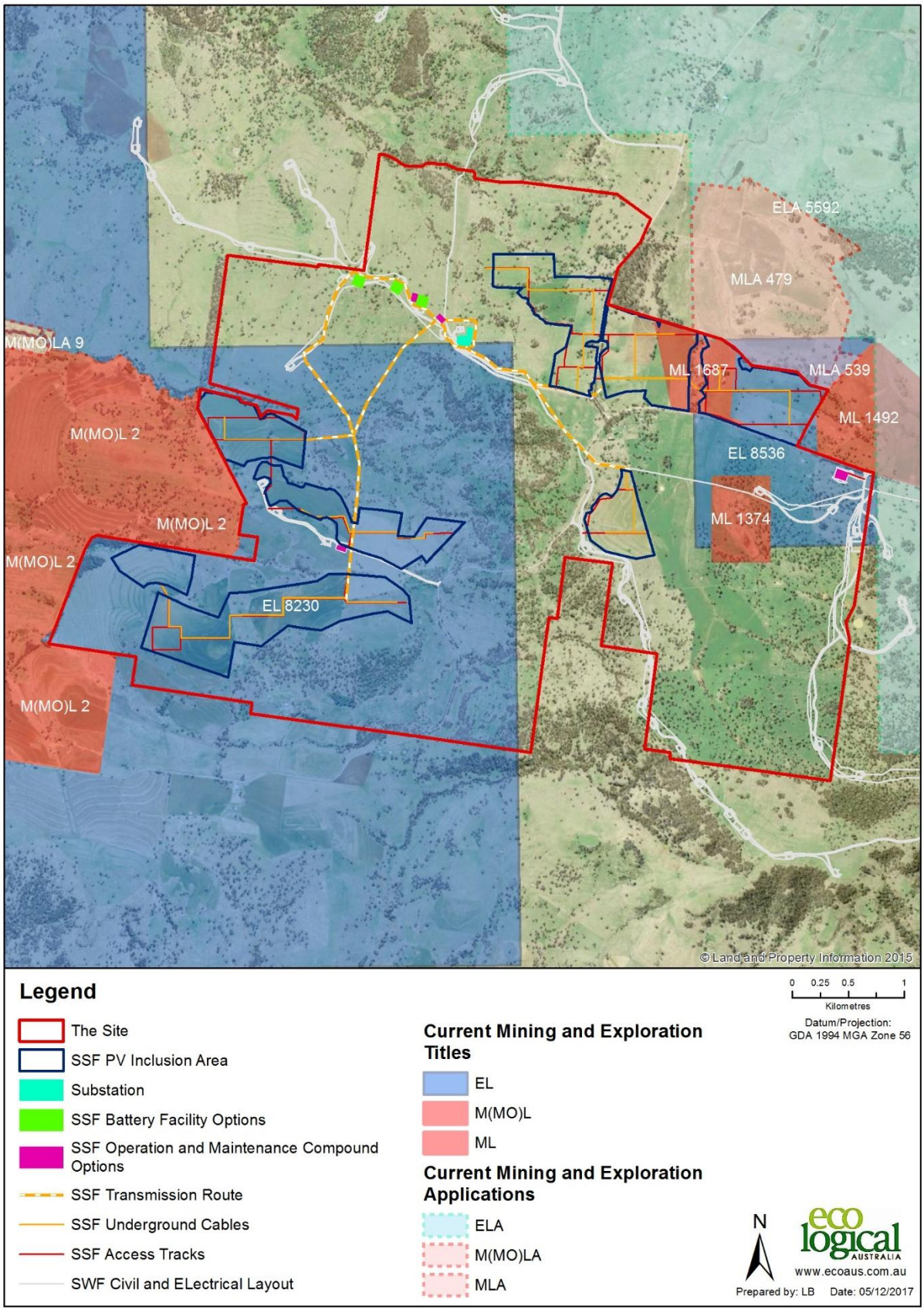

Figure 7-7: Current mining and exploration leases and applications in the Project Outline and immediate surrounds. Source: NSW Department of Industries (2016a) and NSW Department of Industries (2016b)

Regional and Local context

Geology

The Site lies within a geological domain that comprises a large area of Tertiary basalts. The key geological unit that underlies the Site is an unnamed unit of Tertiary Basalt Flows. A small area of Texas Beds is present, in addition to areas comprising Quaternary alluvial, residual or colluvial deposits of sand, silt, clay and gravel associated with Kings Plains Creek, an unnamed tributary of Kings Plains Creek, and Horse Gully (Geological Survey of New South Wales, 2009; ELA, 2011).

Soil Landscapes

The *Reconnaissance Soil Landscape Mapping for the Border Rivers Gwydir Catchments* 1: 100 000 mapsheet (CWP, 2012) identified the following soil landscapes occurring over the project area (Figure 7-8):

- Carters Mountain;
- Highlands;
- Kings Plains;
- Kings Plains variant b;
- Kingsland;
- McKerrow Hill variant a;
- McKerrow Hill variant b;
- Newstead;
- Rumbee; and
- Disturbed Terrain.

The Kingsland and Newstead landscapes are mapped as occurring on the undulating plains, rise and footslopes of the Site, and are the most common soil landscapes within the Proposed Development. The Kingsland soil landscape is associated with Vertosols, while the Newstead landscape is associated with Ferrosols.

The Kings Plains and Kings Plains variant b alluvial landscapes are restricted to drainage depressions in the immediate landscape of the Site. Vertosols are associated with these landscapes.

Carters Mountain and Rumbee landscapes are mapped as occurring on the ridges and upper slopes. These landscapes are associated with Dermosols and Ferrosols respectively.

Occurrence of the McKerrow Hill soil landscape is restricted to small areas on the footslopes. McKerrow Hill is an erosional soil landscape associated with Rudosols and Tenosols.

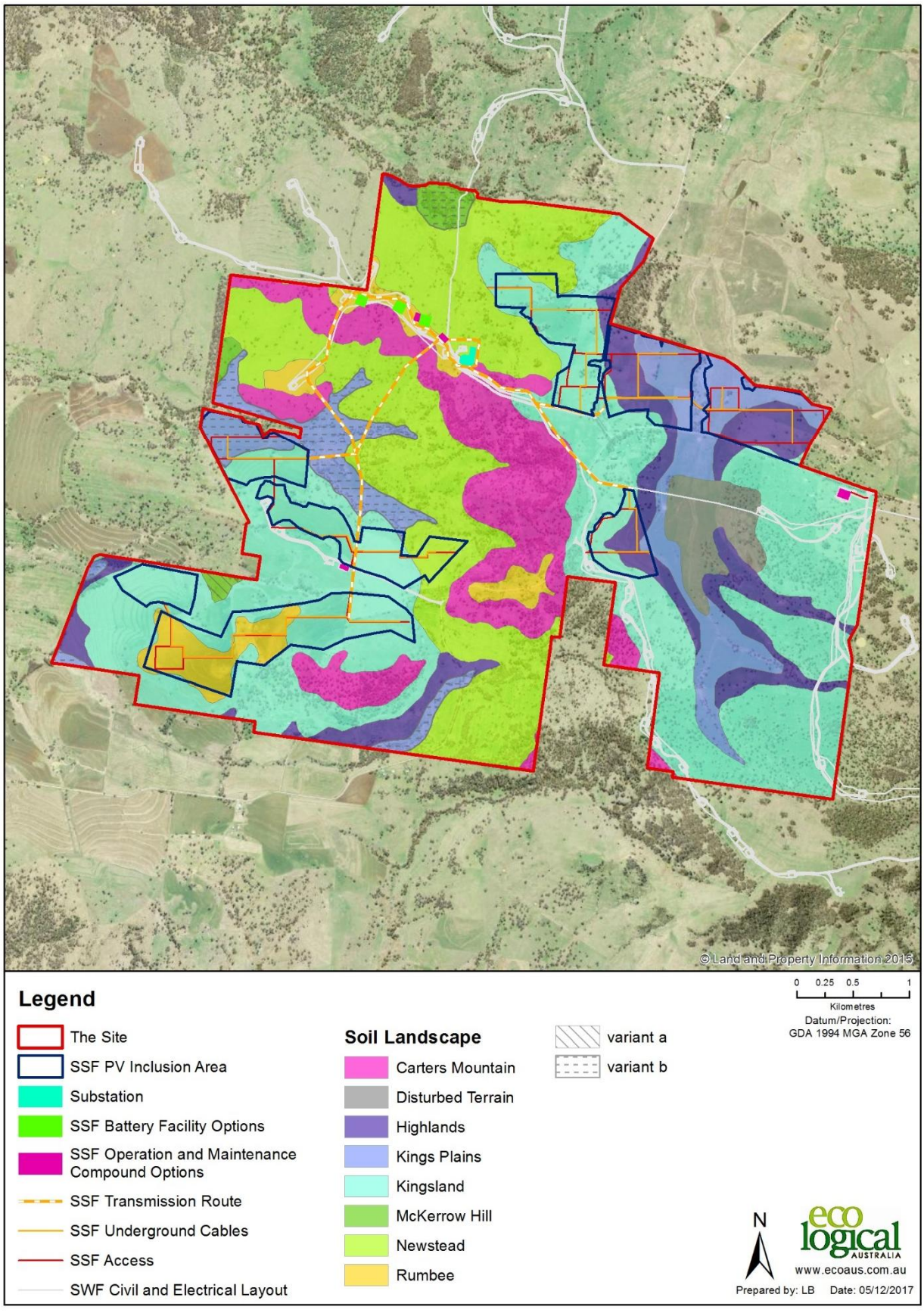

Figure 7-8: Soil landscapes in the Site. Source: CWP (2012)

Land and Soil Capability

Land capability classes aim to classify land according to its inherent ability and protection from erosion and other forms of land degradation. The classification of any land is based on biophysical features which determine the limitations and hazards of that land. The main hazards and limitations include: water erosion, wind erosion, soil structure decline, soil acidification, salinity, waterlogging, shallow soils, rockiness, and mass movement.

The eight class system recognises four types of land uses with land capability decreasing from Class 1 to Class 8 (OEH, 2012):

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

Land and soil capability mapping corresponds to each soil landscape, based on the most limiting factor. The majority of the site has moderate to moderate-severe limitations (Class 3 and Class 4) for more intensive use other than grazing and cultivation, but remains suitable for a variety of land uses if careful management to prevent long-term degradation is implemented. The Site contains patches of land that have not been assessed along Kings Plains Creek. The land and soil capability for each soil landscape is provided in Table 7-20.

Biophysical Strategic Agricultural Land

Ares of high agricultural value have been identified and mapped as Biophysical Strategic Agricultural Land (BSAL). BSAL is highly productive land with a rare combination of natural resources highly suitable for agriculture. Land identified as BSAL has:

- High or moderately high soil fertility;
- Land capability classes 1, 2 or 3; and
- Reliable water of suitable quality.

The Site contains land suitable for grazing and cultivation, of which 527 ha is mapped as BSAL. The development footprint intersects 204 ha of BSAL (Figure 7-9). The harvesting of sunlight for energy production is primarily a passive activity that does not consume or transform the attributes of BSAL. Solar panels are installed above ground with little direct or indirect impact to soil and water resources. Furthermore, at the conclusion of the project life, the subject land will be rehabilitated to predevelopment conditions to allow the resumption of agricultural production.

No critical industry clusters have been mapped in the New England North West region. SSF is not a State significant mining or coal seam gas proposal, and a Gateway assessment is not required, therefore a site verification process is not required (see Section 5).

Table 7-20: Land and soil capability classes within the Site

Hazard Classification	Soil Landscape									
	Carters Mountain	Highlands	Kings Plains	Kings Plains variant b	Kingsland	McKerrow Hill variant a	McKerrow Hill variant b	Newstead	Rumbee	Disturbed Terrain
Soil Acidification	2	1	1	1	2	5	5	3	3	n/a
Water Erosion	7	3	1	3	4	3	3	4	3	n/a
Soil Structure Decline	1	1	1	1	3	3	3	1	1	n/a
Wind Erosion	3	2	3	3	2	3	3	2	2	n/a
Shallow soils/Rockiness	5	1	1	1	3	6	6	2	3	n/a
Salinity	1	1	3	3	1	1	1	2	1	n/a
Mass Movement	7	1	1	1	1	1	1	1	1	n/a
Water-logging	1	2	3	3	1	1	1	1	1	n/a
Land and Soil Capability Class	7	3	3	3	4	6	6	4	3	n/a
Capability	Very Low	High	High	High	Moderate	Low	Low	Moderate	High	n/a

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

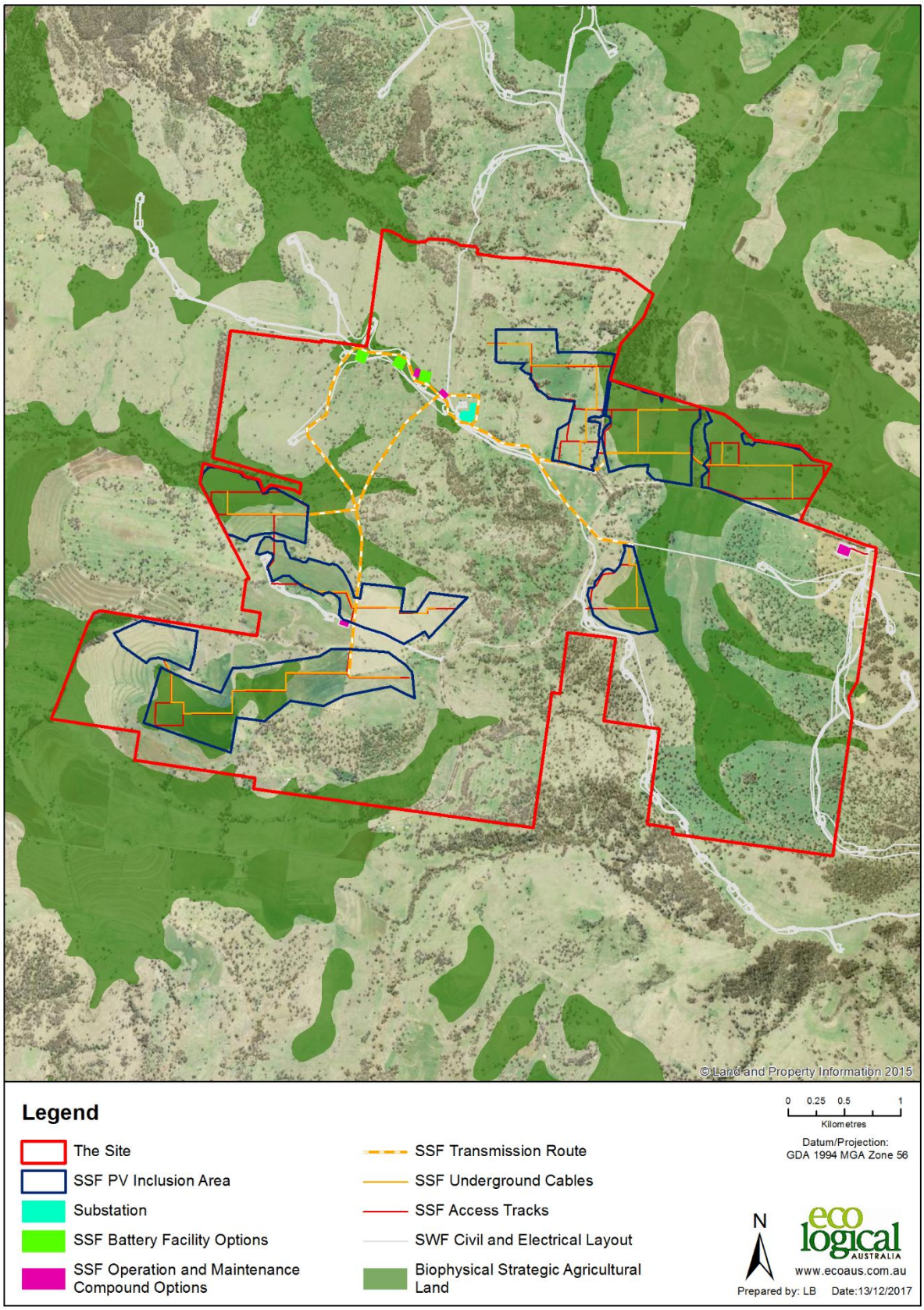

Figure 7-9: Biophysical Strategic Agricultural Land in the Development Footprint and surrounds. Source: NSW Department of Planning and Infrastructure (2013)

Erosion Potential Assessment

Rainfall Erosivity

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

The R-factor for the SSF is approximately 1,700 – 1,800 based on *Map 3: Rainfall Erosivity of the Grafton 1: 250,000 Topographic Sheet in Appendix B* of the 'Blue Book' (Landcom, 2004). Given this range the Rainfall Erosivity for the site can be considered low (ELA, 2011).

Monthly mean rainfall data at the Site is highest in the months of December – February as recorded at the Glen Innes Agricultural Research Station (Station No. 056013) and Inverell Research Station (Station No. 056018) (Bureau of Meteorology).

Soil Erodibility and Dispersibility

The erodibility of the soils based on soil type is provided in Table 1-3. The Revised Universal Soil Loss Equation predicts the long term, average, annual soil loss under specified management conditions, and includes a soil erodibility factor (the K-factor). The K-factor is a measure of susceptibility of soil particles to detach and be transported by rainfall and runoff (Landcom, 2004). Soil texture to the primary driver of the K-factor, however soil structure, organic matter and profile permeability also influence the value.

The K-factors for soil landscapes across NSW generally range from 0.005 (very low) to 0.075 (very high) (Landcom, 2004). In the absence of site specific laboratory data, the K-factor for the SWF Erosion Hazard Assessment was conservatively estimated at 0.05 (ERM, 2016). Given the SSF Site is located within the SWF boundary, this conservative K-factor is also applicable to SSF.

Soil Erosion Hazard

Soil erosion hazard refers to the susceptibility of a parcel of land to the prevailing agents of erosion and is typically described as high or low erosion hazard (Landcom 2004). Sites with high erosion hazard may require control measures beyond the normal suite of erosion control measures applied to construction sites.

The Site is dominated by Vertosols, Ferrosols and Dermosols. Based on general soil characteristics provided in the Australian Soils Classification, the soil types mapped in the Site have an erosion potential ranging from moderate to high. The gradient of the slopes on site range from gently undulating to rolling hills. There are also steep gullies associated with the primary waterways in the area. The slope characteristics of each soil type is summarised in Table 7-21.

Table 7-21 Erosion hazard within the Site*

Rock Type	Australian Soil Classification	Characteristics	Soil Landscape	Slope Range (%)	Erosion Hazard#
Basalt	Ferrosols	Red/Chocolate in colour; shallow on ridges and upper slopes (<1m); clay content increases with depth; surface soils usually clay loams or silty clay loams to light clays	▪ Newstead ▪ Rumbee	5 – 10%	Moderate to high depending on slope and groundcover
	Dermosols	Found on lower colluvial slopes and valley drainage lines; typically deeper with higher organic matter content; clay loam-clay texture	▪ Carters Mountain	5 – 30%	Moderate to high depending on slope and groundcover
	Vertosols	Found in valley plains where basalt makes up large portion of the watershed; typically well drained; uniform texture and cracking characteristics.	▪ Kingsland ▪ Kings Plains ▪ Highlands	0 – 10%	Low; although this potential increases on cleared slopes

*To the extent of available information in desktop assessments

Based on the general soil characteristics for each Australian Soil Classification soil type

Based on the above information, including the R-factor (1,700 to 1,800) and a slope gradient of ~15%, the predominant soil association (Vertosols) for solar array installations is classified as having a high erosion hazard when assessed against Figure 4.6[5] of the 'Blue Book'. If the slope of the work sites is less than around 12% then the potential erosion hazard is low.

Other local environmental constraints

Expansion or reactive soils

Most soils will shrink or swell depending on changes in their moisture content. Soils that shrink significantly are called expansive or reactive soils and may be problematic in structures such as sediment basins or roads (Landcom, 2004). Vertosols typically exhibit shrink-swell properties (or 'cracking') to varying degrees. It is anticipated that geotechnical assessments will occur prior to design finalisation to address the Site soil characteristics.

[5] The potential erosion hazard associated with a specific site can be determined using Figure 4.6, based the R-factor that relates to the site location and the upper slope gradient of the site landform. The A-line on Figure 4.6is based on LS=500/1.3 (RxK) where K is 0.05 and slope length is 80 m. Sites above the A-line have low erosion hazards and standard erosion control measures are considered adequate. Sites above the A-line have high potential erosion hazards require further management, including the calculation of the Soil Loss Class.

Depth to watertable

The design of erosion and sediment controls may be influenced by the presence of watertables near the surface, whether seasonal or permanent (Landcom, 2004). An analysis of groundwater elevation forms part of the water resources assessment (see Section7.9).

Salinity

Salt accumulation in soils can have adverse impacts on developments including damage to building foundations, breaking up road pavements and corrosion of underground pipes and services (Landcom, 2004). Desktop assessments indicate that the Site's soils are well drained and not at risk of salt accumulation (ELA, 2011).

Acid Sulfate Soils

The Australian Soil Resource Information System (ASRIS) online data base indicates that there is a low to extremely low probability of occurrence of acid sulfate soils at the Site (Figure 7-10; Fitzpatrick, Powell & Marvanek, 2011). Acid sulfate soils are typically associated with low lying coastal areas. The Site is approximately 180 km from the coast at high altitude and as such the potential for acid sulfate soils to occur is negligible.

Contaminated Land

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

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

Pursuant to Clause 7 of the *State Environmental Planning Policy No 55 – Remediation of Land* there is no apparent reason to consider that land to be utilised by the Proposed Development would be contaminated.

Whilst no registered contaminated land occurs within the Site, potential contamination associated with agricultural activities include sheep dips, import and fill material, demolition of old buildings and stockpiling of wastes.

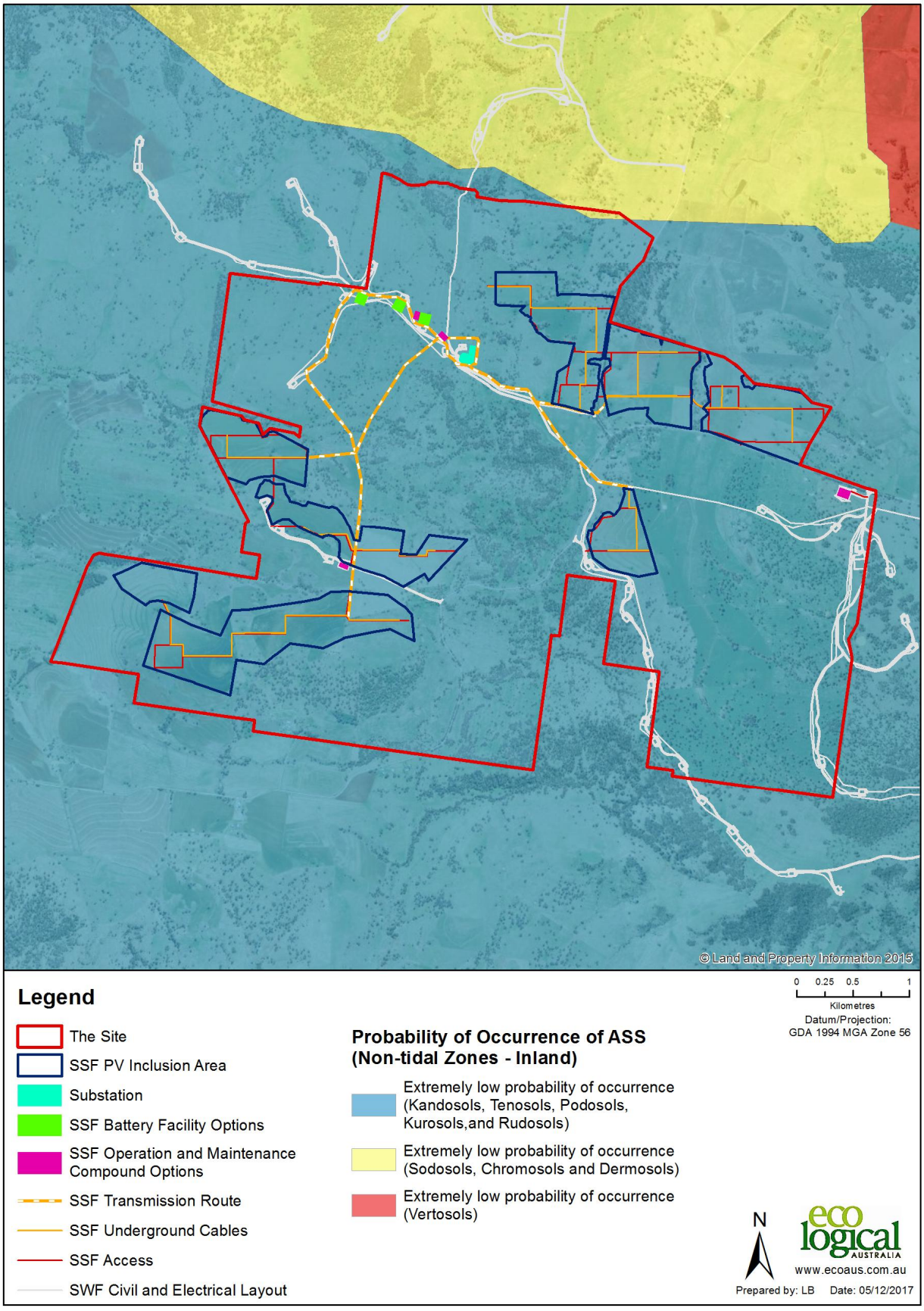

Figure 7-10: Probability of occurrence of acid sulfate soil within the Site. Source: Powell & Marvanek (2011)

7.5.3 Potential Impacts

Land use conflicts

The Proposed Development will have an initial life span of approximately 25 years and will not involve permanent changes to the landscape. The size of the Development Footprint (445 ha) will not compromise or significantly diminish the availability of land for primary production purposes within the Inverell LGA. The Development Footprint intersects with 204 ha of mapped BSAL, however, due to sunshine harvesting being a passive land use, the Proposed Development will not permanently impact any BSAL, or compromise the capacity for immediate neighbours to conduct existing or proposed primary production in the immediate vicinity. Host landholders have entered into contractual agreements with the solar farm proponent that compensate and offset any loss as a result of reduced agricultural production associated with the development.

Post construction, it is proposed that the balance of land within the Site would continue to be used for agricultural purposes, such as sheep grazing, resulting in only a minor net change to the existing agricultural land use. Once the Proposed Development is decommissioned, the land will be returned to a suitable state to permit a return to agricultural use.

A land use conflict analysis based on the DPI's *Living and Working in Rural Areas* handbook (Learmonth, Whitehead, Boyd & Fletcher, 2007) and the resulting assessment outcomes for issues of land use conflict is provided in Appendix D. Most land use conflicts have been assessed as low. Land use conflict analysis indicates that visual amenity and bushfire pose a medium risk. The mitigation measures to reduce these potential conflicts are discussed in Sections 7.6 and 7.10 respectively.

Construction

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

Within the solar array, soil disturbance would be limited to the piles driven, screwed or ballasted to the ground to support and orientate the PV panels, and trenching for cable installation. As such, much of the groundcover will be retained across the Site. Consequently, soil disturbance from localised excavation activities will be relatively small, isolated and temporary.

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

Given the frequent high winds in the locality and the hard setting clays found in the vicinity of the Development Footprint there is potential for wind erosion, and subsequent dust generation, during the construction period. Dust particles can be released through a range of associated activities including:

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

Minor creeks and tributaries pass through, or are adjacent to the Site with some waterway crossings required. If appropriate control measures are not implemented there is potential for direct and indirect impacts on these water bodies during, and post construction from runoff erosion.

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

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

Operation

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

- Compacted and impervious access tracks; and
- Impervious PV panels.

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

Existing sheep grazing may be undertaken in the Site for ongoing production purposes and to control groundcover and weed around the PV arrays, minimising land use conflicts.

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

Decommissioning
At the end of the project life, the Proposed Development shall be decommissioned, with the objective of returning the land capability to its pre-existing agricultural capacity.

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

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

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

7.5.4 Mitigation Measures

Land use
Potential land use conflict management measures are assessed in Appendix D. Land use conflict analysis indicates that conflict regarding bushfire may pose a medium risk. The mitigation measures to reduce potential conflict is discussed in Section 7.10 respectively.

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

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

Design and construction of access tracks should also be carried out in accordance with:

- *Guidelines for planning, construction and maintenance of tracks* (DLWC, 1994);
- *Policy and Guidelines for Fish Friendly Waterway Crossings* (NSW DPI, 2004); and
- *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003).

Soil and erosion control measures in accordance with the above guidelines would be described in a construction management plan to be developed following project approval. Management plans would include a requirement for the establishment of erosion and sedimentation controls at the commencement of works and throughout construction, including the following measures:

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

Existing pasture compositions will be retained in the PV array areas. However, where pasture establishment fails in disturbed areas, agronomic advice will be sought to determine alternative management options for groundcover to protect soil from erosion in addition to the above erosion measures.

Consideration should be given to bury underground cables at a depth greater the 500 mm in areas of land outside of the PV array with a cropping history, or with a capability of cropping. This will allow for greater opportunity for existing agricultural activities to continue in these areas.

Whilst the occurrence of sodic soils in the Site is unlikely, if later soil testing (clay content, Effective Cation Exchange Capacity and electrical conductivity) indicates sodic soils are present trenching through

these soils must include soil amendment with Gypsum. The minimum recommended application rate is 10t/ha, however actual rates are to be determined following soil testing results.

Dust generation from vehicle movements on access tracks will be controlled by the following measures on site:

- All vehicles on-site should be confined to a designated route with onsite speed limits enforced;
- Trips and trip distances should be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips;
- Dirt that has been tracked onto sealed roads should be cleaned as soon as practicable;
- When conditions are excessively dusty and windy, and dust can be seen leaving the works site the use of a water truck (for water spraying of travel routes) should be used; and
- Vehicles and plant shall be maintained in accordance with manufacturer's requirements to minimise emissions. Vehicles and plant shall not be modified in any manner that may increase potential dust or exhaust emissions.

The use of road construction and maintenance equipment for access roads can be significant sources of dust, and emissions should be controlled through the use of water sprays during road construction and maintenance activities. Where conditions are excessively dusty and windy, and fugitive dust can be seen leaving the site, work practices should be modified by limiting the use of such machinery. Road sealing near to dust impacted residences along Waterloo Road may be considered in the future in consultation with individual residences and DP&E.

Dust generation from vegetation clearing and earthworks can occur, particularly during dry and windy conditions. Dust generation can be effectively controlled by increasing the moisture content of the soil surface. Other controls include:

- Modify working practices by limiting construction activities during periods of high winds (greater than 20 km/hour);
- Modify activities if dust is observed leaving the Site towards nearby sensitive receptors;
- Limit the extent of clearing and excavation to the minimum designated footprint required for construction;
- Stage clearing and excavation activities to minimise total areas of cleared ground;
- Minimise the number and volume of stockpiles on-site and the number of work faces on stockpiles; and
- Implement progressive groundcover rehabilitation and revegetation.

To avoid release to the environment, all hazardous materials (fuels, lubricants, herbicides, etc.) will be disposed of off-site in accordance with NSW EPA guidelines. Onsite refuelling shall occur in an area that is located greater than 100 m from the nearest drainage line and within an impervious bunded area.

Machinery will be inspected daily to ensure no oil, fuel or lubricants are leaking from the machinery. All hazardous materials will be stored in accordance with relevant regulations. All contractors and staff will

be appropriately trained through site induction and toolbox talks to prevent, minimise and manage accidental spills.

A spill response procedure will be prepared as part of the suite on management plans. The procedure will outline the responsive actions to a spill event and the measures required to prevent the spread of spills to adjacent areas. It will also include an emergency response protocol, EPA notification procedures and remediation requirements.

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

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

- Protocols for weed hygiene in relation to light vehicles, plant and machinery entering and leaving site, and for the importation of fill to site;
- Protocols to identify the location of listed priority weeds within construction areas prior to disturbance and the active removal and disposal of identified priority weeds using appropriate techniques to avoid the spread of weed seed and material; and
- Management strategies for any priority weeds according to the stipulations of the Biosecurity Act 2015 during the construction phases.

Operation

An operations management plan will be prepared prior to the operational phase of the project to guide operational environmental management.

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

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

The maintenance of low levels of vegetation cover across the Site will assist in reducing potential erosion across the site. This will be especially important below the panels to prevent scouring following significant rainfall events. As such, to minimise the potential for erosion in the areas beneath the panels an inspection program following significant rainfall events would implemented and stabilisation works would be undertaken as required.

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

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

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

In addition, sheep will be permitted to graze within the solar array to help keep vegetation levels down over the Site. This would contribute to weed control and fuel load reduction and the continuation of agricultural activities at a reduced scale.

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

Decommissioning

At the end of the project life, the Proposed Development shall be decommissioned. Decommissioning activities, and hence mitigation, shall be similar to those for construction.

All infrastructure, including underground cables, will be removed to a depth of 500 mm and internal tracks will be removed in consultation with landholders.

Prior to decommissioning, a decommissioning management plan will be prepared with the objective of returning the land capability to its pre-existing agricultural use. The decommissioning management plan shall include appropriate mitigation strategies to manage potential environmental impacts.

7.6 Visual Impact

7.6.1 Introduction

The purpose of the visual impact assessment is to identify and describe the existing landscape character and identify visual amenity receptors within the study area and, as a consequence of the introduction of the Proposed Development, to assess potential visual impacts (including glint and glare). The assessment then considers how mitigation measures could be implemented to reduce the effect of any identified impacts. A full copy of the visual impact assessment can be found in Appendix E. A separate glint and glare assessment is provided in Appendix F.

The assessment adopts a conservative approach, identifying potential receptors based on the broader Development Site and potential impacts across the Site, based on the PV inclusion area, rather than considering individual components. Key visual components associated with the Proposed Development include:

- Installation of photovoltaic solar panels (the 'PV array') providing a combined output of approximately 180 MW; and
- On-site inverters, batteries and support buildings.

The assessment area boundaries vary depending upon which of the following assessments are being considered (Figure 7-11):

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

7.6.2 Existing Environment

The Proposed Development would be located in the north of NSW, within the New England Tablelands Renewable Energy Precinct, around 18 km west of Glen Innes and 28 km east of Inverell. The landscape is undulating and of rural nature, mainly supporting agricultural enterprises, as well as sapphire mining. The Proposed Development generally lies around the intersection of Waterloo Road and Western Feeder Road, north of the Gwydir Highway between Glen Innes and Inverell. The historic "Kings Plains Castle" is located approximately 8 km to the north. The nearest national park is Kings Plains National Park, located 10 km north-west of the Proposed Development. Covering an area of just over 8,000 ha, the park includes walking tracks to take in Ironbark woodlands, creeks, pools and waterfalls. Camping facilities are provided within the park; however, the distribution of dense vegetation and tree cover throughout the park limit the opportunity for views toward the Proposed Development.

Landform within the Site consists of undulating hills with relatively low to medium gradients. The Site is located within an undulating landscape, where elevation ranges between 810 – 1000 m above sea level (AHD). The landscape grades gently from hillsides with granite outcroppings, to alluvial basins with moderately fertile soils. The valleys are broad and there are no cliffs, escarpments, or gorges within the

Site, though some hillsides are relatively steep. Land within the Site and wider landholding has been historically cleared for grazing purposes and most has been sown with improved pastures. There are patches of retained native woodland scattered throughout.

The hydrology of the Site is typified by ephemeral first order drainage lines. Several drainage lines intersect each other upstream of the Development Site to form Kings Plains Creek which is classed as a third order stream (Strahler, 1952) as it passes through the eastern portion of the Development Site. A number of sapphire mining leases exist within close proximity to the Site, including recent mining activity within parts of the Kings Plains Creek catchment.

Within the broader 5 km study area there are a number of minor roads, these include Waterloo Road, the Eastern and the Western Feeder Road, Woodstock Road and Kings Plains Road. Four residences are located on the project area itself, each owned by a participating host landholder. The remainder of residences within the study area comprise scattered rural residences. The nearest village is Wellingrove, located approximately 15 km north east of the Proposed Development area.

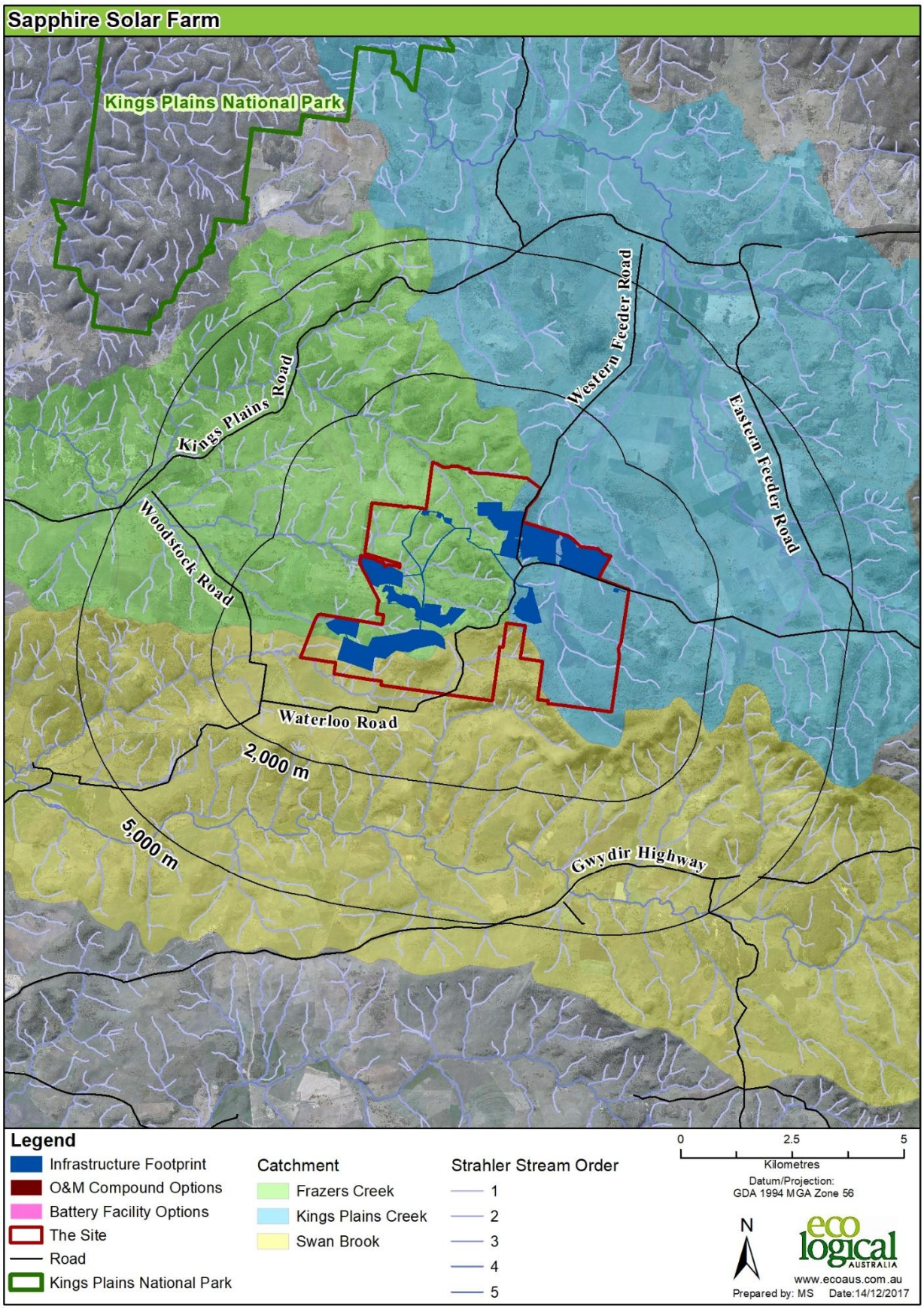

Figure 7-11. Study areas and wider site context.

Landscape Character

The landscape character of the Site and the wider study area is classified into two Landscape Character Units (LCUs):

- LCU1 is Kings Plains Creek catchment dominated by a wide open valley with undulating to rolling hills. The LCU is rural, with 20 dwellings scattered across the wider landscape. Due to historic clearing for agriculture, vegetation cover is generally low except along ridgetops, within road reserves, in isolated patches in paddocks and gullies and within gardens surrounding residences. A representative image of LCU1 is shown in Figure 7-12.
- LCU2 is the Frazers Creek catchment part of the study area (which also includes Horse Gully, Mary Anne Creek and Apple Tree Gully) which lies to the west of Waterloo Road. This LCU is more open than the Kings Plains Creek Valley with open, sub-regional vistas and more dramatic hills and ranges including White Hill, Kings Hill and Swan Peak. This area has been more extensively cleared and incorporates considerable areas of cropping and improved pasture, as well as active sapphire mining leases. Woody native vegetation persists on hill tops and in areas of lower soil fertility. A representative image of LCU2 is shown in Figure 7-13.

Figure 7-12: Typical views of LCU1, showing rolling rural landscape and cleared vegetation from Eastern Feeder Road across Kings Plains Creek valley.

Figure 7-13: Typical views of LCU2 viewed from Waterloo Road looking north east.

General visibility

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

The Proposed Development site has approximately 3 km of direct road frontage to Waterloo Road and the Western Feeder Road. Topography and vegetation in adjoining public areas naturally obscures potential views of the development site. Distant views and glimpses of the site are possible from Waterloo Road, Western Feeder Road, Eastern Feeder Road, Woodstock Road and Kings Plains Road. All roads within the study area are unpaved and, outside of construction periods, subject only to low volumes of local traffic.

7.6.3 Potential Impacts

Landscape character impact assessment

The landscape impact assessment considers the direct and indirect impacts of the Proposed Development on LCUs associated with the Site. In this case, due to the contained nature of landscape in which the Proposed Development is located, this assessment considers potential impacts on two landscape character units (LCU1 and LCU2) identified within the 2 km study area.

An assessment, taking into account the relationship between 'visual sensitivity' (the ability of a landscape character area to absorb a development) and the 'magnitude of visual change' is used to determine the potential impact of the Proposed Development on each LCU.

Landscape Character Unit 1

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

The magnitude of visual change to LCU1 during the construction and operation of the Proposed Development is considered to be moderate, as the introduction of a commercial-scale solar farm involves a moderate scale land form change and vegetation clearing in a landscape already impacted by intensive agriculture and mining.

It should be noted, that due to the location of the Proposed Development, within an undulating landscape, it is never possible to view the Proposed Development in its entirety. In addition, the magnitude of visual change decreases with distance from the site, as shielding from the topography of the landscape and vegetation interact to reduce views of the Proposed Development, such that, it is no longer the defining feature.

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

Landscape Character Unit 2

The visual sensitivity of LCU2 is assessed as low, although it comprises sweeping views and interesting topography, it is highly disturbed, has been extensively cleared of native vegetation and subject to a range of heterogeneous land uses including cropping, grazing and sapphire mining. LCU2 is not covered by a designated landscape classification such as a State Forest, National Park or a World Heritage Area.

For the same reasons as for LCU1, the magnitude of visual change to LCU2 during the construction and operation is considered to be moderate. Similarly, there will also be relatively minor changes to vegetation cover and landform as a consequence of the Proposed Development, although the site chosen for the PV arrays has a history of cropping and soil conservation activities including the construction of contour banks. The overall impact on the landscape character within LCU2 is assessed as low.

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

Viewshed analysis

ZVI mapping has been generated to understand the potential extent of the visibility of the Proposed Development within the study area (5 km). The ZVI for the PV Inclusion Area, Battery Facility Option and Compound Option Areas are presented in Figure 7-14.

The ZVI map illustrates that, despite the relatively large scale of the Proposed Development, theoretical visibility is limited by the undulating topography that characterises the landscape within which it sits. The landscape's ability to contain the visual influence of the development is a key factor in the selection of the site. Within the study area, the main extent of visibility is to the north east and west of the Proposed Development.

ZVI analysis indicates that development within the Kings Plain Creek catchment is predominantly visually independent from development within the Frazers Creek catchment, and *vice versa*. Accordingly, impacted viewpoints associated with Kings Plains Creek catchment are to the north and east, while visual impacts associated with Frazers Creek catchment occur to the west of the Site.

Visual Amenity Impact Assessment

Desktop spatial assessment identified 47 residences and/or potential dwellings within 5 km of the Proposed Development area footprint. ZVI analysis indicates that the Proposed Development is potentially visible from 24 of these locations (Figure 7-15).

Four (associated) residences were located within the project area itself (R013, R014, R016 and R018), each owned by a host landholder. A further two residences outside of the Proposed Development area were also owned by host landholders (R033 and R79) and one property is owned by Sapphire Wind Farm (R026). While visual amenity at associated residences may be impacted by the development, impacts to associated residences, and other residences owned by the host or developer, are not considered further.

ZVI analysis indicates that the Proposed Development is visible to six non-associated residences located within 2 km from the Proposed Development area, and a further 11 non-associated residences located between 2 and 5 km. During field investigations, it was confirmed that due to the mitigating effect of distance, combined with topography and vegetation, visual impacts beyond 5 km are considered to be negligible, and are not considered further.

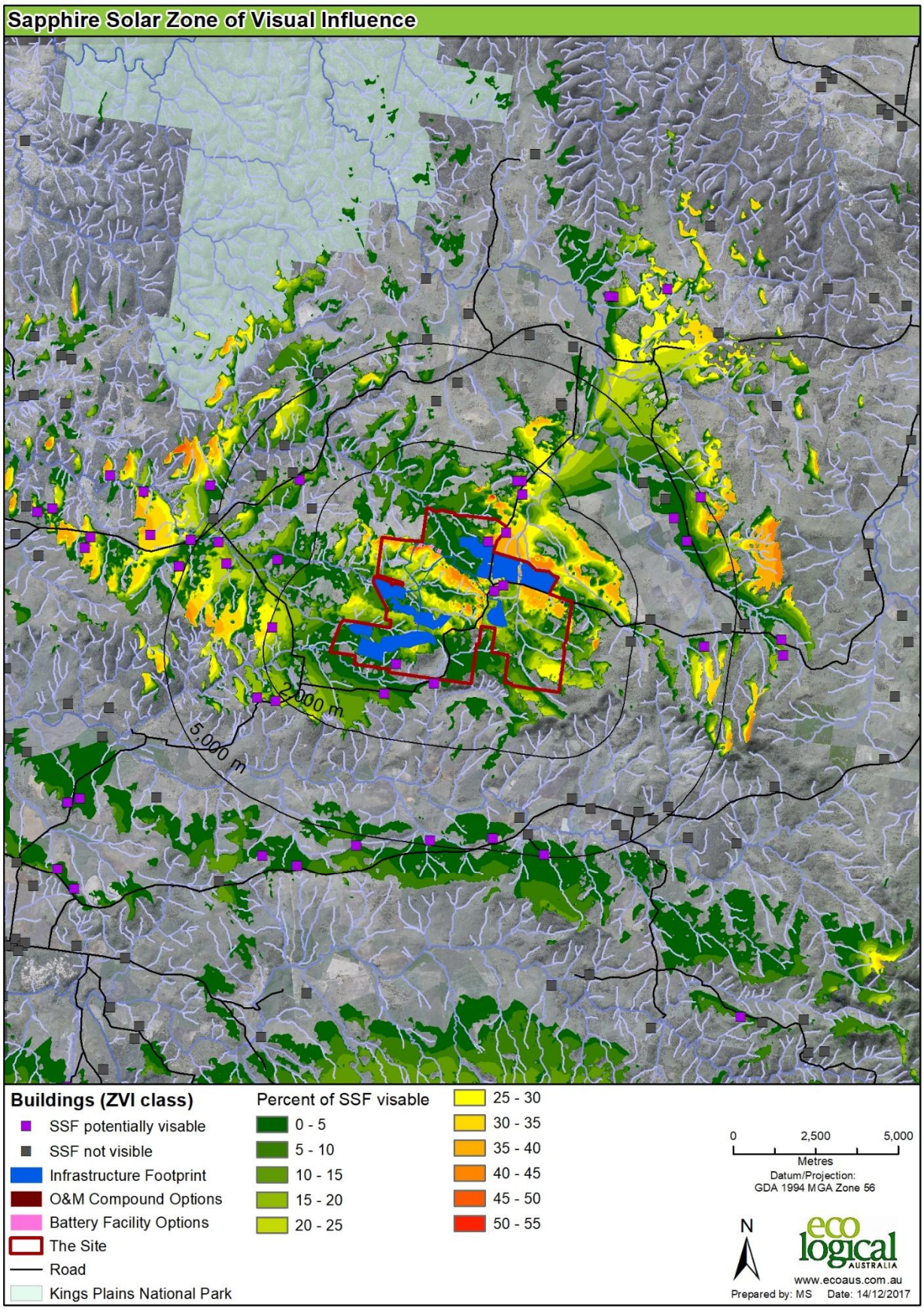

Figure 7-14: ZVI model indicating Development Footprint visibility at a sub-regional level.

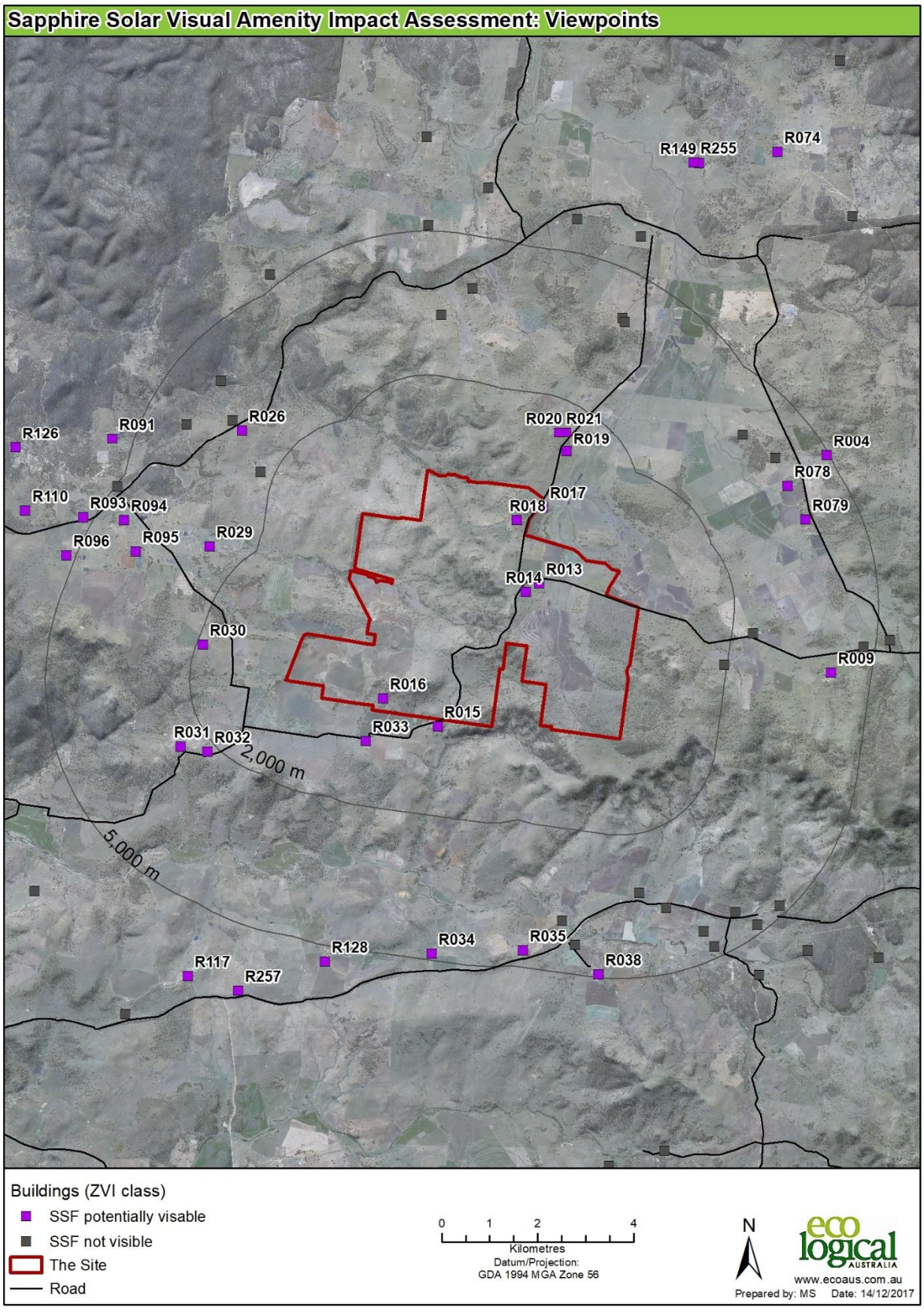

Figure 7-15: Key Public and Private Viewpoints selected for visual amenity impact assessment.

Public Viewpoints

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

- Waterloo Road;
- Western Feeder Road;
- Woodstock Road;
- Eastern Feeder Road;
- Kings Plains Road; and
- Gwydir Highway.

While it may be possible to catch glimpses of the solar array from other roads beyond 5 km from the project area, such glimpses are considered to be insignificant. Table 7-22 summarises the predicted visual amenity impacts at key public and private viewpoints and recommended mitigation strategies.

Table 7-22: Summary of impacts to visual amenity and recommended mitigation strategies

Viewpoint	Approximate distance	Visual sensitivity	Magnitude of visual change	Visual Amenity impact	Recommended Mitigation
R017	75 m	Insignificant	Insignificant	Insignificant	Nil
R015	154 m	Insignificant	Insignificant	Insignificant	Nil
R019	1,073 m	Moderate	Low	Low	Consider viewpoint vegetation screening
R21	1,316 m	Insignificant	Insignificant	Insignificant	Nil
R020	1,394 m	Insignificant	Insignificant	Insignificant	Nil
R030	1,873 m	Low	Low	Low	Consider viewpoint vegetation screening
R032	2,207 m	Insignificant	Insignificant	Insignificant	Nil
R031	2,592 m	Insignificant	Insignificant	Insignificant	Nil
R029	2,685 m	Insignificant	Insignificant	Insignificant	Nil
R095	3,894 m	Insignificant	Insignificant	Insignificant	Nil
R078	3,931 m	Insignificant	Insignificant	Insignificant	Nil
R009	4168 m	Insignificant	Insignificant	Insignificant	Nil
R094	4,431 m	Insignificant	Insignificant	Insignificant	Nil
R035	4,649 m	Insignificant	Insignificant	Insignificant	Nil
R034	4,867 m	Insignificant	Insignificant	Insignificant	Nil
R038	4,936 m	Insignificant	Insignificant	Insignificant	Nil
R004	4,950 m	Insignificant	Insignificant	Insignificant	Nil
A1 – Gwydir Highway	5,600 m	Insignificant	Insignificant	Insignificant	Nil

Viewpoint	Approximate distance	Visual sensitivity	Magnitude of visual change	Visual Amenity impact	Recommended Mitigation
A2 – Kings Plains Road	3,700 m	Insignificant	Insignificant	Insignificant	Nil
A6 – Waterloo Road	0 m	Low	Moderate	Low	Assess visibility post construction in consultation with Inverell Shire Council
A7 – Woodstock Road	1,600 m	Insignificant	Insignificant	Insignificant	Nil
A8 – Western Feeder	0 m	Low	Moderate	Low	Nil
A9 – Eastern Feeder Road	4,100 m	Insignificant	Insignificant	Insignificant	Nil

Other considerations

Night lighting

There is no requirement to light the solar farm at night. The only facilities with provisions for night lighting will be associated with the operations and maintenance compound. Lighting at this location will be predominantly on-demand only. Observer point analysis indicates that the compound is visible from a small number of potential sensitive receivers. As such, it is recommended that night lighting be developed to minimise light spill and that vegetative screenings be established as an additional mitigation, if required.

Glint, glare and reflections

When the sun is reflected off a smooth surface, it can result in a glint (a quick reflection) or glare (longer reflection). In both cases, the intensity of light will depend upon the reflectiveness of the surface from which the sun is being reflected.

Glint and glare effects can only ever occur when the weather is clear and sunny. In the scenario where a solar reflection is possible towards a road user or resident in a surrounding dwelling, the individual will also be looking in the general direction of the sun. This means the sun and solar reflection will be visible simultaneously. The sun is a significantly brighter source of light. Additionally, at any one location, only a particular area of solar panels will produce a solar reflection towards it. Note, that not all receptors will experience a solar reflection at the same time.

Solar reflections are technically possible towards seven surrounding dwelling receptors. Of these, only R017 is a non-associated residence. Visual impact assessment for R017 indicates that this residence is completely screened from the Proposed Development, therefore, no impact is anticipated. Detailed assessment of potential glint, glare and reflections is provided in Appendix F.

Air traffic

The nearest public airports are Glen Innes Airport, located approximately 25 km east of the development site and Inverell located approximately 30 km west. Generally speaking, concerns regarding glare from

solar farms has focussed on solar facilities on, or within 10 km of airfields. Distances to Glen Innes and Inverell airports far exceed this distance, and as such specific aviation modelling is not warranted (Appendix F).
Commercial north-south flightpaths are spread across northern NSW, including within the vicinity and the Proposed Development site. Spaven Consulting (2011) conclude that off-airfield ("*en route*") facilities are unlikely to present glare problems to pilots, for the following reasons:

- Glare is likely to present a hazard only during critical phases of flight, especially approach and landing, the *en route* phase is not normally a critical phase;
- Glare occurs almost exclusively at low angles of elevation, aircraft in the *en route* phase of flight will be at higher angles of elevation;
- Pilots in the *en route* phase are already subjected to glare from a number of existing sources such as large assemblies of parked cars, major glasshouse facilities and large bodies of water, etc.; and
- The pilot view from most cockpits, is severely limited in the downward direction by the aircraft structure, thus blocking the line of sight to any source of glare on the ground.

There are a few private rural landing strips on properties within the surrounding district. The presence of the Proposed Development is anticipated to have an insignificant visual impact on local airfields. PV panels are no more reflective than areas of vegetation such as forests, crops or grasslands and far less reflective than standing water such as water in dams, rivers and lakes, all features which pilots regularly fly over or adjacent to (NGH, 2010).

Further evidence of the limited risks posed by reflections from PV panels is the increasing installation of large solar arrays within airports in order to take advantage of large open areas and high local day-time electricity demand. Australian examples include Adelaide Airport, Alice Springs Airport, Newman (WA) Airport and Ballarat Airport (Solar Choice, 2013).

Road traffic
Solar reflections are theoretically possible towards approximately 7.6km of road classified as local road (Figure 7-16). Road users would be expected to be travelling at (up to) moderate speeds with a low density of traffic expected. Any solar reflection could last for up to 20 minutes, however in reality, its duration would depend on the speed of the car travelling through the solar reflection zone.

The overall expected impact upon road users with respect to safety is conservatively classified as low where the reflecting solar panels are visible. Where the solar panels are not visible, there is no impact. Potential glint and glare impacts to road traffic shall be further minimised through:

- Selection of muted and non-reflective construction materials; and
- Installation of security fencing and where considered appropriate in consultation with Council, screening vegetation between road users and infrastructure.

Detailed assessment of potential impacts to road traffic is provided in Appendix F.

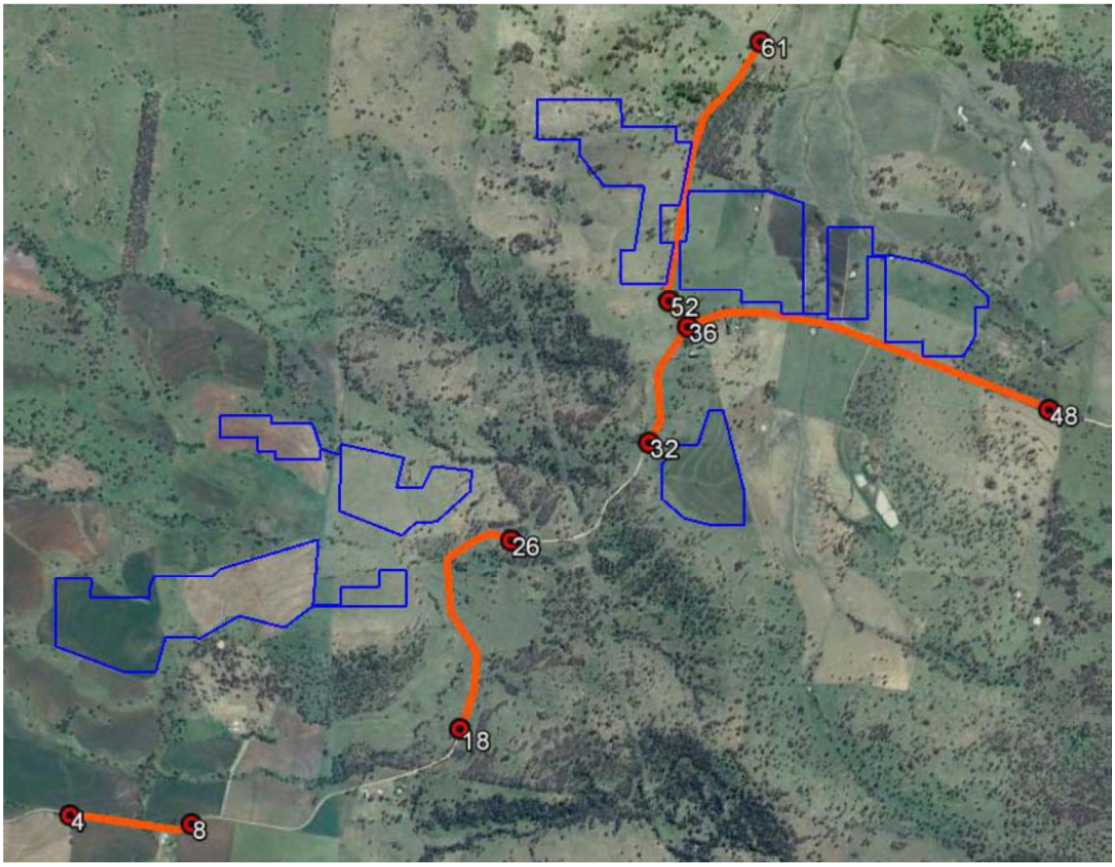

Figure 7-16. Sections of road that could experience solar reflection (Pager Power, 2017)

Decommissioning

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

Cumulative visual impacts

The Proposed Development is co-located with the SWF and is located within the New England Renewable Energy Precinct (Figure 7-17). Other renewable energy projects within the New England Renewable Energy Precinct include:

- Glen Innes Wind Farm – approved;
- White Rock Wind Farm – operational;
- White Rock Solar Farm – under construction; and
- Sundown Solar Farm – SEARs issued, EIS under preparation.

Cumulative impact assessment undertaken by GBD (2011) indicates that, in the absence of local mitigating factors (i.e. vegetation), following full development of these projects, wind turbines will be visible from almost all locations assessed as part the current visual impact assessment.

Wind turbines possess a very different visual presence to PV solar arrays, tending to rise above the existing landscape and to be visible over a far greater distance, whereas solar farms tend to integrate into the landscape and to be visible only within the local setting. Furthermore, wind turbines are typically located on elevated ridgelines, whereas PV arrays require flat areas generally associated with open valleys.

It is anticipated that these disparities in visual characteristics and setting will help to mitigate the potential for cumulative impacts involving the Proposed Development and nearby wind turbine generators. This impact may be further mitigated through the adoption of the identified mitigation strategies.

There are currently three commercial scale PV solar farms, in differing stages of development, proposed for the New England Renewable Energy Precinct. Both Sundown Solar Farm and White Rock Solar Farm are approximately 10 km from the proposed PV array areas identified for the Proposed Development (Figure 7-17).

Based on topography and separation distances it is anticipated that there is limited potential for significant views of the Proposed Development and any other solar farm development. ZVI analyses prepared as part of the Preliminary Environmental Assessment to support an application for SEARs for Sundown Solar indicate that this development will not be visible from any of the residences or public roads within 5 km of the Proposed Development.

Travellers on the Gwydir Highway may catch distant glimpses of each solar farm as they travel between Inverell and Glen Inness, however, these views will be of only one solar farm at any given time and of short duration. Such visual impacts to amenity will be insignificant.

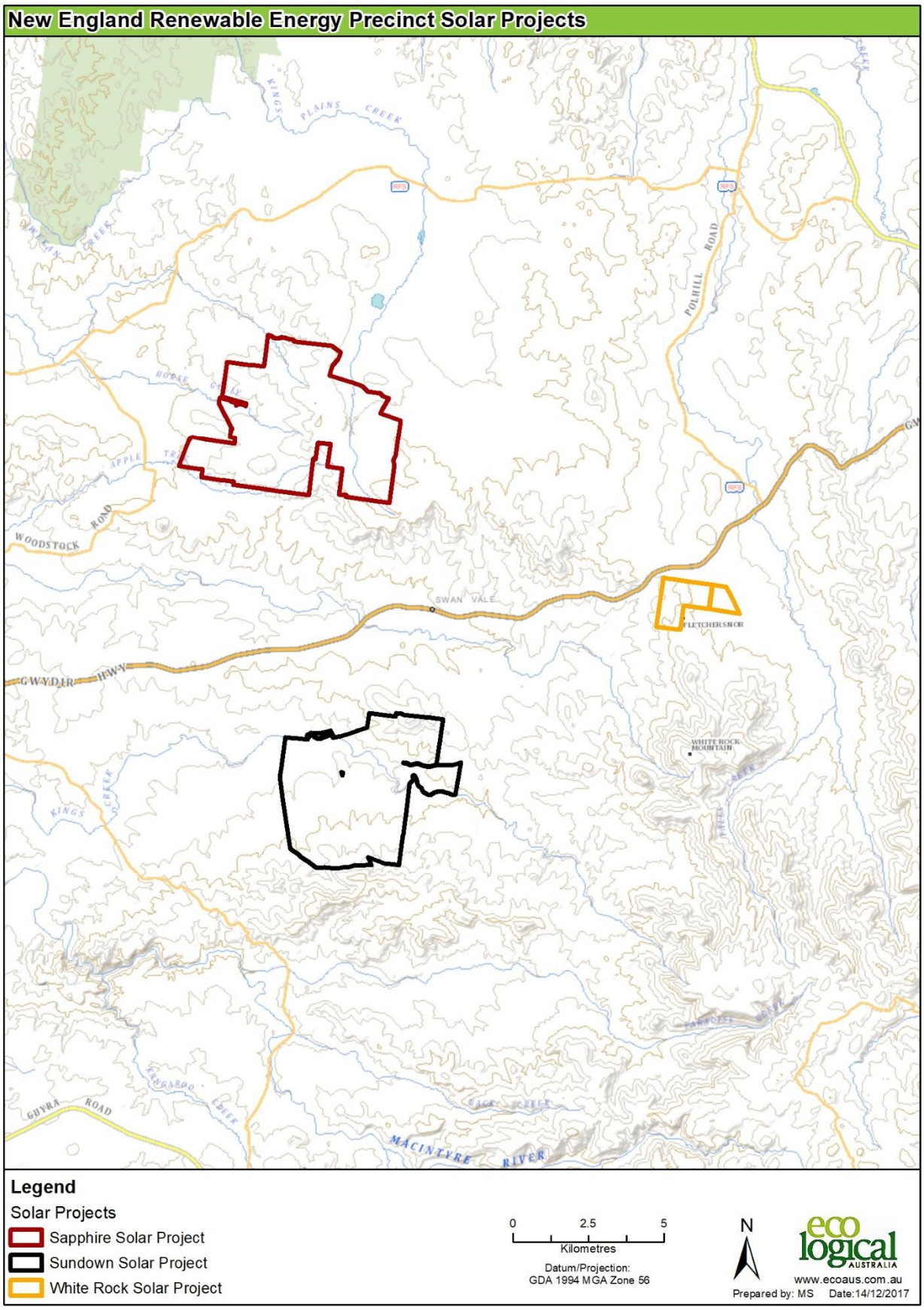

Figure 7-17: Renewable Energy developments in New England Renewable Energy Precinct

7.6.4 Mitigation Measures

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

- Minimise vegetation clearing and earthworks, and rehabilitate bare earth progressively;
- Post-construction, consult with Inverell Shire Council regarding the benefits associated with vegetation buffer to help screen views and reflections from Waterloo Road;
- Continue to consult with landholders at R019 and R030 to identify, where possible, the location of mutually agreeable vegetation screening both pre and post construction;
- In consultation with Inverell Shire Council, promote management of road corridor vegetation to allow natural regeneration of native plant species;
- Use muted, low contrast colours for infrastructure, so that they blend into the landscape as far as possible;
- Select infrastructure to minimise potential for reflectivity and glare;
- As designed, maintain locations of proposed battery facilities away from visual receptors and apply visual screening if necessary; and
- Minimise night lighting.

Draft Landscaping Plan

A draft landscaping plan has been developed in response to the findings of this assessment (Figure 7-18). The proposed planting area comprises a vegetation buffer along the frontage with Waterloo Road. Baseline traffic volumes along this road are very low, with the majority comprising local residents, whom have been consulted extensively regarding the proposed solar farm. As such, it is proposed that the potential benefits of such a visual screening be determined post-construction and in consultation with Inverell Shire Council in respect to visual impacts associated with Waterloo Road.

Additional observer point vegetation screening shall be developed, if requested, in consultation with impacted landholdings, R019 and R030.

Predicted residual impacts following the introduction of mitigation measures discussed above are outlined in Table 7-23 below.

Table 7-23: Summary of residual effects

LCU/Viewpoint	Visual Amenity impact	Anticipated residual effect following mitigation
LCU1	Low	Low
LCU2	Low	Low
R019	Low	Insignificant - viewpoint vegetation screenings would effectively mitigate visual impacts
R030	Low	Low - viewpoint vegetation screening to reduce, but not eliminate, visual impacts
A6 – Waterloo Road	Low	Low - a southern boundary vegetation screen would significantly reduce visual impacts
A8 – Western Feeder	Low	Low

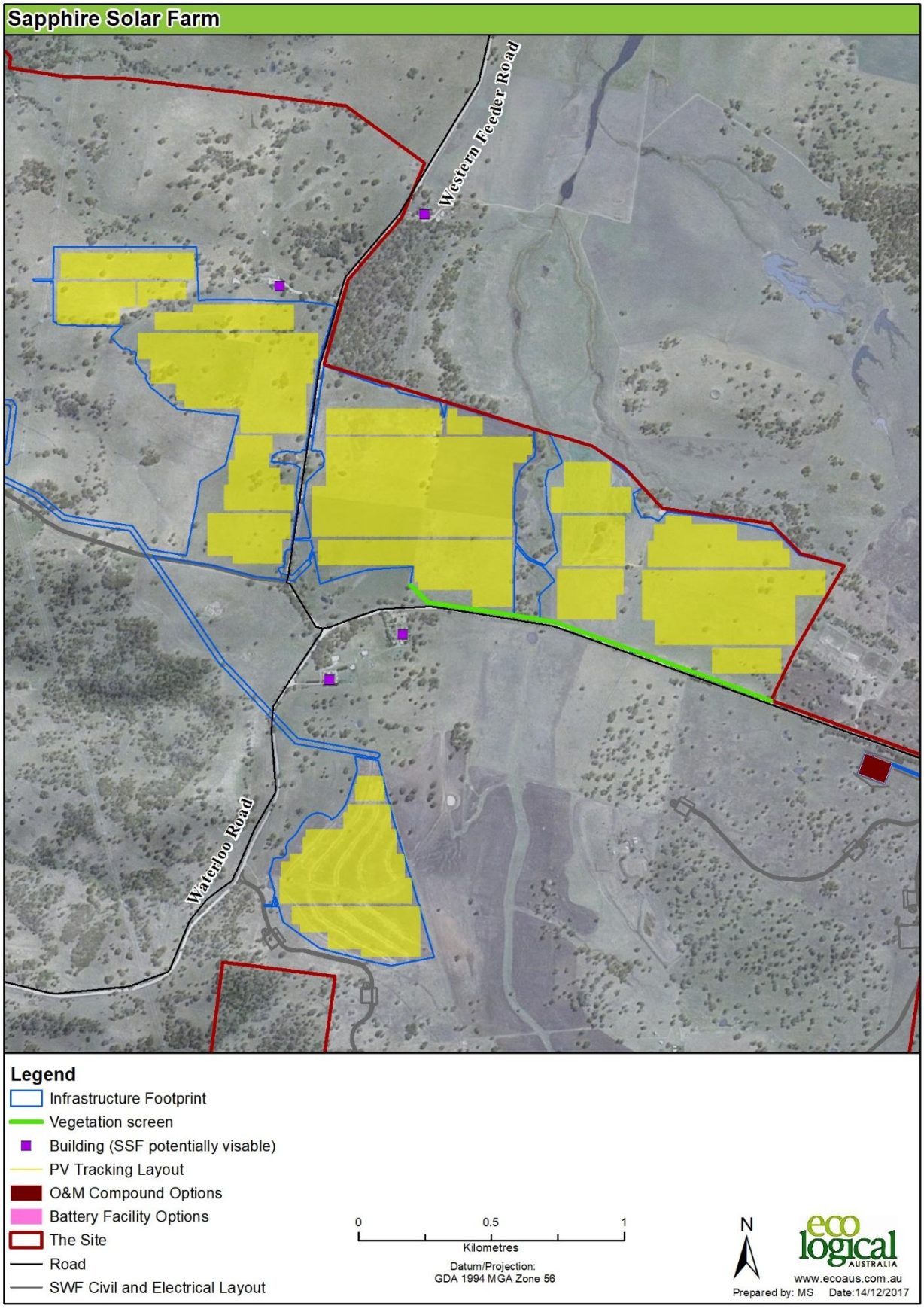

Figure 7-18: Draft landscaping plan for Waterloo Road

7.7 Noise

7.7.1 Introduction

This construction and operational noise and vibration impact assessment has been prepared to satisfy the SEARs for the proposal. The assessment includes the following:

- Construction noise assessment:
  - Identification of construction stages and associated activities including, specialised machinery and equipment used during the works;
  - Assessment in accordance with the *NSW Interim Construction Noise Guideline* (ICNG); and
  - Advice on practical and appropriate in-principle noise mitigation and management, where required.

- Operational noise impact assessment:
  - Identification of the locations of the substation and inverters;
  - Assessment in accordance with the *NSW Noise for Industry Policy 2017*; and
  - Advice on practical and appropriate in-principle noise mitigation and management, where required.

A full copy of the noise and vibration assessment is provided in Appendix G. This chapter provides a summary of the existing environment, methods, results and discussion of the noise impact assessment.

7.7.2 Existing Environment

The closest residential properties which may be adversely impacted by noise from the construction and operation of the solar farm have been identified (Figure 7-19) and are as follows:

- R018 – Property within the solar farm area to the north – 133 Western Feeder, Kingsland NSW 2370
- R017 – Property just outside the solar farm area to the north – 176 Western Feeder, Kingsland NSW 2370
- R013 – Property located in the middle of the solar farm area – Waterloo Rd, Woodstock NSW 2360
- R014 – Property located in the middle of the solar farm area – 816 Waterloo Rd, Woodstock NSW 2360
- R016 – Property within the solar farm area to the south-west – Woodstock NSW 2360
- R015 – Property south of solar farm area – 420 Waterloo Rd, Woodstock NSW 2360
- R033 – Property south-west of solar farm area – 260 Waterloo Rd, Woodstock NSW 2360
- R026 – Property north-west of solar farm area – Sapphire NSW 2360

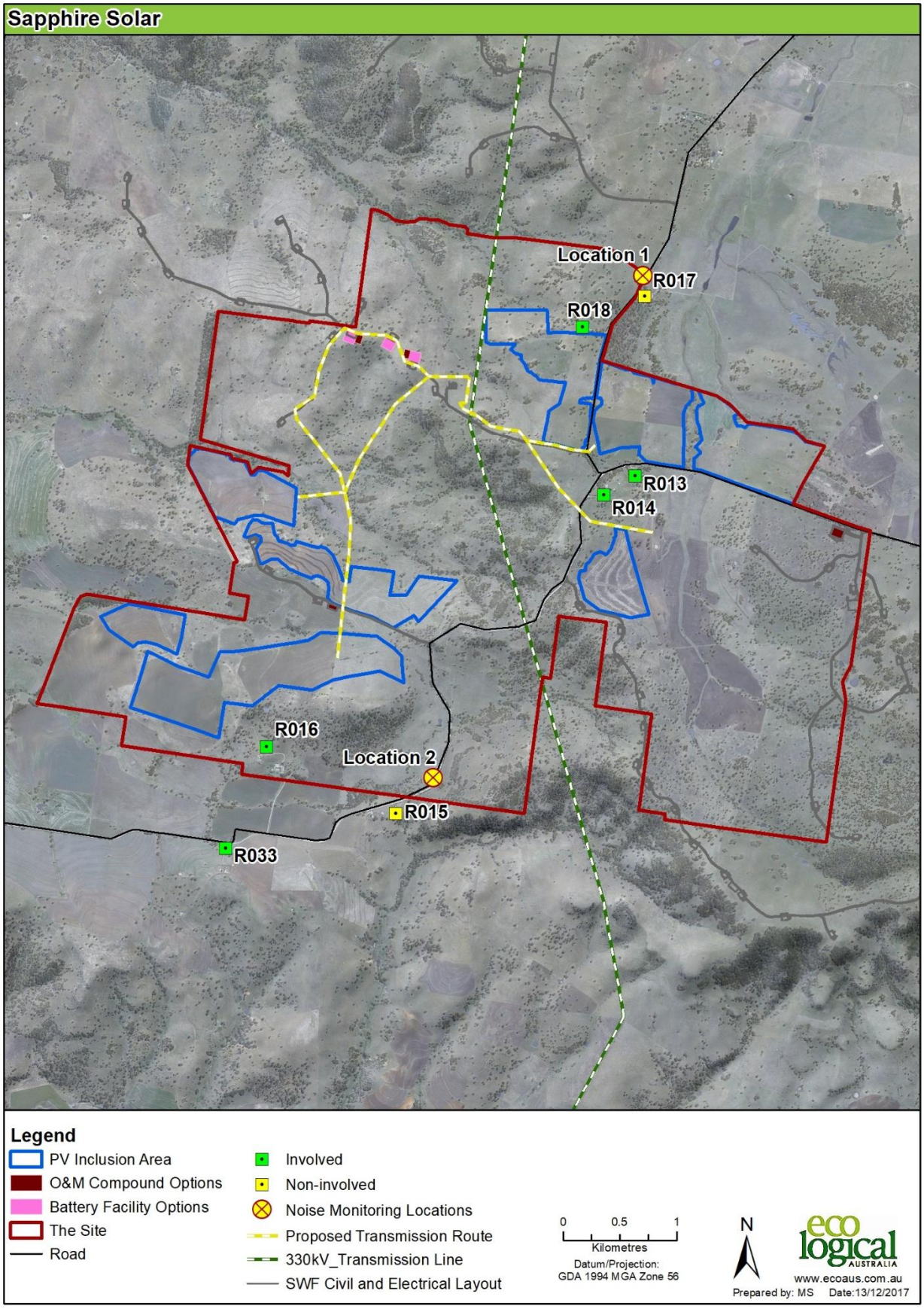

Figure 7-19: Location of noise sensitive receivers

Should the derived noise limits in this report be met at the above identified noise sensitive receivers (NSRs) with or without noise mitigation measures, compliance with the noise criteria is also expected to be met at properties located further away due to increased distance attenuation.

TTM conducted a site visit at the proposed solar farm site on Tuesday, 31st October 2017. During the site visit, NSRs were identified and noise measurements were conducted. Noise loggers were installed at locations representative of the NSRs to measure typical ambient noise levels at the site (Figure 7-19).

Ambient noise levels are typical of a rural area with an acoustic environment that is dominated by natural sounds, having relatively little road traffic noise from Western Feeder and Waterloo Road. The area is generally characterised by low background noise levels.

The unattended and attended measurement results show typical background noise levels for a rural area where traffic on local roads is the dominant noise source. The attended measurements are slightly higher to the unattended measurements. The slight increase is due to the attended measurements being taken closer to the road which recorded higher levels of car pass-bys (Table 7-24).

The existing noise levels at Location 1 are slightly lower than the noise levels at Location 2. This could be mainly due to the noise from the activities of SWF which is closer to Location 2 than Location 1. The measured noise levels generally drops throughout the day, except for the L_{90} parameter, which are similar throughout the day at both measurement locations.

Table 7-24. Summary of unattended and attended noise monitoring results

Period	Rating Background Noise Levels, RBL (L_{A90}) in dB(A)	Existing Noise Levels in dB(A)		
		L_{Aeq}	L_{A10}	L_1
Unattended				
Location 1 – Northern development site boundary				
Day	23	39	37	49
Evening	21	31	33	39
Night	21	33	33	41
Location 2 – Southern development site boundary				
Day	43	43	40	52
Evening	39	39	39	46
Night	39	39	39	46
Attended				
Location 1 – 10:14 am 31/10/2017	33	44	45	54
Location 2 – 11:10 am 31/10/2017	38	46	48	53

Note:
- Day-time period is from 7 am to 6 pm (Monday to Saturday) and 8 am to 6 pm (Sundays and public holidays)
- Evening period is from 6 pm to 10 pm
- Night-time period is from 10 pm to 7 am (Monday to Saturday) and 10 pm to 8 am (Sundays and public holidays)

7.7.3 Potential Impacts

Construction Noise

The noise impact of construction activities for each applicable construction phase has been predicted for a worst-case scenario. The noise prediction has been based on the following:

- Plant and equipment source sound power level information given in Table 7-25;
- Distance attenuation, and
- Atmospheric, meteorological and ground noise attenuation using the CONCAWE8 method, where applicable.

The worst-case scenario represents the use of all the plant and equipment for each activity at the same time at one single point. This scenario represents an unrealistic scenario, but does represent the maximum possible impact of construction noise for a short duration before the work moves to another location.

The main construction process and associated equipment is presented in Table 7-25.

Table 7-25. Summary of construction process, equipment and noise sources

Construction Process	Task	Equipment	% Use per day	Sound Power Level, dB(A)	Reference*
Site Preparation and Substation Construction Phase	Site Clearing, Site Facilities and Construction laydown areas, Site Access Tracks and Construction of Substation	Hydraulic Hammer Rig 4t hammer, Power rating 186kW	75	115	Ref. No. 2, Table 3 in DEFRA
		Dozer 20t, Power Rating 142kW	75	109	Ref. No. 1, Table 2 in DEFRA[6]
		Water Trucks	75	107	AS 2436
		Graders	75	110	AS 2436
		Flatbed Trucks (>20t)	75	107	AS 2436
		Skid Steers	75	105	AS 2436
		Front End Loaders	75	113	AS 2436
		Roller Compactors	75	107	Ref. No. 37, Table 2 in DEFRA
		Tracked Excavator 16t, 72kW	50	104	Ref. No. 5, Table 2 in DEFRA
		Tracked Excavator (Idling) 16t, Power rating 72kW	25	91	Ref. No. 6, Table 2 in DEFRA
		Wheeled Backhoe Loader 8t, Power rating 62kW	50	96	Ref. No. 8, Table 2 in DEFRA
		Wheeled Backhoe Loader (Idling) 8t, Power rating 62kW	25	83	Ref. No. 9, Table 2 in DEFRA
		Gravel Trucks	75	108	Ref. No. 34, Table 2 in DEFRA
		Mobile crane	50	104	AS 2436
		Lifting Platform	75	95	Ref. No. 57, Table 4 in DEFRA

[6] Department for Environment Food and Rural Affairs, DEFRA – Update of Noise Database for Prediction of Noise on Construction and Open Sites - 2005

Construction Process	Task	Equipment	% Use per day	Sound Power Level, dB(A)	Reference*
Installation	Supporting structures and Solar PV Modules Installation	Hydraulic Hammer Rig 4t hammer, Power rating 186kW	75	115	Ref. No. 2, Table 3 in DEFRA
		Backhoe with auger	75	106	AS 2436
		Forklifts	75	106	AS 2436
		Welders	75	105	AS 2436
		Tracked Excavator 16t, 72kW	50	104	Ref. No. 5, Table 2 in DEFRA
		Tracked Excavator (Idling) 16t, Power rating 72kW	25	91	Ref. No. 6, Table 2 in DEFRA
		Wheeled Backhoe Loader 8t, Power rating 62kW	50	96	Ref. No. 8, Table 2 in DEFRA
		Wheeled Backhoe Loader (Idling) 8t, Power rating 62kW	25	83	Ref. No. 9, Table 2 in DEFRA
		Pickup truck (>20t)	50	107	AS 2436
		Water Bowser	75	107	Ref. No. 37, Table 6 in DEFRA
		Flatbed truck (>20t)	50	107	AS 2436
		Wheeled Loader, 170kW	75	104	Ref. No. 28, Table 2 in DEFRA
		Mobile crane	50	104	AS 2436
Inverter and Transformer Assemblies, and Electrical Collection System	Trenching	Tracked Excavator 16t, 72kW	50	104	Ref. No. 5, Table 2 in DEFRA
		Tracked Excavator (Idling) 16t, Power rating 72kW	25	91	Ref. No. 6, Table 2 in DEFRA
		Wheeled Backhoe Loader 8t, Power rating 62kW	50	96	Ref. No. 8, Table 2 in DEFRA
		Wheeled Backhoe Loader (Idling) 8t, Power rating 62kW	25	83	Ref. No. 9, Table 2 in DEFRA
		Pickup truck (>20t)	75	107	AS 2436

Construction Process	Task	Equipment	% Use per day	Sound Power Level, dB(A)	Reference*
		Water truck	75	107	AS 2436
		Flatbed truck (>20t)	75	107	AS 2436
		Water Pump	75	93	Ref. No. 45, Table 2 in DEFRA
		Concrete Pump + Cement Mixer Truck (Discharging)	50	95	Ref. No. 24, Table 4 in DEFRA
		Hydraulic Hammer Rig 4t hammer, Power rating 186kW	75	115	Ref. No. 2, Table 3 in DEFRA
		Lifting Platform	75	95	Ref. No. 57, Table 4 in DEFRA
		Tipper Truck	75	108	Ref. No. 34, Table 2 in DEFRA
		Diesel generator	80	99	AS 2436
Commissioning	-	Tracked Excavator 16t, 72kW	50	104	Ref. No. 5, Table 2 in DEFRA
		Tracked Excavator (Idling) 16t, Power rating 72kW	25	91	Ref. No. 6, Table 2 in DEFRA
		Wheeled Backhoe Loader 8t, Power rating 62kW	50	96	Ref. No. 8, Table 2 in DEFRA
		Wheeled Backhoe Loader (Idling) 8t, Power rating 62kW	25	83	Ref. No. 9, Table 2 in DEFRA
		Pickup truck (light vehicle)	75	97	TTM Database
		Flatbed truck (light vehicle)	75	97	TTM Database
		Concrete Pump + Cement Mixer Truck (Discharging)	50	95	Ref. No. 24, Table 4 in DEFRA
		Hydraulic Hammer Rig 4t hammer, Power rating 186kW	75	115	Ref. No. 2, Table 3 in DEFRA

Construction Process	Task	Equipment	% Use per day	Sound Power Level, dB(A)	Reference*
		Lifting Platform	75	95	Ref. No. 57, Table 4 in DEFRA
		Mobile crane	50	104	AS 2436

Note: *

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

AS 2436:2010. Guide to noise and vibration control on construction, demolition and maintenance sites.

The noise impact of construction activities for each applicable construction phase has been predicted for a worst-case scenario and an average-case scenario. The worst-case scenario represents the use of all the plant and equipment for each activity at the same time at one single point. This scenario represents an unrealistic scenario, but does represent the maximum possible impact of construction noise for a short duration before the work moves to another location.

A worst-case scenario has been modelled to conservatively predict the propagation of noise from source to receiver. The worst-case scenario includes the effects of temperature inversions and favourable winds onto the noise, which is equivalent to CONCAWE Category 6.

A neutral meteorological condition has also been predicted, where the resulting noise levels are neither elevated nor reduced. This condition is equivalent to CONCAWE Category 4.

For the construction noise assessment, noise levels have been predicted at the approximate boundaries of the identified NSRs. The predicted noise levels have then been compared to the following noise targets (Table 7-26).

Table 7-26. ICNG noise targets for NSRs

NSR	R018*	R017	R013*	R014*	R016*	R015	R033*	R026*
ICNG noise management level (dB(A)) Day-time	33	33	33	33	37	37	37	33
Highly noise affected limit (dB(A))	75	75	75	75	75	75	75	75

* solar farm associated residences

The predicted noise levels for each noise significant construction phase are provided in the tables below (Table 7-27, Table 7-28, Table 7-29 and Table 7-30). Exceedances of the ICNG noise management level are shown in bold and red.

Table 7-27. Predicted construction noise levels from Site Preparation and Substation Construction Phase

Construction Stage – Site Preparation and Substation Construction Phase								
NSR Reference	R18	R17	R13	R14	R16	R15	R33	R28
Predicted noise level dB(A) worst-case Met. Cat 6	73	50	70	67	56	40	42	26
Predicted noise level dB(A) neutral-case Met. Cat 4	73	45	70	65	51	34	37	20
ICNG noise management level (Day)	33	33	33	33	37	37	37	33
Meets Target worst-case Met. Cat 6 ✓/✗	✗	✗	✗	✗	✗	✗	✗	✓
Meets Target neutral-case Met. Cat 4 ✓/✗	✗	✗	✗	✗	✗	✓	✓	✓

Table 7-28. Predicted construction noise levels from Installation

Construction Stage – Installation								
NSR Reference	R18	R17	R13	R14	R16	R15	R33	R28
Predicted noise level dB(A) worst-case Met. Cat 6	73	50	70	67	56	40	43	27
Predicted noise level dB(A) neutral-case Met. Cat 4	73	45	70	65	51	35	37	21
ICNG noise management level (Day)	33	33	33	33	37	37	37	33
Meets Target worst-case Met. Cat 6 ✓/✗	✗	✗	✗	✗	✗	✗	✗	✓
Meets Target neutral-case Met. Cat 4 ✓/✗	✗	✗	✗	✗	✗	✓	✓	✓

Table 7-29. Predicted construction noise levels from Inverter and Transformer Assemblies, and Electrical Collection System

Construction Stage – Inverter and Transformer Assemblies, and Electrical Collection System								
NSR Reference	R18	R17	R13	R14	R16	R15	R33	R28
Predicted noise level dB(A) worst-case Met. Cat 6	73	50	70	67	55	40	42	26
Predicted noise level dB(A) neutral-case Met. Cat 4	73	45	70	65	51	34	37	20
ICNG noise management level (Day)	33	33	33	33	37	37	37	33
Meets Target worst-case Met. Cat 6 ✓/✗	✗	✗	✗	✗	✗	✗	✗	✓
Meets Target neutral-case Met. Cat 4 ✓/✗	✗	✗	✗	✗	✗	✓	✓	✓

Table 7-30. Predicted construction noise levels from Commissioning

Construction Stage – Installation								
NSR Reference	R18	R17	R13	R14	R16	R15	R33	R28
Predicted noise level dB(A) worst-case Met. Cat 6	72	50	70	66	55	40	42	26
Predicted noise level dB(A) neutral-case Met. Cat 4	72	44	70	64	50	34	37	20
ICNG noise management level (Day)	33	33	33	33	37	37	37	33
Meets Target worst-case Met. Cat 6 ✓/✗	✗	✗	✗	✗	✗	✗	✗	✓
Meets Target neutral-case Met. Cat 4 ✓/✗	✗	✗	✗	✗	✗	✓	✓	✓

The predicted construction noise levels shown in the tables above show that noise generated from construction activities will impact all noise sensitive receivers except R026 (Table 7-26).

R018 (an involved residence) is the most noise affected NSR and the closest receiver at approximately 60 m from the nearest boundary of the construction site. The ICNG noise management level of 33 dB(A) is exceeded by up to 40 dB under the worst-case meteorological category (Met. Cat 6) at R18. However, the ICNG highly noise affected limit of 75 dB(A) is not exceeded at any of the NSRs.

It should be noted that the prediction method has assumed that all plant and equipment are operating simultaneously (adjusted for the percentage daily use) at the construction site's boundary, to represent maximum noise impact. This is an unlikely scenario in practice, and even if it did occur, it would be only for a short duration before the work moves on to another area of the site further away from the NSRs. Plant and equipment will also be scattered across the Site conducting different work at different times which will further alleviate the noise impact on the NSRs.

Construction noise is expected to be audible at all residences except R026, and there is likely to be some degree of adverse impact, as is typical with construction projects in close proximity to people. However, the majority of the NSRs assessed are associated with the solar farm, limiting potential impacts to R017 and R015.

By incorporating noise control measures, the noise impact to R017 and R015 can be significantly reduced. Construction noise from the proposed development will be managed through a construction noise and vibration management plan to minimise the adverse impact to acceptable levels.

Construction Vibration

The risk of vibration caused by the construction works onto nearby buildings is considered highly unlikely due to the type of activities taking place and the high levels of vibration required to cause damage. The greatest risk of vibration causing an adverse impact to the residents is by causing discomfort or fear of damage to their premises.

As such, it is recommended to set a conservative building damage vibration criterion so that in the unlikely event that the criterion is exceeded, the construction works can be stopped and the vibration

damage established. If no damage is observed and after the resident's concerns have been allayed, the works can resume. The recommended vibration criterion for building damage is set in accordance with BS 7385 at 5mm/s PPV.

For reference, the safe working distances for vibration causing plant which may be used during the construction activities have been taken from the *Transport Infrastructure Development Corporation Construction Noise Strategy (Rail Projects) 2007* and are summarised in Table 7-31.

Table 7-31. Recommended safe working distances for vibration causing plant

Plant Item	Rating/Description	Safe working distance (m)	
		Cosmetic Damage[1]	Human response[2]
Vibratory Roller	<50 kN (1-2t)	5	15 – 20
Vibratory Roller	<100 kN (2-4t)	6	20
Vibratory Roller	<200 kN (4-6t)	12	40
Vibratory Roller	<300 kN (7-13t)	15	100
Hydraulic Hammer	300 kg – 5 to 12t excavator	2	7
Hydraulic Hammer	900 kg – 12 to 18t excavator	7	23

[1] – BS7385, [2] – AS2670

By reference to Table 7-31, the use of large vibratory roller may exceed human comfort criteria if used within 100 m of a residence. All other plant is considered unlikely to exceed criteria.

Construction Traffic Noise

Construction traffic as described in Section 7.8 indicates up to a maximum of 100 light vehicles and 30 heavy vehicles accessing the site per day at the peak of construction activities.

Operational Noise Assessment

Operational activities at SSF that will be part of a routine maintenance program will generally be limited to:

- Equipment, cabling, substation and communications system inspection and maintenance;
- Fence, access road and control room management;
- Vegetation (fuel load), weed and pest management;
- Possible solar PV module washing on an as-needed basis;
- Security monitoring, and
- Communicating with customers, transmission and distribution network operators, Australian Energy Market Operator (AEMO), Council, neighbours and other stakeholders.

For each operation phase, the expected equipment to be used are summarised in (Table 7-32), as well as, the source sound levels for each of the items.

Table 7-32. Summary of operational activities and associated noise generating equipment

Construction Process	Task	Equipment	% Use per day	Sound Power Level, dB(A)	Reference*
Post-construction – Maintenance: Solar module washing	Water spraying	Water Truck	50	107	AS 2436
		Water Pump	50	93	Ref. No. 45, Table 2 in DEFRA
	Mechanical method	Truck	50	107	AS 2436
		Pump	50	93	Ref. No. 45, Table 2 in DEFRA
Upgrading, Repowering and/or Decommissioning	Upgrading, Repowering	Forklifts	50	106	AS 2436
		Welders	50	105	AS 2436
		Pickup truck (>20t)	50	107	AS 2436
		Water Bowser	50	107	Ref. No. 37, Table 6 in DEFRA
		Flatbed truck (>20t)	50	107	AS 2436
		Wheeled Loader, 170kW	50	104	Ref. No. 28, Table 2 in DEFRA
		Mobile crane	50	104	AS 2436
	Decommissioning	Flatbed truck (>20t)	50	107	AS 2436
		Wheeled Loader, 170kW	50	104	Ref. No. 28, Table 2 in DEFRA
		Mobile crane	50	104	AS 2436

Note: *

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

AS 2436:2010. Guide to noise and vibration control on construction, demolition and maintenance sites.

The noise impact of activities for each applicable operational phase has been predicted at each assessed NSR. The noise prediction has been based on the following:

- Plant and equipment source sound power level information given in Table 7-32;
- Distance attenuation, and
- Atmospheric, meteorological and ground noise attenuation, where applicable.

Operational noise levels have been predicted at the identified NSRs from the Site boundary and compared to the Project Noise Target Levels (PNTLs) of 40 dB $L_{Aeq,day}$ for each operation process, as shown in the tables below (Table 7-33, Table 7-34 and Table 7-35). Exceedances of the PNTLs are shown in bold and red.

Table 7-33. Predicted operational noise levels for Maintenance

Post Construction – Maintenance								
NSR Reference	R1	R2	R3	R4	R5	R6	R7	R8
Predicted noise level dB(A) worst-case Met. Cat 6	60	37	57	55	43	27	30	14
Predicted noise level dB(A) neutral-case Met. Cat 4	60	32	57	52	38	22	24	8
Project Noise Target Levels (PNTLs) – Day	40	40	40	40	40	40	40	40
Meets Target worst-case Met. Cat 6 ✓/✗	✗	✓	✗	✗	✗	✓	✓	✓
Meets Target neutral-case Met. Cat 4 ✓/✗	✗	✓	✗	✗	✓	✓	✓	✓

Table 7-34. Predicted operational noise levels for Upgrading, Repowering

Post Construction – Upgrading, Repowering								
NSR Reference	R1	R2	R3	R4	R5	R6	R7	R8
Predicted noise level dB(A) worst-case Met. Cat 6	68	45	65	62	50	35	37	22
Predicted noise level dB(A) neutral-case Met. Cat 4	68	40	65	60	46	29	32	16
Project Noise Target Levels (PNTLs) – Day	40	40	40	40	40	40	40	40
Meets Target worst-case Met. Cat 6 ✓/✗	✗	✗	✗	✗	✗	✓	✓	✓
Meets Target neutral-case Met. Cat 4 ✓/✗	✗	✓	✗	✗	✗	✓	✓	✓

Table 7-35. Predicted operational noise levels for Decommissioning

Operation Process – Decommissioning								
NSR Reference	R1	R2	R3	R4	R5	R6	R7	R8
Predicted noise level dB(A) worst-case Met. Cat 6	63	40	60	57	46	31	33	17
Predicted noise level dB(A) neutral-case Met. Cat 4	63	35	60	55	41	25	28	12
Project Noise Target Levels (PNTLs) – Day	*40*	*40*	*40*	*40*	*40*	*40*	*40*	*40*
Meets Target worst-case Met. Cat 6 ✓/✗	✗	✓	✗	✗	✗	✓	✓	✓
Meets Target neutral-case Met. Cat 4 ✓/✗	✗	✓	✗	✗	✗	✓	✓	✓

It is noted that these activities do not represent “day to day” operations, which will generally not be audible from NSRs, but specific noise generating activities associated with ongoing maintenance and/or upgrading of infrastructure. Such activities will be very occasional and of short-duration and potential impacts to NSRs shall be mitigated in a similar manner to those proposed for construction activities. The predicted operation noise levels shown in the tables above show that some noise generated from operation activities will impact the closer NSRs (R018, R017, R013, R014 and R016). However, operational noise impacts to non-associated NSRs (R017 and R015) are considered negligible, with only the worst-case assessment of upgrading and repowering potentially impacting R017, and no potential impacts to R015.

Cumulative Noise Impacts

Construction phases of SWF and SSF will not overlap, as such cumulative construction noise impacts are not anticipated. However, potential cumulative impacts are anticipated for:

- SSF construction, plus SWF operation; and
- SSF operation, plus SWF operation.

Key to potential cumulative impacts will be operational turbine noise associated with SWF wind turbine generators (WTGs). The SWF WTGs are located further from NSRs than the infrastructure associated with SSF, giving opportunity for potential impacted to attenuate with distance, at which point it is likely to be "drowned out" by construction noise during SWF construction.

SWF operational impacts are demonstrated to be quite low at non-associated NSRs, this and their relative distance from SWF operational infrastructure is likely to provide adequate mitigation of potential cumulative impacts.

7.7.4 Mitigation Measures

Construction noise

The key strategy for managing construction noise impacts shall be the adoption of ICNG standard hours for construction for residential properties where noise impacts are apparent. These are:

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

Opportunities for practical physical noise control are few given the transient and constantly moving nature of the construction work. However, the following provides a list of management measures can be employed to help minimise construction noise impact onto residential premises. These include:

- Informing and consulting residents and interested parties, as far as practicable, regarding impending or current events that may cause high levels of noise and how long they are expected to take. This may take the form of letter drops, or community notices;
- Provide a complaints telephone number prominently displayed where the works are taking place and on any letter drops or community notices;
- Respite hours agreed with residents when noisy works will not take place if necessary;
- Investigate complaints when received to establish the cause, and where possible implement a corrective action such as, provide a respite period or other practical measure;
- Minimising the operating noise of machinery brought on to the site;
- Where appropriate, obtaining acoustic test certificates for machinery brought on to the site;
- Undertake noise monitoring at the start of a new noisy activity so noise levels can be investigated should a complaint be received;

- If there is excessive noise from any process, that process will be stopped and if possible that noise attenuated to acceptable levels. Where there is no alternative the process will be rescheduled to non-sensitive hours;
- Ensuring that plant is not left idling when not in use;
- Ensuring that plant is well maintained and in good working order and not causing unnecessary noise, such as damaged mufflers on plant; and
- All access hatches for plant to be kept closed.

Construction Vibration

Similar mitigation strategies apply for the management of construction vibration. In addition, where residential dwellings are located less than 100 m from construction works and a 10 t vibratory/foot roller is expected to be used, it is recommended to use a smaller vibratory/foot roller to suit the required buffer distance.

Construction Traffic

A traffic management plan will be developed to guide traffic related issues during the construction phase. This shall include driver actions and behaviours to minimise potential noise impacts. Site inductions will include traffic management requirements.

Designated on-site parking areas will be located away from NSRs and car-pooling will be encouraged.

Operational Noise

The operator will maintain effective relationships with NSRs and work in a proactive manner to minimise potential operational noise impacts.

7.8 Transport

7.8.1 Introduction

The transport assessment was undertaken in accordance with the requirements of the SEARs. This includes a Traffic Impact Assessment as well as an independently prepared Road Safety Audit associated with both the construction and operational phases of the Proposed Development (Appendix G and Appendix H). The impacts for decommissioning have not been prepared as future traffic volumes, and road conditions cannot be accurately determined or assessed. However, the impacts are anticipated to be similar to those identified for the construction phase.

The scope of the transport aspects investigated included:

- Likely traffic generation and impacts;
- Access arrangements for staff and deliveries;
- Assessment of the implications and recommendations arising from the independently prepared Road Safety Audit;
- Identification of any roads or intersections which need to be upgraded, in addition to mitigations for pavement impacts;
- Assessment of the outcomes of the Road Safety Audit; and
- Traffic Impact Assessment.

To inform the proposed transport arrangements, the Proposed Development has been assessed against the following guidelines and planning documents:

- RMS (RTA) *Guide to Traffic Generating Developments Version 2.2* (2002);
- RMS (RTA) *Road Design Guide* (as amended);
- Austroads *Guide to Road Design* (and RMS supplements);
- Austroads *Guide to Traffic Management* (and RMS supplements);
- Austroads *Guide to Road Safety: Part 6; Road Safety Audit Third Edition* (2009); and
- RMS (RTA) *Traffic Control at Work Sites Version* 4 (June 2010).

7.8.2 Existing Environment

The Site is located north of the Gwydir Highway (B76) approximately halfway between Glen Innes, located at the junction of the New England Highway (A15), and Inverell. General site access is from the Gwydir Highway via Woodstock Road and/or Waterloo Road, or via Kings Plains Road via Western Feeder Road. Immediate access to site via Waterloo Road and/or the Western Feeder Road. The characteristics and classifications of these roads are provided in Table 7-36.

Table 7-36: Road classifications

Road	Speed Limit	Lanes	Classification	Authority
Gwydir Highway	100 km/h	2 (undivided asphalt road)	Rural	RMS
Waterloo Road	100 km/h	1 gravel road (5-7 m wide)	Rural	Inverell/Glen Innes

Road	Speed Limit	Lanes	Classification	Authority
Woodstock Road	100 km/h	1 gravel / asphalt road (5-7 m wide)	Rural	Inverell
Western Feeder Road	100 km/h	1 gravel road (5-7 m wide)	Rural	Inverell
Kings Plains Road	100 km/h	1 gravel / asphalt road (5-7 m wide)	Rural	Inverell/Glen Innes

All intersections within the vicinity of the Site are priority controlled. The intersection between the Gwydir Highway and Waterloo Road has been upgraded to accommodate over-dimensional equipment associated with the construction of Sapphire Wind Farm (SWF), and it is not expected that further upgrades would be required for the Proposed Development. A site visit undertaken by TTM as part of the Road Safety Audit has identified that maintenance works are currently been undertaken along Waterloo Road and the Gwydir Highway.

The NSW Road & Maritime Services have provided records of traffic counts on Gwydir Highway. The 2017 survey data includes both eastbound and westbound flows. The 2015 and 2016 survey data is for westbound flows only.

The 2017 data shows that the eastbound and westbound flows are roughly equal. For the purpose of this assessment, the estimated 2015 and 2016 eastbound flows have been estimated as that of the westbound flows. No traffic count data is provided for other local roads associated with the proposed development.

Table 7-37. Average daily traffic counts for Gwydir Highway

Location	Year		
	2015	2016	2017
Gwydir Highway – westbound	666	667	739
Gwydir Highway – eastbound	-	-	730
Gwydir Highway – Total	1,335*	1,335*	1,469

* estimated

Daily traffic flows recorded on Gwydir Highway are relatively low and well within the capacity of the road leaving ample spare capacity to accommodate additional traffic. Existing traffic flows on the local roads within the vicinity of the site are negligible in comparison to the Gwydir Highway.

The historical records on Gwydir Highway show a compound growth rate of 5.5% between 2015 and 2017. This rate has been applied to forecast traffic flows on the commencement of construction (assumed 2018) and ten years hence. This results in:

- 1,549 vehicles per day on Gwydir Highway in 2018; and
- 2,509 vehicles per day on Gwydir Highway in 2028.

Records of road traffic crashes within the vicinity of the subject site were obtained from the NSW Roads and Maritime Services. The records cover the five year period from 01/01/2012 to 31/12/2016. Copies of the records are attached to the Road Safety Audit (Appendix H). No crashes have been recorded at the following intersections:

- Gwydir Highway / Waterloo Road; and
- Gwydir Highway / Woodstock Road.

Crashes within the area were generally limited to single vehicles leaving the road and hitting an object. It is concluded that the crash data does not identify a historical road safety issue related to the intersections or roads providing access to the site.

7.8.3 Potential Impacts

Construction and operational access for staff and material deliveries to the site shall be from the Gwydir Highway via Waterloo Road or Woodstock Road. Over-dimensional loads shall access the Site via Waterloo Road only. Site access arrangements will be as identified in Figure 7-20.

Staffing arrangements during construction will depend on the staging of the development. Peak staffing estimates are provided in Table 7-38.

Table 7-38. Staffing arrangements

Stage	Duration	Peak Staff (estimated)	Standard Hours of Work
Construction	12 – 18 months	200 (peak)	Monday to Friday 7.00am to 6.00pm; Saturday 8.00am to 1.00pm; and No work on Sunday or public holidays.
Operation	30 years	Up to 10 full time positions would operate and maintain the plant	Monday to Friday 7.00am to 6.00pm

Material deliveries will depend on day to day operational requirements. Heavy vehicles into the site are estimated to be up to 30 vehicles per day during construction activities (12-18 months). Overall construction traffic movements during will be up to 100 light vehicles and 30 heavy vehicles daily. It is expected that 2 construction staff would share a single light vehicle, however car-pooling and use of buses will reduce these daily movements.

Construction phases of SWF and SSF will not overlap, as such cumulative impacts are not anticipated on local road network. Potential cumulative impacts with concurrent developments associated with New England Renewable Energy Precinct would impact the Gwydir Highway only, however, with appropriate project specific controls these impacts are considered to be within the capacity of the existing Gwydir Highway.

Additional vehicle movements associated with the operational phase (up to 10 vehicles per day) are considered negligible.

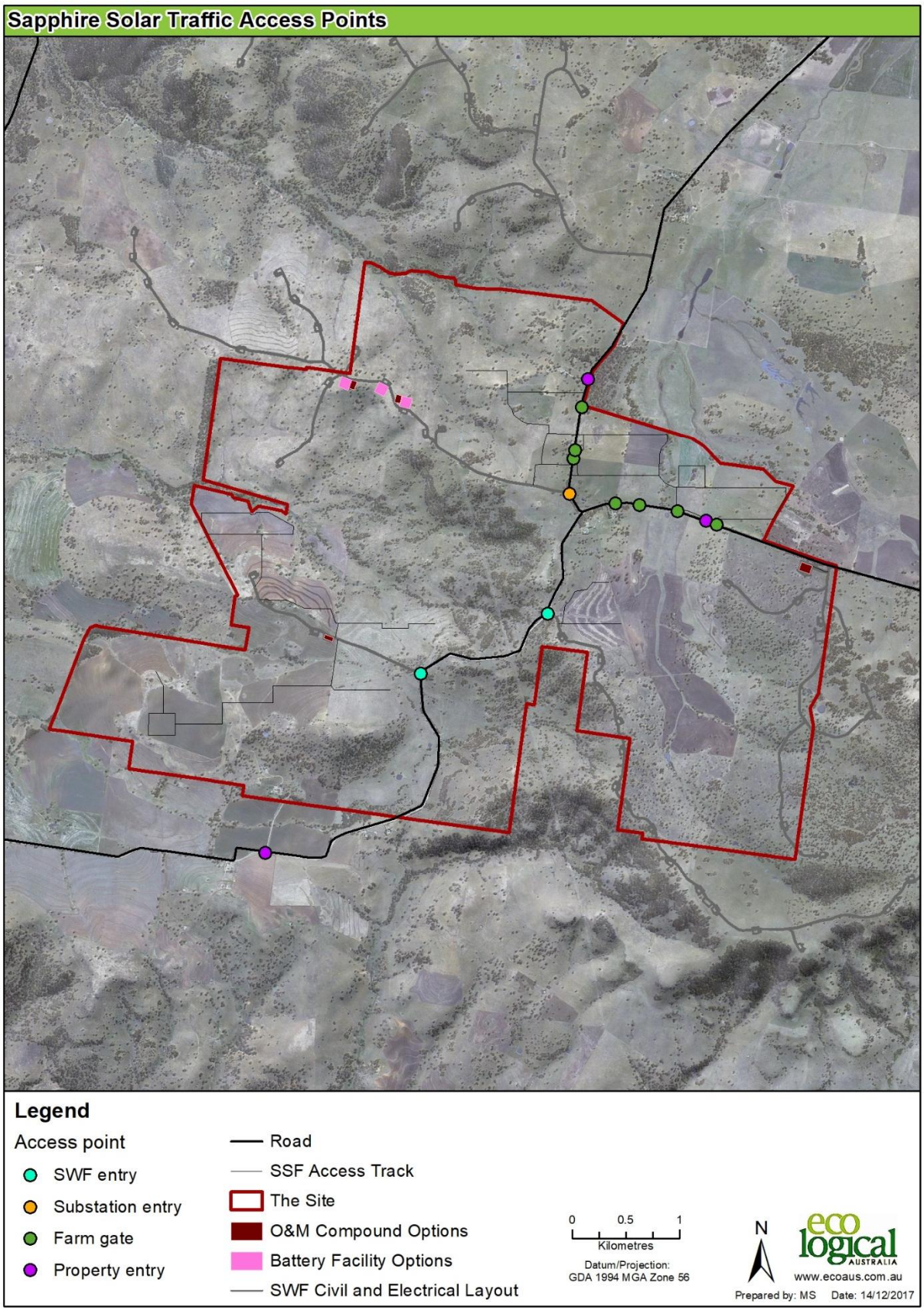

Figure 7-20. Site access arrangements

7.8.4 Mitigation Measures

To prevent potential cumulative impacts, construction phases of SWF and SSF shall not overlap.

The independent road safety audit (Appendix F) identifies concerns regarding pavement condition and line markings at the intersection of the Gwydir Highway and Waterloo Road. This site is currently the primary heavy and/or oversize vehicle access point for the construction of SWF. A Works Authorisation Deed (WAD) has been enacted between SWF and RMS and the intersection has been upgraded during SWF construction to facilitate heavy vehicle.

The WAD includes "make good" provisions, and as such a bond is held by RMS in this regard. In accordance with the WAD, SWF will make good damage caused to the intersection at the end of the construction period, prior to SSF commencing works.

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

7.9 Water

7.9.1 Introduction

This water resources assessment has been developed in accordance with the requirements of the SEARs for the Proposed Development. The assessment included the following steps:

- Desktop assessment;
- Field investigations;
- Consideration of existing environmental conditions;
- Flood modelling (Appendix H);
- Impact assessment; and
- Identification of mitigation and management measures.

The SEARs require

- *"an assessment of the likely impacts of the development (including flooding) on surface water (including Kings Plain Creek, Mary Anne Creek, Frazers Creek, Horse Gully and Apple Tree Gully and riparian land) and groundwater resources, wetlands, riparian land, groundwater dependent ecosystems, aquatic ecology and acid sulfate soils, related infrastructure, adjacent water users and basic landholder rights, and measures proposed to monitor, reduce and mitigate these impacts;*
- *details of water requirements and supply arrangements for construction and operation; and*
- *a description of the erosion and sediment control measures that would be implemented to mitigate any impacts in accordance with Managing Urban Stormwater: soils and construction (Landcom, 2004)."*

Further details of OEH's requirements regarding water resources are provided in the SEARs (Appendix A) and are addressed, as relevant, in following sections. A summary of key responses to the SEARs is provided as a cross referencing table in Appendix J.

7.9.2 Existing Environment

The Proposed Development is located within the upper tributaries of the Macintyre River, part of the Border Rivers Catchment. This catchment occupies 49,500 km^2, and comprises 24,500 km^2 in northern NSW and 25,000 km^2 in southern Queensland (NSW Office of Water Border Rivers website). In NSW, the catchment's major urban centres are Glen Innes, Inverell, and Tenterfield, all located within the upper catchment. Goondiwindi, on the northern bank of the Macintyre River in Queensland is the major town in the middle of the catchment, along with the smaller town of Boggabilla in NSW. The town of Mungindi lies on the Barwon River at the lower end of the catchment. The Barwon becomes the Darling River, which joins the Murray in South Western NSW before flowing to the Southern Ocean.

The Proposed Development occurs in the area covered by the *Water Sharing Plan for the NSW Border Rivers Unregulated and Alluvial Water Sources* which commenced on 1 June 2012 (NOW, 2012). The majority of the site is located within the Kings Plains Surface Water Source, with a small southern portion falling within the Inverell Surface Water Source.

Surface Water

The Proposed Development is located in the upper reaches of the Macintyre catchment and comprises the following sub-catchment areas (all Uncontrolled Streams):

- 849 ha in the upper reaches of Kings Plains Creek catchment;
- 1,150 ha in the upper reaches of Frazers Creek catchment; and
- 424 ha in the upper Swan Brook catchment.

Kings Plains Creek drains the eastern portion of the Proposed Development site. The source of Kings Plains Creek is located upstream of the Proposed Development and passes through the solar array located to the north of Waterloo Road as a Third Order stream (Strahler, 1952). Downstream of the Proposed Development, Kings Plains Creek flows in a northerly direction for approximately 20 km, passing through Kings Plains National Park, before turning west to joint Weean Creek, which is part of the Frazers Creek Catchment.

The Frazers Creek Catchment area drains the western portion of the Proposed Development, and includes Weean Creek, Frazers Creek, Horse Gully and Mary Anne Creek. Frazers Creek converges with the regulated Severn River just north of Ashford, approximately 55 km North West of the Proposed Development site. The Severn River converges with the Macintyre River within Kwiambal National Park, 80 km North West of the Proposed Development site.

The southernmost portion of the Proposed Development site drains via Apple Tree Gully into Swan Brook. Swan Brook flows into the Macintyre River North of Inverell, approximately 20 km west of the Proposed Development site.

Water Quality

Water Quality Objectives for Uncontrolled Streams within the NSW Border Rivers include:

- Aquatic ecosystems;
- Visual amenity;
- Primary and secondary contact recreation;
- Livestock water supply;
- Irrigation water supply;
- Homestead water supply;
- Drinking water at point of supply (disinfection only/clarification and disinfection/groundwater); and
- Aquatic foods (cooked).

Baseline water quality monitoring is undertaken to comply with the conditions of approval and the environmental licence for SWF. Water quality monitoring is undertaken at LOC1 in Frazers Creek and LOC2 in Kings Plains Creek (Figure 7-21). Baseline water quality data is provided in Table 7-39, below.

Table 7-39. Baseline surface water quality monitoring data for Sapphire Wind Farm

Parameter	Units	Date	Frazers Creek (LOC1)	Kings Plains Creek (LOC2)
pH	pH unit	10 November 2016	8.30	7.60
		30 November 2016	8.36	7.28
Electrical conductivity	µS/cm	10 November 2016	754	1520
		30 November 2016	1,430	2,150
Total suspended solids	mg/L	10 November 2016	122	55
		30 November 2016	10	526

While not conclusive, the existing baseline water quality data suggests that existing surface water quality at the Proposed Development is relatively poor, at least in respect of ANZECC Guidelines for the protection of upland aquatic ecosystems. This correlates with regional water quality monitoring observations. State of the Catchments (DECCW, 2010) assessed water quality data and trends at the Severn River at Strathbogie (30 km north of the site) between 2005 and 2008. Total Phosphorous concentrations exceeded 0.02 mg/L in 97% of samples. Turbidity exceeded 25 NTU in 11% of samples. During the same period, no temporal trend was apparent for water temperature, electrical conductivity (salinity) or turbidity.

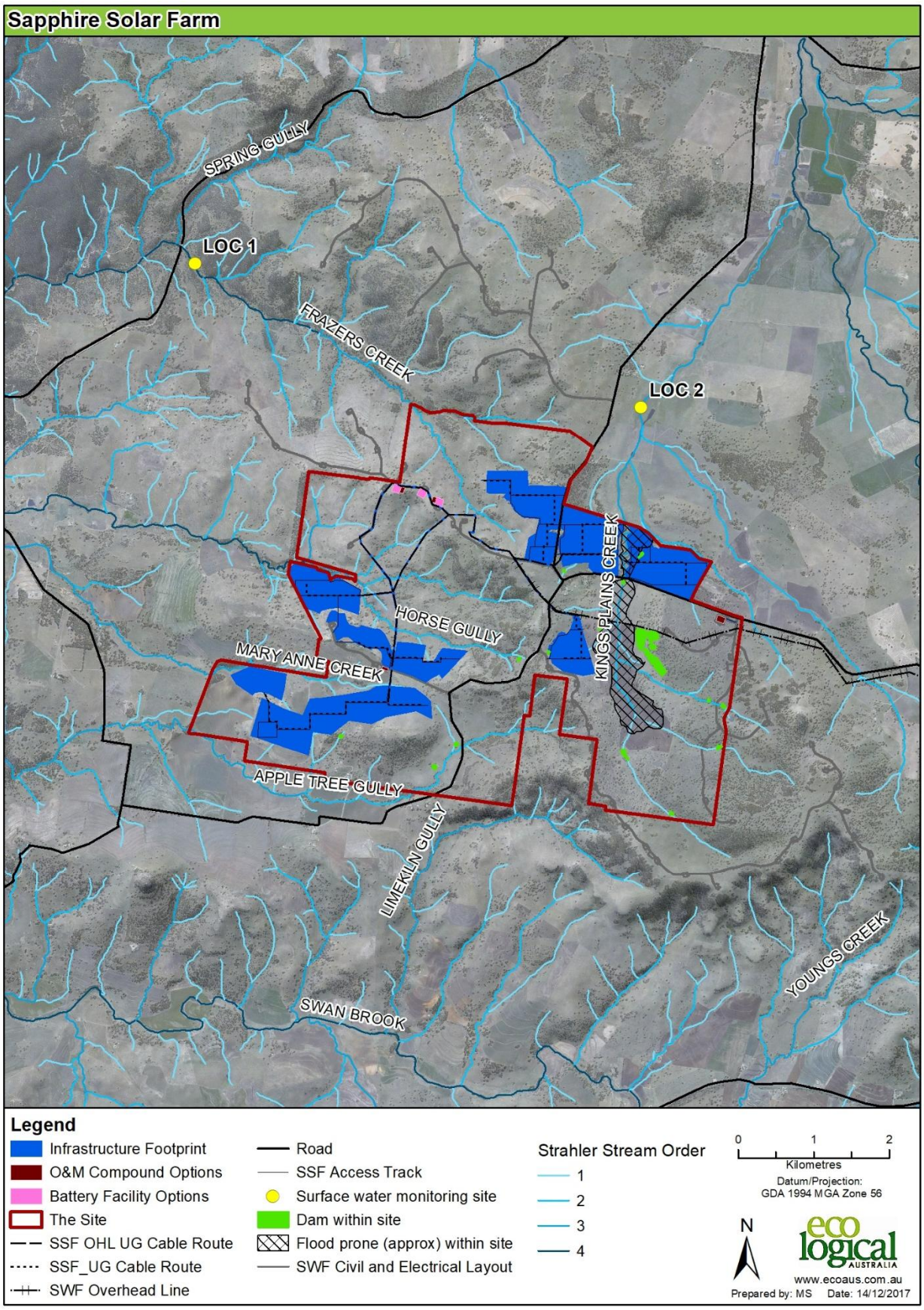

Figure 7-21. Surface water resources

Hydrology

The nearest downstream flow gauging station is Frazers Creek at Glenorchy (416069), located approximately 35 km North West of the Proposed Development and draining a catchment area of 678 km^2. Operational since 2002, the average monthly flow is 2,064 ML, with the highest average monthly discharge occurring during January (4,505 ML) and the lowest in May (253 ML).

Water access at the Proposed Development is in accordance with the *Water Sharing Plan for the NSW Border Rivers Unregulated and Alluvial Water Sources 2012*. River Flow Objectives for Uncontrolled Streams within the NSW Border Rivers include:

- Protect pools in dry times;
- Protect natural low flows;
- Protect important rises in water levels;
- Maintain wetland and floodplain inundation;
- Manage groundwater for ecosystems; and
- Minimise the effect of weirs and other structures.

Flooding

The Proposed Development is located in the headwaters of the following catchments:

- Kings Plains Creek
- Frazers Creek;
- Horse Gully;
- Mary Anne Creek; and
- Apple Tree Gully.

The site is characterised by low rolling hills and undulating plains with areas of floodplain identified within the Kings Plains Creek catchment only. By definition, areas of floodplain are considered as flood prone land (DIPNR, 2005). The Proposed Development does not lie within land mapped as Flood Liable Land within the Inverell Shire LEP (ISC, 2012).

Flood modelling was undertaken to assess the impacts of the Proposed Development for all relevant catchments using the RORB (flow modelling) and HEC-RAS (water level modelling) software (Appendix H). The modelling assesses the likely effects on flooding associated with the Proposed Development, and the potential impacts of any changes on the downstream environment. Such modelling provides an opportunity to examine likely flood behaviour and to form an opinion as to whether the Proposed Development is likely to have a significant impact on flood behaviour and downstream flood risks. The small areas of the Proposed Development that are not captured by the catchments would have an inconsequential impact on flooding.

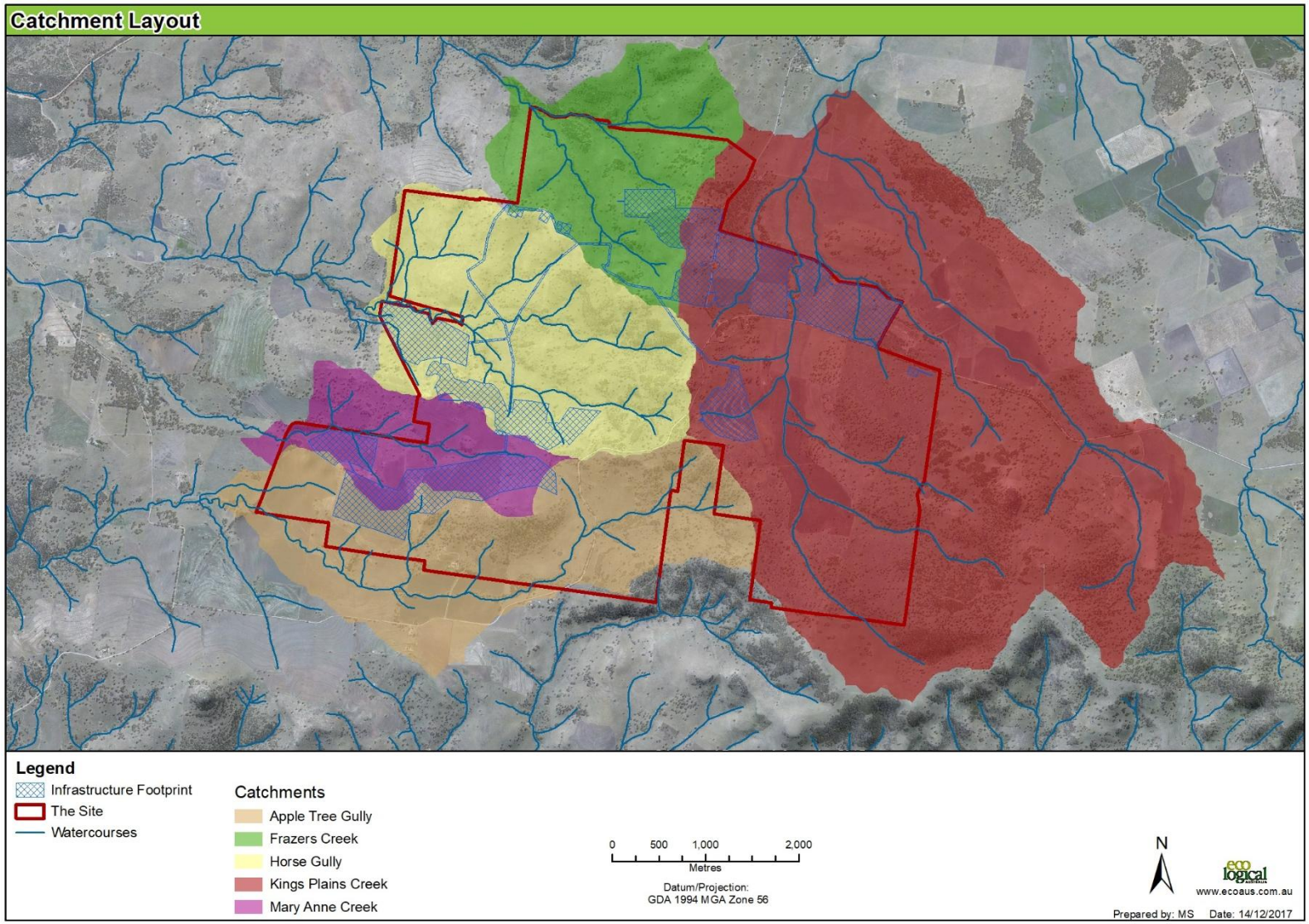

Figure 7-22: Flood modelling catchments.

To categorise the existing flood conditions required the use of regionalised flood models as no appropriate rainfall, water level or flow information exists in or near the Site. The flood volumes and levels were determined by the RFFE model (Western Sydney University), RORB (Monash University and Hydrology and Risk Consulting) and HEC-RAS (U.S. Army Corps of Engineers) programs. As such, the flow volumes and water depths determined by the models should be examined in a comparative sense, not in absolute terms.

Event durations from 10 minutes to 7 days were run through the models to determine the critical flood duration and volume for the 10% Annual Exceedance Probability (AEP), 1% AEP, 0.5% AEP, 0.2% AEP and 0.1% AEP events. For this development, the probable maximum flood was not examined as it was not deemed appropriate given that the Proposed Development is demonstrated to not increase flood risk (flow rates or levels) and there is negligible downstream development (i.e. only grazing land) that could potentially be impacted. The critical flood (the flood with the highest peak flow) for these catchments are:

- Kings Plains Creek: 6 hours or 12 hours;
- Frazers Creek: 6 hours or 12 hours except for the 0.1% AEP which is 24 hours;
- Horse Gully: 6 hours or 12 hours except for the 0.1% AEP which is 24 hours;
- Apple Tree Gully: 6 hours or 12 hours; and
- Mary Anne Creek: 3 hours or 6 hours.

The resultant existing condition peak flow volumes are outlined in Table 7-40 at the downstream end of each catchment (as shown in Figure 7-22).

Table 7-40. Peak flows for existing conditions

AEP (%)	Catchment Peak flow (m^3/s)				
	Kings Plains Creek	Frazers Creek	Horse Gully	Apple Tree Gully	Mary Anne Creek
10%	40.4	6.9	11.2	10.8	6.4
1%	93.8	16.9	27.4	26.3	15.6
0.5%	111.8	19.9	31.8	32.3	18.5
0.2%	128.2	22.4	35.4	36.5	20.4
0.1%	128.2	22.4	35.4	36.5	20.4

The flows in Table 7-40 were used as inputs to the HEC-RAS models for each catchment. The flow depths for the peak flows at the end of each catchment is shown in Table 7-41. The depths are the depth of water from the surface to the lowest point in the cross section in the Digital Elevation Model (DEM). The regionalised model results provide a sound basis to compare the flood risk under existing levels of development (current conditions) with those under the Proposed Development.

Table 7-41. Peak water levels for existing conditions

AEP (%)	Catchment Water Depths (m)				
	Kings Plains Creek	Frazers Creek	Horse Gully	Apple Tree Gully	Mary Anne Creek
10%	0.28	0.34	0.21	0.19	0.31
1%	0.42	0.51	0.31	0.31	0.46
0.5%	0.46	0.55	0.33	0.34	0.5
0.2%	0.49	0.58	0.35	0.37	0.52
0.1%	0.49	0.58	0.35	0.37	0.52

Groundwater

The New England 1:500,000 Geological Map (Pogson and Hitchins, 1973) and an airborne geophysical survey by Brown (2006) indicates the regional geology within the Project area consists predominantly of Tertiary volcanic basalt and dolerite materials, ranging in age from approximately 36 to 18 Ma (Brown, 2006). These rocks contain mafic intrusions such as dykes and plugs that are commonly rich in minerals.

Quaternary alluvial deposits of sand, silt, clays and gravels and colluvial deposits form a thin cover over much of the region (Brown, 2006), and are present within the eastern area of the Project near Kings Plains Creek. Some small outcropped areas of the Permian Emmaville Volcanics (ashfall and ashflow tuffs) and the Palaeozoic Texas Beds (wacke, conglomerate, siltstone, mudstone, chert and basalt) have also been identified along the northern edge and to the south-west of the Project boundary respectively.

Limited hydrogeological studies have been undertaken within the Proposed Development area. Therefore, the hydrogeological setting for the Proposed Development has been based on the available hydrogeological information from the Environmental Assessment for the Project (Wind Prospect CWP, 2011), and data from the NSW Office of Water's (NOW) PINEENA Groundwater database (NOW, 2017) and the Bureau of Meteorology (BoM) Groundwater Explorer database.

Two groundwater sources exist within the Proposed Development area as follows:

- Groundwater within the alluvial deposits of the Kings Plains Creek floodplain; and
- Basalt fractured rock groundwater source.

NOW have reported an important groundwater source within the Kings Plains Creek floodplain area, and high-quality groundwater within the fractured basalts of the hills region (Wind Prospect CWP, 2011).

Interrogation of the NOW (2017) PINNEENA groundwater database identified twenty-one registered groundwater bores within the Site (Table 7-42), which access groundwater from the basalt fractured rock aquifer. Hydrogeological data and bore construction data are not available for five bores installed in the vicinity of Kings Plains Creek (GW900949, GW900948, GW900946, GW900945 and GW900947). It is therefore unknown if these bores target the alluvial deposits within the Kings Plain Creek area, or the fractured basalt aquifer.

Groundwater in the vicinity of Kings Plains Creek has been previously used to support sapphire mining; however, groundwater has also been licensed and used for stock, domestic and agricultural purposes (Wind Prospect CWP, 2011). (Table 7-42) presents the locations of the registered bores identified within the Proposed Development area.

Table 7-42. Registered bore details

Bore ID	E (m)	N (m)	Type	Total depth (m)	SWL* (mbgl)	Salinity (ppm)	Yield (L/s)
GW038638	345109	6713005	Stock	12.2	5.1	--	~0.8
GW043112	346404	6710652	Stock	37.5	--	"Good"	1.5
GW043585	346099	6709385	Stock	89.0	15.5	--	0.2
GW048644	348128	6714339	Stock/Domestic	12.8	--	"Good"	--
GW050600	348846	6712933	Stock	10.0	5.5	1000 – 3000	--
GW050601	348086	6713477	Stock	11.0	4.0	1000 – 3000	--
GW900945	348511	6711820	Mining	--	--	--	--
GW900946	348509	6711974	Mining	--	--	--	--
GW900947	348406	6711695	Mining	--	--	--	--
GW900948	348559	6712313	Mining	--	--	--	--
GW900949	348610	6712498	Mining	--	--	--	--
GW965380	350302	6712478	Monitoring	52.0	8.0	"Good"	>4.0
GW965381	350304	6712487	Monitoring	48.0	7.0	--	1.5
GW965384	350181	6712697	Monitoring	53.0	7.0	--	>5.0
GW965949	349965	6712920	Mining	48.0	6.5	--	--
GW965950	349839	6713129	Mining	36.0	6.9	--	--
GW015812	349353	6711185	Stock	23.2	--	--	--
GW015818	347643	6712424	Stock	22.6	12.8	--	0.1
GW015849	348171	6711199	Stock	--	--	--	--
GW015850	347962	6712674	Stock	10.7	3.4	1000 – 3000	~0.8
GW027851	345665	6709718	Stock/Domestic	36.6	--	500 – 1000	~0.6

*SWL = standing water level (within the fractured basalt aquifer).

Groundwater levels within the fractured rock aquifer are generally shallow across the Proposed Development area, and range from approximately 3.5 metres below ground level (mbgl) in the central portion, to 8 mbgl on the eastern side of the Project area. One bore (GW015818) reported groundwater level at 12.8 mbgl within the central portion of the Proposed Development area, and a second (GW043585) reported groundwater level at 15.5 mbgl towards the southern area of the Proposed Development boundary.

It is expected that groundwater level is also shallow (< 5 m) within the alluvial aquifer in the vicinity of Kings Plains Creek, however this needs to be confirmed through further investigation.

Groundwater quality information was available for six registered bores within the Proposed Development area. The available data describes water quality from the fractured basalt aquifer as "Good" with salinities ranging from 1000 – 3000 ppm for all bores except GW043585 located in the south of the Proposed Development area, which reported a salinity level of 500 – 1000 ppm (NOW, 2017).

Available groundwater yield records suggest the fractured rock aquifer has low productivity, with seven of the nine registered bores containing yield data (Table 7-42) reporting groundwater yields of < 2 L/s.
No groundwater quality or yield data is available for the alluvial groundwater source.

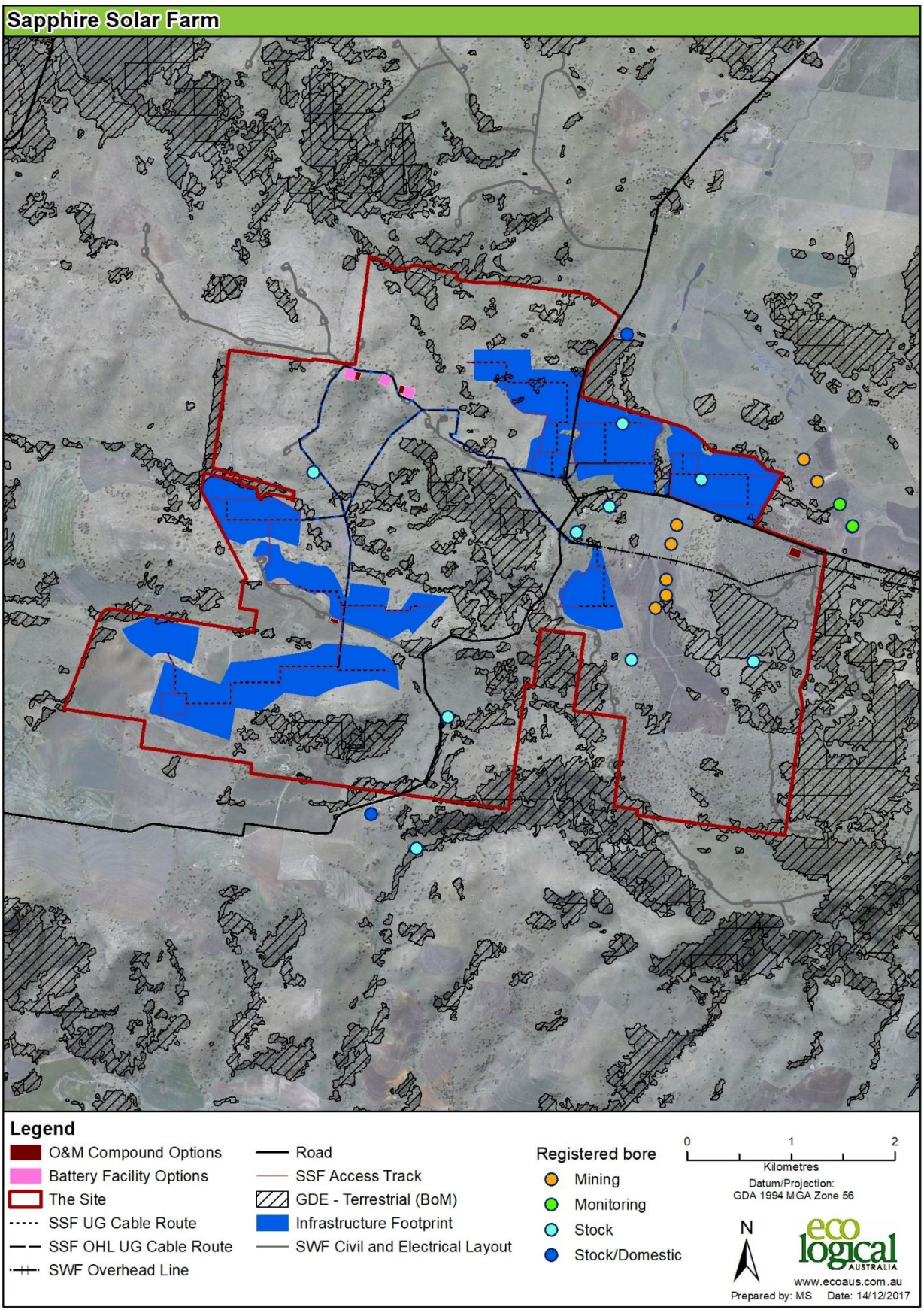

Figure 7-23. Groundwater resources

Aquatic Ecosystems

Wetlands

A small number of freshwater wetlands identified in Border Rivers' vegetation mapping are located within 10 km of the proposal. These wetland features include River Oak Riverine Forests and Northern Montane Heaths composed on Tea-Tree Shrublands in drainage lines (ELA, 2011).

The River Oak communities in the drainage lines occur downstream of the proposal and are a widespread feature in the catchment. The Northern Montane Heaths occur in the upper reaches of neighbouring sub-catchments and will not be directly or indirectly impacted by the Proposed Development. The Montane Heaths are not part of the EPBC listed *Upland Wetlands of New England Tablelands and Monaro Plateau*. The EPBC listed wetlands occur in closed, high altitude topographic depressions that are not connected to rivers or streams and are distinguished by the absence or near absence of heath (DEH, 2005).

Kings Plains Upland Wetland (upland wetlands of the drainage divide of the New England Tablelands Bioregion Endangered Ecological Community - Schedule 6 Water Sharing Plan for the *NSW Border Rivers Unregulated and Alluvial Water Sources, 2012* is located approximately 10 km north of the Proposed Development site. The wetlands in the locality are not considered as being influenced by groundwater, instead they rely on ephemeral overland flows. The Proposed Development is not likely to influence the quantity, quality or timing of natural flows of surface water into these wetlands.

Streams and waterways

Most waterways in the Proposed Development area are ephemeral and dry. They lack aquatic vegetation and are dominated by grasses. In some areas, extensive erosion has deepened the channel and left large parts of the bed and bank as bare soil. Pools persist in some higher order streams (i.e. 3rd order and above), and these pools become larger and more permanent downstream of the Proposed Development boundary. Permanent water within the Proposed Development boundary is dominated by artificially deepened holes along the watercourses, or farm dams.

Riparian land

The solar PV inclusion area includes 1st, 2nd and 3rd order streams (Strahler, 1952). Riparian vegetation and the riparian zone generally throughout the study area are degraded, having been cleared, grazed, sown and modified to support agricultural and sapphire mining activities. Riparian exclusion zones shall be established in accordance with NOW Core Riparian Zone (CRZ) guidelines as per Table 7-43.

Table 7-43. Required width of riparian exclusion zones as determined by stream order

Types of watercourse	CRZ Width
Any first order[1] watercourse where there is a defined channel where water flows intermittently.	10 metres
Any permanent flowing first order watercourse, or any second order[1] watercourse where there is a defined channel where water flows intermittently or permanently.	20 metres
Any third order[2] or greater watercourse and where there is a defined channel where water flows intermittently or permanently. Includes estuaries, wetlands and any parts of rivers influenced by tidal waters.	20 - 40 metres[2]

[1] as classified under the Strahler System of ordering watercourses and based on current 1:25,000 topographic maps.

[2] merit assessment based on riparian functionality of the river, lake or estuary, the site and long-term land use.

Groundwater Dependent Ecosystems

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

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

A search of the Bureau of Meteorology GDE Atlas (BoM, 2017) identified terrestrial vegetation as the only potential GDE within the Project area. The following terrestrial vegetation types were identified by BoM (2017) as moderate to high potential GDEs within the Project area:

- White Box grassy woodland;
- Blakely's Red Gum;
- Ribbon Gum;
- Rough Barked Apple; and,
- River Oak.

The BOM assessment is based on regional studies involving remote sensing, vegetation community mapping and groundwater level data. Terrestrial vegetation is described and potential impacts assessed in accordance with the FBA in Section 7.2.

The Water Sharing Plan (WSP) for the *NSW Border Rivers Unregulated and Alluvial Water Sources* (2012) identified no high priority GDEs within the Project area. Environmental assessment for SWF identified freshwater wetlands (including River Oak Riverine Forests and Northern Montane Heaths) within the Border Rivers Basin within the broader regional context (Wind Prospect CWP, 2011), however, these are located well

beyond the boundaries of the Proposed Development and are not considered to be groundwater dependent, but reliant on ephemeral overland flows.

Threatened species, populations, and communities

A search of threatened species databases indicate that the following aquatic species, communities, or populations have the potential to occur on-site:

- Booroolong Frog (*Litoria booroolongensis*) - EPBC Endangered – Species or Habitat may occur within 10 km radius of site;
- Bell's Turtle (*Wollumbinia bellii*) – EPBC Vulnerable – Species or Habitat may occur within 10 km radius of site;
- Murray Cod (*Maccullochella peelii*) – EPBC Vulnerable – Species or habitat may occur within 10 km radius of site;
- Purple-spotted Gudgeon (*Mogurnda adspersa*) – NSW FM - has been modelled or is known to occur in Horse Gully, Frazers Creek, and Kings Plains Creek;
- Murray-Darling Basin population of Eel-tailed Catfish (*Tandanus tandanus*) - Endangered Population (FM Act 1994) may occur within 10 km of the project site; and
- The aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River. – NSW FM Act Endangered Ecological Community – This EEC includes the Severn River and associated rivers, lagoons, and billabongs, downstream of Pindari Dam. Drainage works and farm dams are excluded from this category.

The likelihood of these species and the EEC occurring on-site are considered in Table 7-44.

Table 7-44. Likelihood of occurrence table.

Scientific Name	Common Name	Status		Source	Habitat Potential
		EPBC Act	FM Act		
Litoria booroolongensis	Booroolong Frog	E		DoE 2017a	Unlikely. The site does not contain permanent streams with cobble banks and other rocky substrates along the margins.
Wollumbinia belli	Bell's Turtle	V		DoE 2017b	Unlikely. There are no permanent pools deeper than 2 m with complex underwater habitat. There are no permanently-flowing rivers on-site.
Maccullochella peelii	Murray Cod	V		DoE 2017c	Unlikely. There are no suitable habitat features including permanent rivers, boulders, under cut banks, or overhanging vegetation.
Mogurnda adspersa	Purple-spotted Gudgeon		E	FSC 2008	Unlikely. There are no slow moving or still waterbodies with weed, rocks or snag habitat.

Scientific Name	Common Name	Status		Source	Habitat Potential
		EPBC Act	FM Act		
Tandanus tandanus	Eel-tailed Catfish		EP	DPI 2015b	Unlikely. There are no deep, permanent pools on-site, so no suitable habitat.
Lowland Darling River Endangered Ecological Community	Lowland Darling EEC		E	FSC, undated	Unlikely. The site occurs within the defined area of this EEC, but there is no permanent water apart from that residing in constructed habitat, which precludes it from inclusion in the EEC.

V = Vulnerable; E = Endangered; EP = Endangered Population.

Booroolong Frog occurs along permanent, generally rocky, streams with fringing vegetation (Anstis 2002). There is unsuitable habitat in the project area because riparian areas are generally cleared, the streams are highly ephemeral and they lack suitable rocky habitat.

The ephemeral nature of waterways occurring on the project site are generally unsuitable for Murray Cod and Silver Perch which require permanent deep pools. Purple-spotted Gudgeon prefer slow moving water with aquatic weed and hard substrates (McDowall 1996). The ephemeral nature of water within the areas to be developed, would preclude its presence within the Proposed Development.

Eel-tailed Catfish are modelled to occur in the area downstream of the project boundary in Frazers and Kings Plains Creeks (DPI 2015a). However, the waterways on-site are ephemeral and contain no deep or permanent water, so are unsuitable for catfish.

Bell's Turtle inhabits narrow rivers in granite-dominated landscapes, with sand or rock substrate. They require permanent pools deeper than 2 m, with complex underwater habitat such as rock overhangs, logs, and caverns (DEWHA 2008). It occurs in the Severn and Deepwater Rivers, but there no suitably deep pools or habitat on-site.

7.9.3 Potential Impacts

The Proposed Development has been designed to minimise potential impacts to water resources. A single vehicular crossing is proposed for Kings Plains Creek (Figure 7-23), all other infrastructure is located away from aquatic habitats and potential areas of KFH (Strahler 3rd Order streams and above).

Potential impacts to water quality, hydrology and aquatic ecosystems for both surface and groundwater resources during construction (including decommissioning) and operational phases are considered in the following sections.

Water Quality

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

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

All surface water streams associated with the proposed development site are Upland Rivers (ANZECC, 2000). Water quality trigger levels for the protection

Table 7-45. ANZECC trigger values for the protection of upland aquatic ecosystems

Indicator	Trigger value	Comment
Total Phosphorus	20 µg/L	The construction phase has potential to impact on Total Phosphorous concentrations through the erosion of phosphorus bound to soil and sediments from cleared areas into surface water streams, potentially leading to nuisance algal growth and Blue-Green Algal blooms. Measures will be put in place to minimise phosphorous inputs to streams during construction and operation of the proposed solar farm.
Total Nitrogen	250 µg/L	The project has potential to impact on Total Nitrogen concentrations during soil disturbance associated with the construction phase, potentially leading to nuisance algal growth and Blue-Green Algal blooms. Measures will be put in place to minimise nitrogen inputs to streams during construction and operation of the proposed solar farm.
Turbidity	2-25 NTU	The project has potential to impact on Turbidity through increased sediment inputs, particularly during construction, leading to higher suspended sediment loads and decreased light penetration. Background water quality data suggests variable suspended sediment concentrations exist at the site, with occasional high levels indicating turbidity well above ANZECC trigger values. Measures will be put in place to minimise increased turbidity during construction and operation of the proposed solar farm.
Salinity	30-350 µS/cm	Baseline data indicates relatively saline surface water flows, consistently exceeding ANZECC trigger values. The project is considered unlikely to influence salinity concentrations.
Dissolved Oxygen	90-110%	Provided that phosphorus, nitrogen and turbidity are affectively managed, the project is considered unlikely to influence dissolved oxygen saturation.
pH	6.5-8.0	pH of background water quality sites is mildly to moderately alkaline with values within Frazers Creek exceeding ANZECC trigger values. The project is considered unlikely to influence salinity concentrations.

The use of fuels, lubricants, herbicides and other chemicals during construction pose a risk of surface and groundwater contamination in the event of a spill.

Operational impacts to water quality are considered negligible. The post-construction land use as a solar farm would likely reduce the potential for impacts to water quality, compared to current agricultural landuse practices.

Potential water quality benefits would include a decrease in soil disturbance as the current agricultural practice is to cultivate much of the Site on an annual basis, increasing the potential for sediments to enter surface water. A reduction in stocking rates would also reduce erosion, sedimentation and riparian disturbance at the Site and hence impacts on surface water. In addition, a decrease in fertiliser use and stocking rates would reduce the potential for nutrients to enter surface waters.

Although the installation of PV panels presents a large impervious surface standing above the ground at approximately 1.5m, the shape of the panels, and the separation distance between rows will quickly return rainfall as runoff to the natural ground to allow surface penetration and/or run-off to occur in a typical manner (Appendix H). Disturbed areas would be revegetated in order to stabilise the ground surface. This should prevent soil erosion and, thus, sedimentation impacts to surface water. However, it is acknowledged that soil scarring resulting from large rainfall events could occur under the panels which may, if left untreated, result in soil erosion and potential impacts to surface water.

Surface water quality could also be impacted through sedimentation during the operational phase as a consequence of increased runoff due to the more impervious nature of the permanent access tracks and hardstand areas.

The operational use of fuels and other chemicals on site pose a risk to surface and groundwater contamination in the event of a spill. Chemicals commonly used onsite would include fuels, lubricants and herbicides.

Due to the limited potential for surface and groundwater quality impacts associated with the construction, operation and decommissioning of SSF, it is considered that the existing water quality monitoring program implemented for SWF provides appropriate environmental monitoring for both developments, and that no further water quality monitoring is required.

Hydrology

Construction

It is estimated that the Proposed Development will require approximately 60 ML (pers. comm. Zenviron) of potable and/or non-potable water for dust suppression and other construction purposes. This water would be sourced as described below:

- Approximately 30 ML of potable water sourced from Glen Innes Severn Council standpipes at Strathbogie Road and Glen Innes Sales Yards;
- Approximately 30 ML from non-potable sources including:
    - existing onsite dams, including sedimentation dams; and

- Wellingrove Creek, under existing Glen Innes Severn Council licence conditions, for dust suppression on public roads.

Water access and use is authorised under the WM Act. The volumes of surface water likely to be used on-site because of the Proposed Development would not exceed 10 % of the annual surface water total permitted under surface water harvesting rights, and therefore would not require a surface water access licence under the plan.

Subsurface construction disturbances would be limited to trenching, shallow excavation, and piling activities during the construction phase of the development. Interference of the groundwater resource during construction is considered to be negligible. This is because construction activities at a depth of approximately 1.6 m would not intersect groundwater at the Site (Table 7-42). Therefore, the Proposed Development is not considered likely to influence groundwater systems or the water balance of the Site, nor would an aquifer interference approval as per the *NSW Aquifer Interference Policy* be required.

Operation

Facilities water consumption during the operational phase of the Proposed Development is estimated at approximately 210 kL per year, and shall be sourced from on-site rainwater tanks or delivered to site as potable water. Groundwater will not be used during the operational phase.

Panel cleaning requirements depend on prevailing weather conditions at the Site. Some solar plants are never cleaned, while others require multiple cleanings per year. Given the vegetated landscape and climate associated with the Site (approximately 80 days of rain $\geq$ 1 mm average per annum), resulting in generally low levels of dust, it is anticipated that the Proposed Development will require annual cleaning. As such, the long-term average water demand for solar panel cleaning is estimated to be 290 kL per annum. It is anticipated that water requirements for panel cleaning would be secured through commercial arrangements with a local water supply company and trucked to site. The volumes of water used for individual panel cleaning shall be insufficient to pose an erosion threat, given the proposed erosion and sedimentation mitigation discussed below.

No operational activities would affect groundwater at the Site. No groundwater is proposed to be sourced during operation of the Proposed Development.

Flooding

To determine the impact of the Proposed Development on flooding, the increase in impervious area was applied to the RORB model to represent solar panels and associated hard areas (e.g. operations and maintenance facilities).

As with the existing (no development) conditions, event durations from 10 minute to 7 days were run through the models to determine the critical flood duration and volume for the 10% Annual Exceedance Probability (AEP), 1% AEP, 0.5% AEP, 0.2% AEP and 0.1% AEP events.

For the events modelled in RORB, the critical flood for the catchments were as per the existing conditions except for the north and North West 0.1% AEP events which reduced from 24 hours down to 6 hours. The

peak flows showed minor decreases and increases in flows (-4.6% to 6.8%). These changes are due to the increase in impervious area resulting in the water running off in a different pattern and changing when peak flows occur compared to the existing conditions (fully pervious). The results are shown in

.

Table 7-46: Peak flows for Proposed Development

AEP (%)	Catchment Peak flow (m^3/s) [Difference from existing (%)]				
	Kings Plains Creek	Frazers Creek	Horse Gully	Apple Tree Gully	Mary Anne Creek
10%	40.4 [-0.1%]	7.2 [5%]	11.7 [4%]	10.8 [0.4%]	6.9 [6.8%]
1%	81.8 [1.1%]	14.5 [1.7%]	23.3 [-0.8%]	22.9 [1.5%]	13.3 [-0.8%]
0.5%	92.7 [-1.2%]	16.5 [-2.4%]	26.9 [-1.8%]	26.5 [0.9%]	15.7 [1%]
0.2%	109 [-2.6%]	20.3 [1.6%]	32.2 [1.3%]	31.8 [-1.6%]	18.9 [2.2%]
0.1%	122.3 [-4.6%]	23.3 [3.9%]	36.2 [2.2%]	35.8 [-1.8%]	21.5 [5.2%]

No structural change was made to the HEC-RAS models as construction and operational facilities will be placed outside the potential flood zone and the solar arrays should be designed and constructed so as to not impede the flow of flood water underneath them. Table 7-47 outlines the water level results from the HEC-RAS models.

Table 7-47. Peak water levels for the Proposed Development

AEP (%)	Peak Water Level Depth (m) [Difference from existing (%)]				
	Kings Plains Creek	Frazers Creek	Horse Gully	Apple Tree Gully	Mary Anne Creek
10%	0.3 [0%]	0.3 [2.9%]	0.2 [0%]	0.2 [0%]	0.3 [3.2%]
1%	0.4 [2.6%]	0.5 [0%]	0.3 [0%]	0.3 [0%]	0.4 [0%]
0.5%	0.4 [2.4%]	0.5 [-2%]	0.3 [0%]	0.3 [0%]	0.5 [0%]
0.2%	0.5 [2.2%]	0.5 [0%]	0.3 [3%]	0.3 [0%]	0.5 [2%]
0.1%	0.5 [2%]	0.6 [1.7%]	0.4 [2.9%]	0.4 [-2.7%]	0.5 [1.9%]

Climate change assessment was undertaken using the Australian Rainfall and Runoff guidelines. The approach recommends applying a 5% increase in design rainfall per degree of global warming. Predicted changes in temperature data is provided by the Australian Government through the Climate Change in Australia website (https://www.climatechangeinaustralia.gov.au). The assessment of the RCP 6 (Representative Concentration Pathway) climate change scenario (median greenhouse gas emissions, representing 1.4 to 3.1 ^{o}C warmer conditions) for 2050 projected conditions (representing the design life of the Proposed Development) using the CMIP 5 global climate models (latest global climate models) produced a mean change in temperature of 1.5 degrees Celsius. Therefore, the Intensity – Frequency - Duration (IFD) information used as part of the initial assessment was increased by 7.5% and the RORB models re-run. The results are outlined in Table 7-48 and show that the peak flows increase by between 6.3% and 10.5% over the flows calculated without climate change impacts.

Table 7-48. Comparison of climate change flow results for RORB model

AEP (%)	Peak existing conditions climate change flow (m^3/s)	Difference to base design flows (%)	Peak proposed conditions climate change flow (m^3/s)	Difference to base design flows (%)
10%	843	9.4%	867	7.8%
2%	1,188	6.3%	1,203	8.6%
1%	1,337	7.1%	1,372	9.6%
0.5%	1,503	10.5%	1,481	8.2%
0.2%	1,695	8.4%	1,694	8.2%
0.1%	1,875	10.2%	1,908	8.6%

These flows were applied to the HEC-RAS model to determine the effects of climate change on the water levels. The results show that for the critical duration storm event, the water levels will increase due to climate change. At the downstream end of the proposed site the levels are expected to increase by between 3.0% and 4.7% for the existing conditions events and between 3.6% and 4.5% for the proposed conditions events due to climate change (Table 7-49). Comparing the climate change results within an event (e.g. the 1% AEP) shows that, there is a slight decrease in the water levels for the 0.5% AEP event between the existing and proposed condition models and a slight increase in levels for the other AEP events.

The difference between the existing conditions and the Proposed Development under current and climate change rainfalls show that there will be negligible impact or a slight reduction in the flows and water levels from the critical storm within the catchment.

Table 7-49. Comparison of climate change water level results for the HEC-RAS model

AEP (%)	Peak existing conditions climate change water level (m)	Difference to base design water level (%)	Peak proposed conditions climate change water level (m)	Difference to base design water level (%)
10%	2.39	4.0%	2.42	3.9%
2%	2.79	3.0%	2.81	3.7%
1%	2.95	3.1%	2.99	4.5%
0.5%	3.12	4.7%	3.1	3.7%
0.2%	3.31	4.1%	3.31	4.1%
0.1%	3.43	4.5%	3.45	3.6%

The modelling undertaken as part of the EIS has been to clarify whether the Proposed Development would have any significant impact on the flooding within and downstream of the development. Given the nature of a solar farm development, being the installation of solar panels which will be raised above the ground (and therefore not impeding flow), the flow and water level analysis focused on whether the change in impervious area (hard surfaces) within the catchment would change the critical (peak) design flood flows.

As there was no historic flow or water level information for the catchment, the RORB (flow modelling) and HEC-RAS (water level modelling) were parameterised based on regionalised information (including regionalised flood frequency estimates) and used to compare the differences between pre- and post-development conditions. This means that the flow volumes and water depths determined by the models should be examined with more reliance on the comparison of results rather than in absolute terms.

The overall outcome of analysing the effect of the development on flows and water levels shows that the development should have minimal impact on flooding associated with the critical storm for the catchment. The results show either minor increases or decreases in flow and level depending on which annual exceedance probability event is being examined.

The events that show an increase in these levels would have negligible impact downstream of the site and those that show a decrease will reduce the flooding impact downstream for the critical storm duration (3, 6 or 12 hours, depending on the catchment).

Impacts on Adjacent Water Users

As indicated in the sections above, the Proposed Development would not impact on the quality or quantity of water available at the Site. Therefore, there would be no impact on water quality or quantity for adjacent water users.

Aquatic Ecosystems

Direct impacts

Likelihood Assessments (Table 7-44) indicates that threatened fish, frogs, and/or turtles are unlikely to occur in the waterways on-site because there is not suitable habitat to support such populations. Accordingly, the Proposed Development is considered unlikely to pose a direct threat to threatened aquatic species. Potential impacts to terrestrial and aquatic biodiversity have been assessed in accordance with the FBA methodology (Section 7.2). Construction and decommissioning activities have the potential to cause direct physical disturbance to small areas of riparian, aquatic and groundwater dependent ecosystems. These impacts are assessed and mitigated under the FBA methodology.

Operational activities will have negligible direct impacts on riparian, aquatic and ground water dependent ecosystems. The design of the Proposed Development, which will include buffer distances as described in Table 7-43, shall generally negate the need for access to these environments, except to undertake environmental improvements works such as weed, pest and vegetation management activities.

The reduction of stock and reduced agricultural pressure would improve the ecology of riparian and aquatic habitats relative to current conditions.

Indirect impacts

Through the same processes described above, the construction and decommissioning of the Proposed Development has the potential to indirectly impact riparian, aquatic and ground water dependent ecosystems. While direct impacts are considered to be minor, it is concluded that indirect impacts do not pose a threat to the aquatic environment. In fact, the reduction in grazing and cropping pressure is likely to result in an improvement to the aquatic environment of the site. Mitigation measures to reduce risk of runoff induced

sedimentation to existing riparian, aquatic and ground water dependent ecosystems, as well as to reduce impacts from potential chemical spills are proposed in Section 7.9.4.

The Proposed Development would not alter the hydrology of surface water resources such that there would be significant changes to the quantity, timing or duration of flows available to riparian, aquatic or ground water dependent ecosystems.

As there would be no significant change in the overall hydrology of the Site during the operational period of the Proposed Development, operational activities would have negligible indirect impacts on riparian, aquatic and ground water dependent ecosystems.

7.9.4 Mitigation Measures

General

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

- Exclusion of 3rd order streams from the Development Footprint (except one internal access crossing of Kings Plains Creek);
- Application of a minimum 20 m (from stream centreline) buffer zone for 3rd order and higher riparian zones;
- Avoidance of footings and pilings, where practicable, within 1st and 2nd drainage lines;
- Minimisation of creek crossings for internal access and electrical cabling;
- Sourcing of non-potable water from onsite dams and existing water licenced sources offsite; and
- Sourcing from offsite all potable water requirements.

Specific mitigation to potential impacts by topic are outlined below.

Construction and Decommissioning

Water Quality

Protocols for erosion and sediment mitigation to protect water quality at the Site would be included in the appropriate management plan for the Proposed Development. A similar plan would be developed to guide decommissioning activities in accordance with relevant requirements at the time.

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

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

Procedures shall be adopted to minimise the risk of water quality impacts associated with contamination of surface water resources (Section 6.2.4, 'Mitigation', in 'Landuse and Soils', provides detail on erosion control measures).

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

Hazardous materials (fuels, lubricants, construction chemicals, herbicides, etc.) will be transported off site in accordance with DECC guidelines (see Section 7.11, which details commitments for responsible disposal of this material under the POEO Regulations and the WARR Act). Onsite refuelling shall occur within designated areas located more than 100 m from the nearest drainage line and within an impervious bund. Machinery will be inspected daily to ensure no oil, fuel or lubricants are leaking from engines or hydraulic systems. All contractors and staff will participate in toolbox talks to prevent, minimise and manage accidental spills.

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

Water Quantity

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

Aquatic ecosystems

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

To minimise impacts to riparian, aquatic and groundwater dependent ecosystems, excavation activities will be located away from drainage lines where possible. Apart from a single vehicular access and cable crossing of Kings Plains Creek, no other construction activities will occur within a minimum 20 m (from stream centreline) riparian buffer zone surrounding all 3rd order (Strahler) streams. Thus ensuring against direct impacts to riparian, aquatic and groundwater dependent ecosystems.

Although approval under the WM Act is not required for SSD, the Kings Plains Creek crossing is a controlled activity. As such, relevant design considerations will be followed as per the NSW Office of Water's *Controlled Activities: Guidelines for laying pipes and cables in watercourses*. Any new vehicular crossing will be designed in accordance with the requirements of Class 4 waterway recommendations under the *Policy and Guidelines*

for Fish Friendly Waterway Crossings (NSW DPI, 2004) and *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull & Witheridge, 2003). These measures will avoid negative impacts to the aquatic environment.

Operations

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

Water Quality

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

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

All hazardous materials (fuels, lubricants, herbicides, etc.) will be disposed of offsite in accordance with DECC guidelines (see also Section 7.11). Onsite refuelling shall occur in an area that is located greater than 100 m from the nearest drainage line and within an impervious bunded area. Machinery will be inspected prior to use, to ensure no oil, fuel or lubricants are leaking from the machinery.

A spill response strategy will be included in appropriate environmental plans and all contractors and staff will be appropriately trained through toolbox talks to prevent, minimise and manage accidental spills. Should a spill event occur, incident management procedures will be implemented and the EPA will be notified of incidents that cause harm to the environment, pursuant to sections 147 – 153 of the POEO Act.

Water Quantity

No water quantity impacts were identified as a consequence of the Proposed Development during the operational period, therefore no mitigation is proposed.

Flooding

No flooding issues were identified as a consequence of the proposed development. Appropriate design solar arrays shall be designed and installed so as to not impede overland flow. Construction and operational structures shall not be located within flood prone land.

Aquatic Ecosystems

No impacts to aquatic ecosystems were identified as a consequence of the Proposed Development during the operational period, therefore no mitigation is proposed.

7.10 Hazards and Risks

An environmental hazard is an item or situation that has the potential to threaten the environment or human health. This section provides an assessment of potential hazards associated with the Proposed Development. It first considers relevant guidance within NSW, in particular *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development*, to determine if the Proposed Development is potentially hazardous, then applies a risk screening and preliminary hazards assessment (PHA) in accordance with NSW DPE's SEPP 33 Guidelines. It then considers potential hazards identified regarding electrical and bushfire, as well as the potential for electromagnetic interference.

7.10.1 Battery Storage Facilities

The Proposed Development incorporates a battery-based storage facility which would enable electricity generated by the SSF (and the SWF) to be stored for later dispatch to the National Energy Market (NEM) grid. Some batteries are classified as a dangerous goods according to the Australian Dangerous Goods Code (ADGC), whilst others remain unclassified despite their chemical constituents being classified separately. Battery types and potentially present hazardous materials for each battery type initially considered for SSF are provided in Table 7-50.

Table 7-50: Hazardous materials in the battery system, quantities on site and the classification of each good

Battery Option	Hazardous Material	UN Code	ADG Class	Quantity on Site (tonnes)	SEPP Assessment Limit (tonnes)	Exceeds Screening Threshold?
Lithium-ion batteries certified to UN 34.80	Lithium-ion batteries	3480	9	1,700	No SEP33 assessment/ limit	No
Wet lead acid batteries	Batteries, wet, filled with acid, electrical storage	2794	8	2,500	50	Yes
Vanadium flow battery	Vanadium pentoxide, non-fused form	2862	6.1	120	2.5	Yes

As a result of numerous factors (including functional and commercial), lithium-ion batteries seem the most likely battery option in the proposed SSF development.

The SEPP 33 screening process does not specify a screening threshold for ADGC Class 9 materials (Miscellaneous Hazardous material). As lithium-ion batteries are categorised as Class 9 goods, this Battery Option would not trigger a PHA based solely on the screening threshold. However, the SEPP 33 documentation is clear that the hazardous materials screening method will not be considered in isolation when determining whether an industry is considered potentially hazardous, and would therefore require a PHA to be carried out.

Taking a precautionary approach, other factors that may warrant consideration in the screening process to determine whether the proposed battery system at SSF would be considered potentially hazardous, and their consequences, are assessed in Appendix K.

Existing Environment

The proposed location for battery facilities include three option areas all located within cleared areas, away from infrastructure, residences and environmentally sensitive landscapes.

Potential Impacts

The risk prioritisation considered lithium-ion batteries, and found that the not-insignificant but low level hazards related to the battery system included electrocution, crushing and toxicity, whilst the medium level hazards included fire and explosion.

The results show that the low level hazards can be prevented by employing a combination of common measures, including following all applicable AS/NZ Standards, specific fire-fighting and battery system operational training, setbacks, physical protection and control systems measures. Mitigation measures are also available to reduce the severity of the hazards should they occur. There were no risks to society due to the localised nature of the consequences, and very minimal risks to the environment.

The likelihood of an explosion event occurring is very low, and prevention measures exist to reduce the risk further. Modelling of the potential blast radius suggest that it is very unlikely that a cascade event occurs (where one battery-filled container causes another to explode and so one), and in both cases there are no offsite impacts due to the limited (40 m) blast radius compared to the distance to the Site boundary and key infrastructure. There is no risk to society due to the localised nature of the consequences, and no risk to the environment.

There is potential for a fire event in the battery system to initiate a bushfire in the surrounding grazed grasslands, which presents the only potential impact to society from the SSF; however, many prevention measures exist to dramatically reduce the likelihood of a fire starting in the battery facility, and effective mitigation measures exist to contain the fire within the battery facility area if it were to eventuate. With application of the risk management measures and an effective fire management plan, it is concluded that there is a very low risk to society of a battery system initiated fire event, and very minimal risks to the environment.

Mitigation Measures

The recommendations from this PHA are separated into two categories; recommendations to reduce the likelihood of major incidents occurring and recommendations to limit the consequences of major incidents. These recommendations are summarised below (Table 7-51).

Table 7-51: Summary of key prevention measures to reduce the likelihood and consequences of major incidents at the SSF

Hazard	Key Prevention Measures to reduce Major Incident Likelihood	Key Mitigation Measures to limit Major Incident Consequences
Explosion/ Flammable Gas	▪ Consider a HVAC system capable of air cycling as well as thermal control ▪ Consider redundant HVAC system as backup, in addition to backup power	▪ Containers separated by minimum distance as specified by supplier. If no distance is specified, install containers with a minimum 2 m clearance on all sides

Hazard	Key Prevention Measures to reduce Major Incident Likelihood	Key Mitigation Measures to limit Major Incident Consequences
	▪ Variety of additional Battery Management System (BMS)/Control System solutions to reduce electrical abuse that leads to gassing of battery cell ▪ Variety of additional BMS/Control System solutions to reduce electrical abuse that leads to gassing of battery cell ▪ Consider additional physical overcharge protection (e.g. breakers) at system, rack, battery and cell level	▪ Include a 20 m buffer of non-combustible material (e.g. gravel) surrounding the battery system. Fence to area to prevent unauthorised access and animal ingress ▪ Include pressure release valve in container to direct an explosion to designated space/direction
Toxic Liquid	▪ Measures as for Crush incidents ▪ Clear operating procedures for maintenance staff and fire-fighters	▪ Battery system-specific maintenance and fire fighter training
Fire/ Flammable Liquid	▪ Variety of BMS/Control System solutions to reduce thermal runaway events ▪ Consider additional physical overcharge protection (e.g. breakers) at system, rack, battery and cell level ▪ Consider redundant HVAC system as backup, in addition to backup power ▪ Separation of DC cabling back to first overcharge breaker circuitry ▪ Measures as for Crush incidents ▪ Containers separated by minimum distance as specified by supplier. If no distance is specified, install containers with a minimum 2 m clearance on all sides ▪ The surrounding grassland area should be kept well grazed, slashed or mowed to a distance of 200 m surrounding the battery system	▪ Install a fire suppression system in each container ▪ Containers separated by minimum distance as specified by supplier. If no distance is specified, install containers with a minimum 2m clearance on all sides ▪ Ground cover around containers should be gravel, and extend to a minimum 20m buffer around the outermost containers. A fence should be present to prevent animal and person ingress.
Toxic Gas	▪ Clear operating procedures for maintenance staff and fire-fighters ▪ Measures as for Explosion/Flammable Liquid and Crush incidents	▪ Consider installing gas sensors inside container to protect maintenance staff ▪ Battery system specific maintenance and fire fighter training
Electrocution	▪ Clear operating procedures for maintenance staff and fire-fighters ▪ Prevent water incursion with appropriate IP rated container ▪ Prevent humidity build up with appropriate HVAC selection and potentially dehumidifier if required ▪ Install a fire suppression system in each container	▪ Consider separating the DC cable running from the battery units back to the first overcharge circuit breaker, in case of short circuit, to prevent escalation ▪ Battery system-specific maintenance and fire fighter training
Crush	▪ Include bund crash wall between access road and battery containers ▪ Procure certified battery racking that is appropriate for battery pack ▪ Install battery racking in accordance with supplier specification and installation standards	▪ Battery system-specific maintenance and fire fighter training

7.10.2 Bushfire and Electrical Fire

Fire presents a threat to human life, property, infrastructure and ecology. Risk can be considered in terms of environmental hazards that increase the risk or severity of fire (vegetation, topography and weather patterns), as well as specific activities and infrastructure that increase combustion or ignition risks.

Section 100B of the Rural Fires Act requires that the Commissioner of the RFS issue a Bush Fire Safety Authority (BFSA) for residential, rural residential or rural subdivision and special fire protection purpose developments on bushfire prone land. Special Fire Protection Purpose Developments include:

- a school;
- a child care centre;
- a hospital (including a hospital for the mentally ill or mentally disordered);
- a hotel, motel or other tourist accommodation;
- a building wholly or principally used as a home or other establishment for mentally incapacitated persons;
- housing for older people or people with disabilities within the meaning of *State Environmental Planning Policy No 5 - Housing for Older People or People with a Disability* (now SEPP (Seniors Living));
- a group home within the meaning of State Environmental Planning Policy No 9—Group Homes;
- a retirement village; and
- any other purpose prescribed by the regulations.

The Proposed Development is classified as SSD, is not a subdivision for residential or rural residential purposes, nor is it a development for a special fire protection purpose, hence issue of a bush fire safety authority under section 100B of the Rural Fires Act is not formally required. Nonetheless, the Rural Fires Act places a duty of care on land owners/managers to prevent fire spreading on and from their land, which is a principle that will be adhered to through all phases of the Proposed Development.

Existing Environment

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

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

The Site will cover up to 2,423 ha of rural land, the majority of which has been cleared for grazing and sown with improved pastures and there are patches of retained native woodland scattered throughout. The Site is located within an undulating landscape, where elevation ranges between 810 - 1000 m above sea level (AHD). Portions of the Site and its surrounds are mapped as bushfire prone land on the Inverell Shire LGA Bushfire Prone Land Map (Inverell Shire Council & LPI, 2016).

Existing land uses of the Site include agricultural activities and energy generation at the SWF. Existing fire hazards on site include small areas of native vegetation and whilst managed, grazed pastures are also

susceptible to grass fires in hot, dry and windy conditions. Other on-site ignition sources due to the existing land uses include:

- Machinery operating in long grass;
- Hot work activities, including welders and grinders;
- The storage of waste and combustible materials onsite;
- Storage of flammable liquids;
- Electrical faults;
- Lightning strikes;
- Agricultural activities; and
- Carelessly discarded cigarette butts.

The existing overhead electricity transmission lines also pose a potential hazard, however, TransGrid is required to maintain line infrastructure to minimise fire risk.

The statutory Bush Fire Danger Period is between October and March reflecting seasonal fire hazards; however, this will vary from year to year depending on the prevailing climatic conditions in the region.

All NSW Fire and Rescue stations are equipped with the resources and trained personnel required to deal with fire (and hazmat incidents). The nearest NSW Fire Brigades are the Glen Innes Fire Station 30 km east from the Site, and Inverell Fire Station 31 km west from the Site. The nearest RFS Brigade is at Kings Plains, approximately 7 km north of the Site.

In terms of onsite resources, the Site is well serviced by multiple graded roads (Western Feeder Road and Waterloo Road in addition to SWF access roads) which affords direct access to the centre of the Site. There will also be access tracks created for SSF. These roads can provide emergency evacuation routes and emergency vehicle entry.

Existing receivers and assets at risk from fire include four dwellings located within the Site boundary, as well as farm structures. There are three additional dwellings and associated infrastructure located within 2 km of the Site boundary.

Potential Impacts

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

Woodland fragments are sparse across the Site and will be cleared within the area of the array as detailed in Section 7.2, hence it is considered unlikely the Proposed Development will pose a significant bushfire risk. Whilst cleared areas of the Site are not mapped as bushfire prone land, grassland fires burn at a higher intensity and spread more rapidly with a shorter residence time than that of fires in other vegetation classifications (RFS, 2017a).

The flammability of solar farms is very low as they are predominantly constructed of glass, silicon, steel and aluminium. The potential for fire originating from a battery storage facility has been assessed in above in

7.10.1 and Appendix K and concludes that the consequence of major hazards was confined to a small area around the storage site and that the likelihood of all events was either very unlikely or extremely unlikely, primarily due to the wide range and comprehensive nature of the preventative measures available.

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

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

Considering the sparse vegetation cover over the Site and other factors discussed above, it is considered unlikely that the Proposed Development would pose a significant bush fire risk. The bush fire hazard associated with the activities listed above is considered highly manageable through electrical equipment selection, appropriate access arrangements, fuel load reduction programs, safety protocols during periods of high fire risk and the implementation of an emergency response plan as detailed below in Section 7.10.1.

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

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

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

Mitigation Measures
The *Planning for Bush Fire Protection 2006* (PBP) has been revised to account for lessons learnt in major bushfire events, and changes in building codes and construction standards. The revised draft of *Planning for Bush Fire Protection 2017* is in the final stages of being finalised, the release of the final publication anticipated in late 2017 (RFS, 2017b). The following mitigation measures are proposed to reduce and manage the risk of fire, and reduce the impact of any fires within or surrounding the Proposed Development, and are in accordance with the draft PBP guidelines.

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

Design

Electrical equipment selected for the 25-year life span of the Proposed Development would be designed to minimise the potential for ignition and certified to comply with relevant Australian Standards. All equipment installed would be earthed appropriately following comprehensive testing of soil conductivity to ensure lightning effects are not harmful to the operation of the Proposed Development.

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

There will also be a 20,000 litre water tank located in the support building area for the sole use of fire protection in line with the RFS standards (RFS, 2017a).

Battery Storage Facility

The risk of fire occurring in and spreading from the battery storage facilities will be mitigated by a suite of measures for potentially hazardous events including thermal runaway, flammable gas release, toxic liquid, electrocution, crush, bushfires and external impact. These are outlined above in Table 7-51.

Further detail is provided in Appendix K.

Access and Firebreaks

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

Fuel reduction

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

Emergency Response Plan

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

Safety protocols

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

- Basic training of all staff in the use of firefighting equipment on site;
- Firefighting equipment lists will be detailed in the Work Method Statements;
- Management procedures for hot works, smoking, vehicle use off formal access tracks, and the use and storage of fuel and flammable chemicals; and
- Daily monitoring of the Fire Danger Rating, and communication of any further mitigation measures required to all staff and contractors.

7.10.3 Electromagnetic Interference

This section considers the potential for nuisance and health impacts from Electromagnetic Fields (EMFs) associated with the Proposed Development within the vicinity of the Site.

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

Existing Environment

The existing environment exhibits variable topography, is sparsely populated and is likely to be characterised by relatively weak radio signal strengths (primarily due to distance from transmission stations). Existing potential sources of electromagnetic interference within the vicinity of the Site include a double-circuit TransGrid 330 kV transmission line, a TransGrid 330 kV substation, Essential Energy 11 kV distribution lines and SWF internal underground and overhead (up to) 33 kV electric cabling and associated wind turbine generators.

The SWF wind turbine generators are a source of electromagnetic fields, created by the generator and electrical equipment whilst operational. However, these electromagnetic fields are reduced by the shielding of the electrical equipment in the turbine structure and specifically in relation to each generator being located at 137 m above the ground.

Due to the function of substation and the required components, substations have the highest variation in magnetic fields, ranging from 0.1 µT to 6 µT at the security fence (EMFs Info, 2017).

Potential Impacts

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

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

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

In the absence of Australian standards for regulating exposure to extremely low frequency EMFs, the National Health and Medical Research Council's (NHMRC) *Interim guidelines on limits of exposure to 50/60 Hertz electric and magnetic fields* has been used to assess the impact of the existing and Proposed Development infrastructure to contractors and the general public's health (Table 7-52).

Table 7-52: Summary of NHMRC's Interim Guidelines on limits of exposure to 50/60 Hz electric and magnetic fields

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

Construction and decommissioning

The potential of EMF impacts during the construction and decommissioning phases is low. Exposure by construction staff would be limited to intermittent periods, during works at and around the existing 330 kV transmission lines and substation on Site. Furthermore, construction of the solar array would not occur within the transmission line easements.

Operation

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

EMF generating components at the Proposed Development include:

- The battery-based storage system;
- The PV array and its wiring system; and,

- The underground and/or overhead (up to) 33 kV cables connecting the array area and battery-based storage facility with the substation.

The battery-based storage facility will comprise enclosed lithium-ion cells. High levels of EMFs are not associated with lithium-ion batteries, therefore the EMF produced by the battery-based storage facility would be below NHMRC recommended levels (Appendix K)

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

The 33 kV cabling connecting the solar array and battery-based storage facility to the adjacent existing TransGrid 330 kV substation may either be underground or overhead, producing both electric and magnetic fields. The magnetic field associated with the line would be greatest if installed overhead, with approximately 1.7 µT directly below the line diminishing to 0.4 µT at a distance of 10 m. Under the same scenario, the electrical field would be approximately 2.6 kV/m (2600 V/m) directly below the line, diminishing to 0.7 kV/m (700 V/m) within 10 m (EMFs Info, 2017). The typical magnetic field from the underground cables is 1 µT immediately above a 33 kV cable buried at 0.5 m (Figure 7-24).

These levels are below the requirements for contractors and public exposure levels as per NHMRC's Interim guidelines in Table 7-52. Any EMFs produced by the substation would comply with exposure limits (EMFs Info, 2017) and is not considered further.

The maximum electric and magnetic fields for a 33 kV overhead powerline is shown respectively in Figure 7-25 and Figure 7-26. The maximum electric field produced by a 33 kV overhead powerline is less than 0.85 kV/m (850 V/m) at the source, while the maximum magnetic field produced is approximately 26 µT at the source. These are also below the exposure limits for contractors and the general public as per the NHMRC's Interim Guidelines (Table 7-52), and does not pose a health risk.

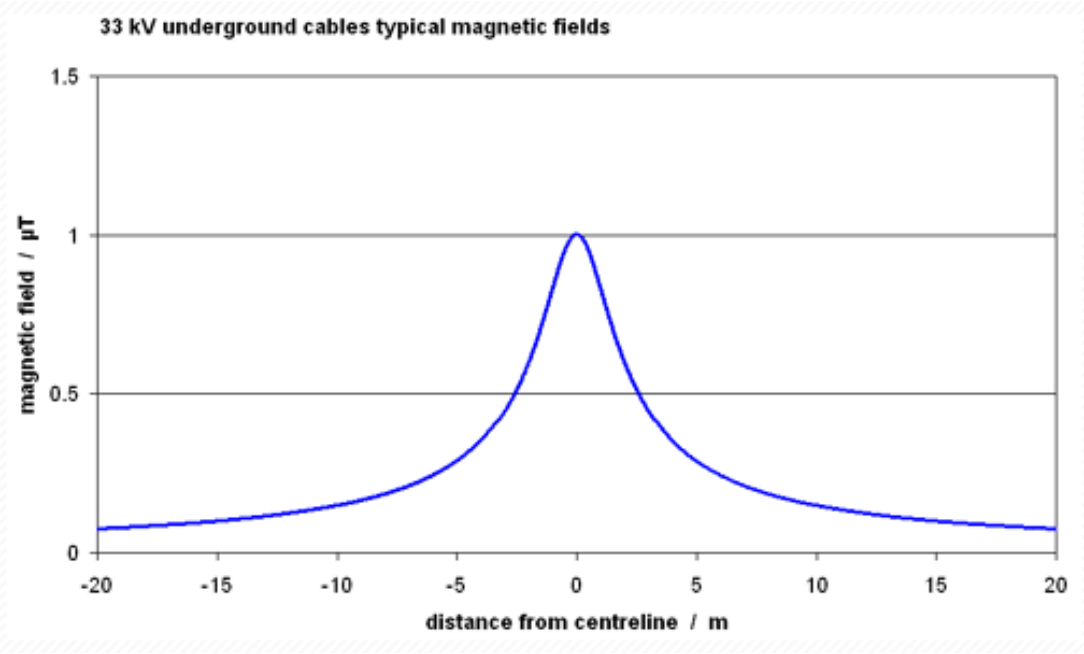

Figure 7-24: Typical magnetic field from a 33 kV underground cables (EMFs Info, 2017)

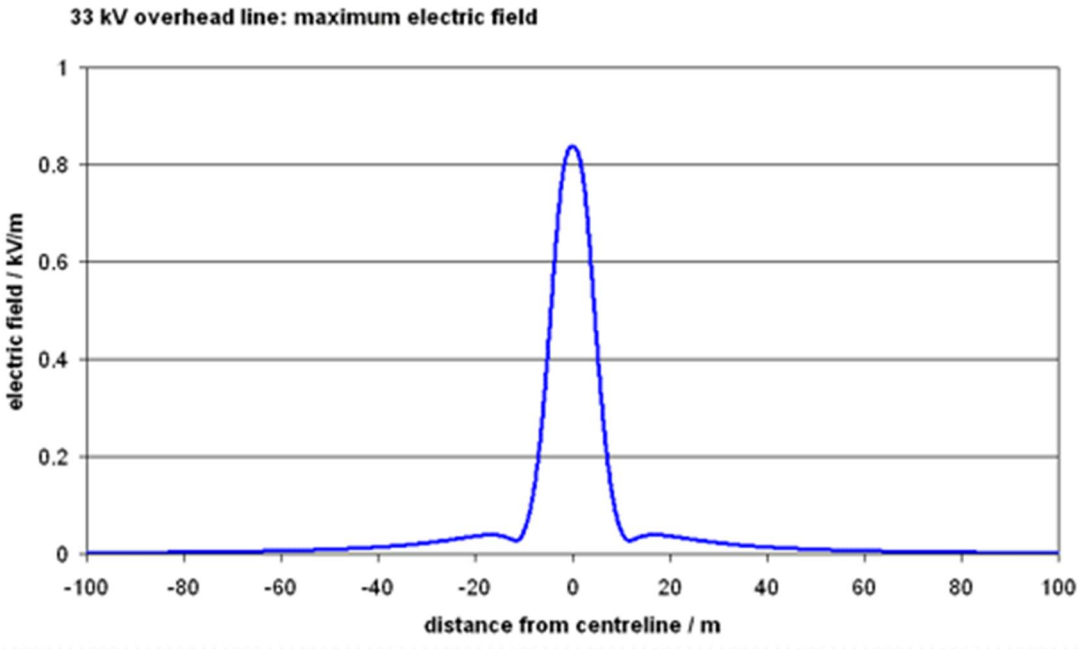

Figure 7-25: Maximum electric field from a 33 kV overhead powerline (EMFs Info, 2017)

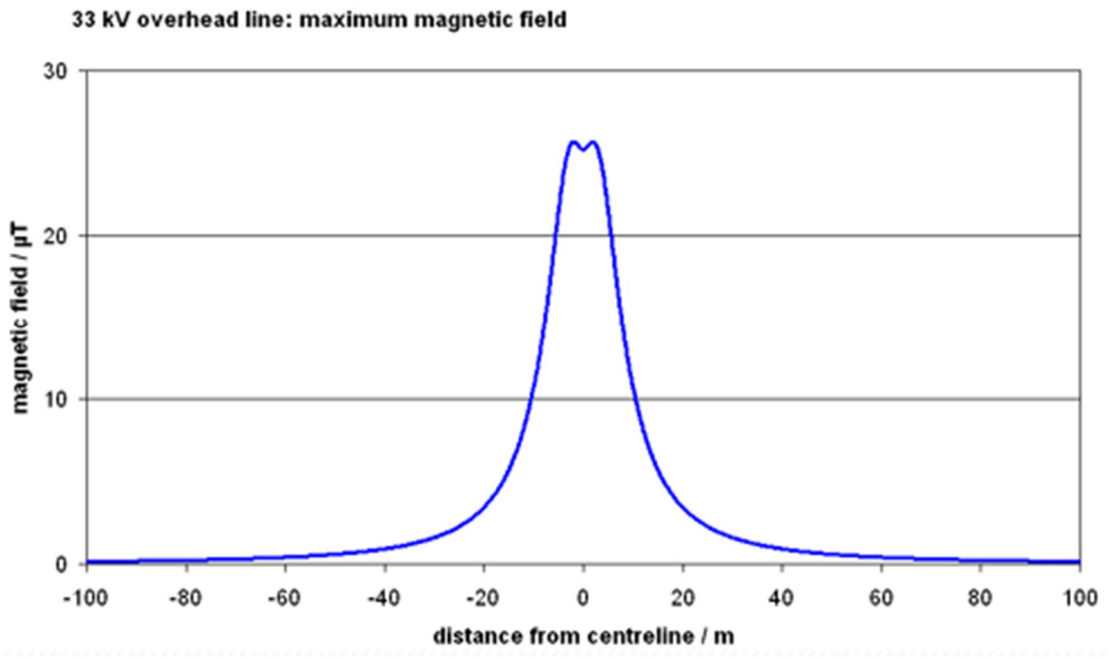

Figure 7-26: Maximum magnetic field from a 33 kV overhead powerline (EMFs Info, 2017)

There are six residences located within approximately 1 km of the boundary of the solar arrays, the closest of which (R13, owned by Landholder 2) is 80 m away. Four residences are within approximately 2 km from the Substation, the closest (Landholder 2, the host landowner) being approximately 1.2 km. Given the distance from the highest EMF emitter (the substation) and the low EMFs emitted from the PV solar arrays, and the existing Essential Energy 11 kV distribution network and the double-circuit 330 kV transmission lines located near these residences, EMFs from the Proposed Development are likely to be indistinguishable from background levels at the boundary fence.

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

Mitigation Measures

Design principles and staff safety

In limiting exposure to EMFs, following advice from the International Commission on Non-Ionizing Radiation Protection, priority will be given to engineering and access controls that limit exposure (ICNIRP, 2010). This means that:

- The final design of the Proposed Development would meet relevant Australian standards, ensuring EMFs would be minimised as far as possible; and
- Access to electrical equipment would be limited to qualified personnel only.

In addition to the design and access control measures outlined above, potential exposure levels on Site are predicted to be below the exposure limits for staff in the NHMRC's Interim Guidelines (Table 7-52), therefore further mitigation is not proposed.

Receptors – public safety

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

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

The landholder or its employees would not have access to the substation or inverters.

Receptors - electrical devices

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

7.11 Waste and Resource Use

7.11.1 Introduction

The consumption of resources, and production and disposal of waste has the potential to have a negative impact upon the environment, and needs to be managed to ensure that:

- Resources are used efficiently;
- Waste production is minimised;
- Reuse of materials is maximised; and
- Contamination of land and water is avoided.

The developer's obligations in regard to waste management are guided by the following legislation:

- Waste Avoidance and Resource Recovery Act 2001 (WARR Act) – promotes waste avoidance and recovery;
- POEO Act – requires a licence to carry out certain scheduled waste activities and makes it an offence to pollute or potentially pollute land, air or water with waste; and
- Protection of the Environment Operations (Waste) Regulation 2005 (POEO (Waste) Regulation) – prescribes requirements for the tracking and management of certain wastes.

The POEO Act and the POEO (Waste) Regulation regulate waste management and pollution in NSW. Under section 134 of the POEO Act, it is an offence to unlawfully transport and deposit waste, and littering is an offence under section 145 of the same Act.

The WARR Act aims to encourage the most efficient use of resources and to reduce environmental harm. Waste management hierarchy principles are provided in the WARR Act and are considered in the following order:

- Avoidance of unnecessary resource consumption;
- Resource recovery (including reuse, reprocessing, recycling and energy recovery); and
- Disposal.

Adopting the above principles would encourage the most efficient use of resources, and reduce costs and environmental harm in accordance with the principles of ecologically sustainable development.

7.11.2 Existing Environment

The existing site is characterised by agricultural production and grazing activities. Responsibility for the management of waste generated by these activities lies with the landholder.

7.11.3 Potential Impacts

Resource use

Construction

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

Operation

The production of electricity using PV panels utilises an energy resource (sunlight) that is renewable, as such, there would be no impact on this resource as a consequence of the Proposed Development.

During operation, the resources used would largely be associated with maintenance activities and the use of machinery and vehicles. While this would require the use of non-renewable resources such as hydrocarbon fuels to power machinery and vehicles, in the very limited volumes required, the Proposed Development is unlikely to place significant pressure on the availability of these resources. Furthermore, their use during this period is considered reasonable in light of benefits of offsetting fossil fuel electricity generation.

Imported potable water may be required for cleaning panels intermittently during dry periods (Section 7.9). The consumption of resources during the operation of the Proposed Development would not place significant pressure on necessary resources.

Decommissioning

The main resources required to support the decommissioning phase of the Proposed Development would be the use of machinery and vehicles associated with the activities of removing all onsite infrastructure. While this would require the use of non-renewable resources such as, hydrocarbon fuels to power machinery and vehicles, in the volumes required, the Proposed Development is unlikely to place significant pressure on the availability of these resources. Accordingly, their use during this limited period is considered reasonable in light of benefits of the initial 25 year term of the Proposed Development.

Waste Generation

In accordance with definitions of the POEO Act and associated waste classification guidelines, most waste generated during the construction and decommissioning phases would be classified as building and demolition waste within the class general solid waste (non-putrescibles).

Potential impacts associated with waste management on Site include:

- Contamination of land and water from inappropriately managed waste and waste storage areas;
- Human and animal health impacts; and
- Resource wastage through inefficient use or the recycling of over-ordered stock.

Construction

Solid wastes will be the main pollutant generated by construction activities. Solid wastes will include packaging, excavated material, metal and cable off-cuts, excess building materials, general refuse and other

non-putrescible wastes. Ancillary facilities in the site compound would also produce sanitary wastes classified as general solid waste (putrescibles) in accordance with the POEO Act.

The Glen Innes Landfill does not generally accept general waste from outside of the Glen Innes Severn LGA. Furthermore, the Glen Innes Landfill is close to exceeding the amount of waste permitted to be received in any one year, as per the NSW EPA Licence. However, Glen Innes Severn Council can accept sorted recyclables from outside its LGA subject to prior consultation with Council and Glen Industries.

Inverell Shire Council Waste Services were consulted regarding the types and volumes of waste streams likely to be generated during construction, and the options for disposal and re-use of the identified waste streams. The quantities and proportion of generated waste that can be recycled within the Inverell LGA from the PV modules, the delivery of torque tubes and the cable drums is detailed in Table 7-53, Table 7-54 and Table 7-55. Quantities of waste generated from miscellaneous items is provided in Table 7-56.

Table 7-53: Sapphire Solar Farm – *Indicative Only* Waste Quantities Associated with PV Modules

Source	Waste in Box (Item)	Quantity of Item Per Box	Weight of Waste Per Box (kg)	Total Weight of all Boxes (kg)	Recyclable within Inverell LGA Yes / No
PV Panels	Timber Pallet	1	30	673,920	NO
	Cardboard Box	1	15	336,960	YES
	Plastics Bags	29	0.87	19,544	NO
	Polystyrene Sheets	31	1.86	41,783	NO
	Plastic Corner Pieces	116	0.58	13,029	NO (dependent on plastic type)
	Aluminium Straps	4	2.95 (kg)	66,269	YES
Total				Quantity	Recyclable
Total kg of wastage associated with PV Modules				1,151,505	403,229 (Plastic corner pieces may be; dependent on plastic type)

Table 7-54: Sapphire Solar Farm – Indicative Only Waste Quantities Associated with Torque Tubes

Source	Waste Item in each Container (Item)	Quantity of Item Per Container	Total Waste from all Containers	Weight of Waste Total (kg)	Recyclable within Inverell LGA Yes / No
Torque Tubes & Piers	Plastic Wrap Ends	4	1,656 (item)	238	NO (dependent on plastic type)
	Aluminium Long Banding	4	1372 (kg)	1,372	YES

Source	Waste Item in each Container (Item)	Quantity of Item Per Container	Total Waste from all Containers	Weight of Waste Total (kg)	Recyclable within Inverell LGA Yes / No
	Foam Long Banding	4	1656 (item)	78	NO
	Aluminium Short Banding	12	2286 (kg)	2,286	YES
	Foam Short Banding	12	4968 (item)	234	NO
	Aluminium Banding to Piers	20	3658 (kg)	3,658	YES
Total				Quantity	Recyclable
Total kg of wastage associated with Torque Tubes				7,866	7,316

Table 7-55: Sapphire Solar Farm – Indicative Only Waste Quantities Associated with Cable Drums

Source	Waste in Box (Item)	Quantity of Item per Cable Drum (Average)	Total Waste per Drum (kg)	Total Waste over project duration (kg)	Recyclable within Inverell LGA Yes / No
Cable Drums	Timber Bracing	15	30.45	6,120	NO
	Aluminium Banding	20m	3.68	740	YES
	Aluminium Casing	25m^2	56	11,256	YES
	Steel Cable Drums	1	38	34,628	YES
	Timber Cable Drums	1	163	122,108	NO
Total				Quantity	Recyclable
Total kg of wastage associated with Cable Drums				174,852	46,624

Table 7-56: Sapphire Solar Farm – Indicative Only Waste Quantities Associated with Miscellaneous Items

Potential Waste Source (Non-Putrescible)	Total Potential Wastage of Miscellaneous Items (tonne)
Piling Machines	200 (t) (Allowance for 1 x 3m^3 bin across 7 locations to be collected weekly, allowance for 1 8m^3 bin across 3 locations to be collected fortnightly)
Site Buildings	
Plant & Equipment	
Workshops	
Switchroom	

Operation

Waste streams during the operation of the Proposed Development would be limited to minor quantities of putrescible waste, redundant equipment, and general waste from maintenance workers. No waste streams would be associated with the generation of electricity using PV panels. Some materials such as fuels and lubricants, redundant equipment and metals may require replacement over the operational life of the Proposed Development.

Decommissioning

The Proposed Development has a design life of at least 25 years. At the end of its useful life, the Proposed Development will be decommissioned and the Site will be returned to agricultural use.

Decommissioning activities will involve the removal of all above ground infrastructure, including the PV modules, the racking system, the piles, and grid connection infrastructure. Note, underground cables (inert and stable) at a depth greater than 500 mm would be left in-situ to avoid unnecessary ground disturbance.

Decommissioning of the site would involve the recycling or reuse of materials including:

- Solar panels and mounting system; and
- Metals from posts, cabling, fencing.

Infrastructure and equipment that may be suitable for reuse include grid connection equipment, substation equipment and inverters. Support buildings will be removed from the Site for reuse if possible.

Solid wastes will be generated by decommissioning activities (non-putrescibles, putrescibles), although to a lesser degree than during the construction phase. Solid wastes will include packaging, excess building materials, general refuse and other non-putrescible wastes.

Lithium-ion batteries

Lithium-ion batteries have a lifespan of 5 to 15 years (DEWS, 2016), hence batteries may require replacement 1 to 2 times during the lifespan of the Proposed Development.

Under the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code), lithium-ion batteries are classified as dangerous goods. Special provisions, including packaging instructions, for lithium-ion batteries transported for disposal or recycling is provided in the ADG Code.

No facilities for recycling lithium-ion batteries are currently available in Australia. However, facilities do exist in Asia, North America and Europe. Therefore, spent batteries are likely to be exported and will require an export permit under section 40 of the Hazardous Waste Act. Currently, six companies in Australia provide a collection and recycling service for used lithium-ion batteries (ABRI, n.d.). Given the rapid rise in lithium-ion batteries in Australia, cost effective recycling initiatives may be available locally by the time battery replacement or decommissioning occurs. Predictions for strong growth in the consumption of lithium-ion batteries in photovoltaic panel electricity storage projects over the next 20 years may significantly impact waste streams from 2025 (Randell Environmental Consulting, 2016).

Waste Classification

The classification and description of the potential waste types likely to be generated by each phase of the Proposed Development are summarised in Table 7-57 below.

Table 7-57: Potential waste description

Waste Type	Project phase*	Waste Classification#	Details
Hydrocarbons	C,D	Liquid Waste	Used lubricants, etc.
Construction/ structural Waste	C,D	General Solid Waste (non-putrescible)	Waste from construction would include excess concrete, metal, timber, fittings and packaging.
Domestic/ office waste	C,O,D	General Solid Waste (non-putrescible and putrescible)	Waste would consist of everyday items such as paper, aluminium cans, plastics, packaging and other material generated by onsite contractors.
Green Waste	C	General Solid Waste (non-putrescible)	Cleared vegetation.
Liquid waste	C, D	Liquid waste	Oil, paint, lubricants, glue etc.
Sewage	C,O,D	Liquid Waste General Solid Waste (putrescible)	Effluent from ablutions and office buildings.
Chemical/ hydrocarbon containers	C,O,D	General Solid Waste (non-putrescible)	Fuel and lubricant storage. Herbicides and pesticide storage.
Dangerous goods	O,D	Hazardous Waste	Lithium-ion cell and batteries

* C – construction; O – operation D – decommissioning
# As defined in clause 49 of Schedule 1 of the POEO Act

Managed effectively, in line with the mitigation measures described in the section below, the generation of waste as a consequence of the construction, operation and decommissioning of the Proposed Development would not result in significant impacts.

7.11.4 Mitigation Measures

In order to encourage the efficient use of resources and reduce environmental impacts in line with the POEO Act, POEO (Waste) Reg, and the WARR Act, resources and waste will be managed according to the following hierarchy:

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

Waste will be classified in accordance with the NSW EPA *Waste Classification Guidelines – Part 1: classifying waste* (EPA, 2014) and *addendum* (EPA, 2016). Waste that cannot be recovered will be disposed of lawfully at a licensed waste facility. A Waste Management Plan will be prepared in order to meet the hierarchy set out above, and will form part of a suite of management plans. The objectives, protocols and responsibilities within it will be communicated to all staff and contractors through a site induction process, subcontractor agreements and ongoing training.

Specific measures to be incorporated into the Waste Management Plan would include, but not limited to the following:

- Protocols to identify opportunities to follow the waste hierarchy - to ensure that waste is minimised, recovered, and disposed of appropriately, and also to ensure a culture of responsible waste management is upheld by staff;
- Quantification, classification, and tracking of all waste streams - to encourage waste reduction and minimise inter-contamination of waste streams;
- Controls on the disposal methods of all waste streams;
- Adequate bins (with lids that prevent wind-blown litter and exclude pest and native animal scavenging) will be provided on site, including for each identified waste stream, and clearly labelled with the appointed waste stream.
- All waste will be disposed at facilities permitted to accept the waste. All controlled waste will be removed from the Site by a licenced waste contractor and the associated controlled waste tracking forms / information captured for reporting and auditing purposes.
- Provision of toilet facilities for onsite workers and how sullage would be disposed of (i.e. pump out to local sewage treatment plant);
- Provision of recycling facilities onsite to reduce waste streams;
- Provision of a dedicated waste management area onsite;
- Provisions as per the ADG Code for the packaging, transportation of spent lithium-ion batteries to collection and/or recycling facilities;
- An export permit under section 40 of the Hazardous Waste Act will be obtained prior to spent batteries being exported; and
- Protocols on the transportation of waste, for example covered loads.

7.12 Socio-economic Factors

7.12.1 Introduction

In this section the potential socioeconomic impacts of the Proposed Development are considered within the Inverell Shire LGA and the wider New England Tablelands. First the socioeconomic makeup of the area is summarised, including a review of the Council and the communities' longer term strategies for the region. Secondly, potential socioeconomic impacts throughout the Proposed Development's lifecycle are considered along with strategies to enhance positive effects and mitigate negative impacts.

7.12.2 Existing Environment

The proposed Development occurs within Inverell Shire Council, near to the border of Glen Innes Severn Council. The proposed Development is located roughly equidistant from Inverell and Glen Innes, and as such any existing or potential impacts will be localised within these two Council areas. Under current NSW planning, the population of the greater New England North West region is expected to grow modestly over the next 20 years from 188,200 in 2016 to a predicted 202,000 in 2036 (DPE, 2016).

The Inverell Shire LGA has a population of 16,483, of these 48.9% were male and 51.1% were female (ABS, 2017a). Aboriginal and Torres Strait Islander people made up 8.5% of the population. Population growth rates for the Inverell Shire LGA between the 2013 and 2016 census dates were, +3.56% and +2.46%, respectively. The median age of people in the Inverell LGA is 42 years, four years older than the national median. Children aged between 0 and 14 years make up 20.2% of the population and people aged 65 years and over made up 21.2% of the population (ABS, 2017).

The Glen Innes Severn LGA has a population of 8,836, of these 49.6 % were male and 50.4 % were female (ABS, 2017b). Aboriginal and Torres Strait Islander people made up 6.0 % of the population. Population growth rates for the Glen Innes Severn LGA between the 2013 and 2016 census dates were, -1.47% and +2.05%, respectively. The median age of people in the Glen Innes Severn LGA is 47 years, nine years older than the national median. Children aged between 0 and 14 years make up 17.1 % of the population and people aged 65 years and over made up 25.9 % of the population (ABS, 2017b).

Local Economy

The New England North West regional economy has historically been based on agriculture, and it remains one of the most productive agricultural areas in Australia. The agricultural industry in the region is worth approximately $1.8 billion annually, employing 30,000 people directly or indirectly and equating to 42% of the region's employment (NSW DPI, 2012). The agricultural industry is complemented or supported by urban industries and services ranging from manufacturing to professional services. The region has been identified as one of the best locations in NSW for the generation of renewable energy from wind and solar power (Department of Planning & Infrastructure, 2012). Solar farms have been approved at Metz, Moree and White Rock (Inverell).

Inverell is a service town for the New England Tablelands and provides educational facilities, transport facilities, sporting and recreational facilities, hospitals and services for the tourism industry. Of the employed people in Inverell (Local Government Area), 8.2% worked in Meat Processing. Other major industries of employment included Beef Cattle Farming (Specialised) 4.3%, Aged Care Residential Services 3.2%, Local

Government Administration 2.9% and Supermarket and Grocery Stores 2.8%. The unemployment rate is 7.4%, greater than the national unemployment rate of 6.3% (ABS, 2017a).

Glen Innes Severn's main industries include agriculture, retail trade, health and community and the tourism/service industry. Of the employed people in Glen Innes Severn (Local Government Area), 8.8% worked in Beef Cattle Farming (Specialised). Other major industries of employment included Aged Care Residential Services 4.1%, Supermarket and Grocery Stores 3.3%, Hospitals (except Psychiatric Hospitals) 3.2% and Local Government Administration 3.1%. The unemployment rate is 8.1%, greater than the national unemployment rate of 6.3% (ABS, 2017b).

Community Strategic Plans

Both the Inverell Shire and Glen Innes Severn Councils have in place Strategic Plans to provide information on aspiration goals for each community, including each Council's mission and purpose.

Inverell Shire Community Strategic Plan 2009 – 2029

The Inverell Shire Community Strategic Plan 2009 – 2029 was adopted by Inverell Shire Council in 2009. The Community Strategic Plan establishes the community's goals and long-term aspirations (Inverell Shire Council, 2009). As a part of Inverell Shire Council's community aspirations, their aim is to end up a community that is "healthy, educated and sustainable" (2009b). The Proposed Development finds support in a number of the community's main priorities and aspirations which are identified in the Community Strategic Plan and detailed below:

- C.06 Reduce the consumption of non-renewable resources: The Proposed Development will provide renewable energy directly to the section of the grid that in turn supplies the Inverell region.
- C.14 Provide opportunities for residents to gain employment: The Proposed Development will provide up to 200 jobs during the construction phase, and up to 10 will be created during the operation phase.
- B.01 Business, institutions and Council are working cooperatively towards agreed initiatives to strengthen and expand the Shire's economic base: The Proposed Development will allow for the diversification of industry in Inverell, which is currently highly geared to the rural sectors, by directly providing construction jobs which in turn will benefit the services, hospitality and retails sectors.

Glen Innes Severn Community Strategic Plan 2017-2027

Glen Innes Severn Council's vision is to "have a vibrant, confident and inclusive community supported by a sustainable and prosperous economy underpinned by a well-maintained road network." (Glen Innes Severn Council, 2017). The Proposed Development will assist this vision by helping Council meet its strategic outcomes to:

- Facilitate a growing local economy by continuing to support an attractive business Climate: The Proposed Development will directly provide construction jobs which in turn will benefit the services, hospitality and retails sectors.
- Continue to be a leader in environmental sustainability, by promoting energy efficiency and the use of renewable resources across Council facilities and assets: The Proposed Development will provide renewable energy directly to the section of the grid that in turn supplies the Glen Innes region.

Tourism

Both the Inverell Shire and Glen Innes Severn Councils have indicated increased tourism as an objective of their Community Strategic Plans, with Inverell wishing to "*promote the Shire as a destination for visitors"* and Glen Innes wishing to *"review tourism opportunities and promotion, with a particular focus on strengthening accessibility and providing incentives to draw visitors into the Glen Innes Highlands"*.

Glen Innes Severn Council regularly holds events and venues, including:

- Gourmet in the Glen NSW Wine and Food Festival;
- New England Regional Wine Show;
- Land of the Beardies Festival;
- Minerama Fossicking and Gem Show;
- Australian Celtic Festival;
- Grafton to Inverell Cycle Classic; and
- Glen Innes Show.

The Inverell Shire Council Annual Report (2009-2010) lists agri-tourism and eco-tourism amongst Council's economic development objectives. Inverell Shire Council regularly holds events and venues including:

- Sapphire City Festival;
- Opera in the Paddock Sapphire;
- Grafton to Inverell Cycle Classic;
- City Floral Festival; and
- Tom Roberts Festival.

Community *and National Attitudes to Solar Farms*

As detailed in Section 6, approximately 30 people attended the community fire shed meeting in March 2017 to discuss the proposal. Attendees expressed generally positive attitudes towards the Proposed Development with the key concerns being raised being:

- Visual impacts to neighbouring properties;
- The potential for property devaluation;
- Impacts on agricultural use of the land; and
- Proposed commercial terms of hosting the project.

At a national-level, solar power is viewed as the single most preferred form of electricity generation. For example, in a 2016 survey, 86% of respondents named solar power among their top three most preferred energy sources, up from 81% in the same survey in 2012 (The Climate Institute, 2016).

7.12.3 Potential Impacts

General

The socioeconomic and environmental benefits of developing renewable energy sources, and transitioning to a low carbon future are large, providing potential benefits to entire communities and helping to maintain quality of life. Indeed, increased adoption of renewable energy sources will assist Australia to transition away from traditional carbon intensive energy production which is linked to atmospheric pollution and carbon

emissions associated with climate change. Reduced carbon emissions have the potential to reverse or slow the effects of climate change, benefitting current and future generations.

Electricity produced from the Site provides a clean power source for local and regional consumers in a cost-effective manner. Sapphire Solar Farm (SSF) would produce approximately 390 GWh of clean renewable energy to the local electricity transmission network, providing enough energy to power up to 68,000 average NSW homes each year. Moreover, the addition of battery-based storage (c.100 MWh) will allow for the SSF (along with the Sapphire Wind Farm) to dispatch scheduled and reliable renewable energy generated power to the National Electricity Market (the NEM). This would reduce up to 340,000 tonnes of CO_2 per annum through the displacement of conventional electricity supply (based on current NSW emission figures of 0.87 kg of CO_2-equivilent per kWh).

Construction

SSF would have an overall positive impact on the local and wider economy during the construction period. Construction will take up to 18 months and up to 200 staff will be required. The construction and decommissioning stages of the Proposed Development will generate the largest economic gain for the greatest number of people and businesses in both Council areas. This is due to the hiring of a large temporary work force over approximately two years of construction and later one year of decommissioning. Employment opportunities would involve concreting, earthworks, steel works and electrical cabling during construction, with demolition and removal during decommissioning. Where possible the Proponent will source from local companies. Indirect employment opportunities would involve food industries, fuel, accommodation and other services that contractors coming to the area would require. Local employment opportunities will be generated, while additional workers from outside the region would stimulate the local economy through demand for accommodation, hospitality and retail services. A temporary influx of staff may lead to a small increase in pressure on local services, including accommodation.

Construction noise and additional traffic on the Western Feeder and Waterloo Roads will be noticeable to local residents during the construction period, however longer term, the improvements made to those roads will be of benefit to local residents (Section 7.8).

During the construction period, there would be a large-scale change to the character of the Site as viewed from Western Feeder and Waterloo Roads, however this would be temporary in nature, and would be lessened in magnitude by the changes in construction activities and their location across the Site. Furthermore, views of the Proposed Development from Western Feeder and Waterloo Roads would only extend over part of the Site (see Section 7.6).

There would be a reduction in farming related income on those areas of the Proposal Site within the Development Footprint, although income generated from the lease arrangements during this time would offset these losses. There will be some short-term impacts during construction, such as modified grazing activities of associated landowners. However, all associated landowners will receive a rental income from hosting the Proposed Development and therefore localised negative economic impacts will be minimised.

Operation

SSF would have an overall positive effect on the local and wider economy through the employment of up to 10 full-time equivalent employees. Increased employment from SSF would provide an opportunity for the diversification of rural incomes and, therefore, would increase economic security for the local economy. SSF would result in a diversification of farm income for the landholders. SSF would not create major land disturbances or land use conflict (Section 7.5). Furthermore, the size of the Proposed Development (up to 2,423 ha) would not significantly diminish the availability of land for agricultural production purposes within the Inverell Shire LGA (Section 7.5). Noise and traffic impacts during this time are not predicted to be significant.

It is not anticipated that SSF would have any adverse impacts on tourism given its limited visibility and the general positive attitude of Australians towards renewable energy and solar developments. Solar farms, as well as other renewable energy projects are already being used as a tourism drawcard in the Australian Capital Territory as part of the Renewable Energy Trail (SERREE, 2016). With the potential for increased traffic from visitors to the solar farm and wind farm, other economic opportunities exist through activities such as tours, souvenirs, food and drink, accommodation, etc. which could form the basis of a renewable energy tourism industry/ solar and wind tourism industry.

In the ACT, one of the benefits of the Renewable Energy Trail to regional communities is visitors who take the Trail experience also call in and spend at local cafes and shops (SERREE, 2016). There is global precedent to support the Green Energy Trail concept as being a valued tourism and education resource e.g. www.greenenergytrail.co.uk. Similarly, increased visitor numbers attracted by the solar farm could result in increased exposure to other local attractions and amenities. The Proposed Development will have the potential to increase visitor numbers to both Councils and become a source of revenue for the regional towns, as demonstrated with other solar farms including Williamsdale Solar Farm in the ACT. As the Proposed Development occurs on private land, tourists will only be able to access the solar farm area from public roads, which may be screened from Waterloo Rd as a mitigation measure for visual amenity.

Community wellbeing will be positively influenced by the Proposed Development during the construction phase in a number of ways, including:

- A short-term increase in population during construction due to the incoming workforce, stimulating the local economy due to demand for local accommodation, hospitality and retail services; and
- An increase in the number of jobs available in the area during the construction of the Proposed Development;

Community wellbeing may be positively influenced by the Proposed Development by a small increase in full-time employment during operation for a select skilled workforce.

No negative socioeconomic impacts are expected as a result of the introduction of the Proposed Development during the operational period.

Decommissioning

The Proposed Development would not create major land disturbances or land use conflict (Section 7.5). Furthermore, 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.

It is anticipated that decommissioning would be of a shorter duration than the construction period (up to 6 months). However, the same economic benefits and opportunities identified for the construction period would arise during this time. Further economic benefits may include local recycling of infrastructure.

Cumulative Impacts

The approved Sapphire Wind Farm, Glen Innes Wind Farm, White Rock Wind Farm, White Rock Solar Farm and the proposed Sundown Solar Farm will not have an adverse cumulative effect to community wellbeing or the local economy from the introduction of the proposed development into the area. Instead, these wind and solar farms will provide additional jobs and resources into the surrounding Councils and will help both Councils reach their aspirations and visions, utilising existing resources in the surrounding area where feasible. There will not be a significant increase on local services at the one time, rather the benefits will be spread over a longer time period as it is anticipated that construction of the approved neighbouring renewable energy projects will be completed prior to SSFs construction.

7.12.4 Mitigation Measures

Construction

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

To ensure that the local Councils benefit from the construction of the Proposed Development, the Proponent will liaise with relevant local industry representatives to utilise the full potential of local resources and maximise the benefits to the local economy. This will involve recruiting contractors from the local area where feasible and implementing an informal 'buy local' practice where goods and services are purchased from local businesses, provided that they are competitive in terms of quality and price. Several local businesses have already made themselves and their services known to the Proponent.

Mitigation measures that would reduce risk associated with increased traffic volumes during construction to acceptable levels have been provided in Section7.8.

Mitigation of noise impacts are addressed in Section 7.7. It is concluded that predicted noise levels for the Site will be acceptable with the implementation of standard construction noise mitigation measures. These procedures will also be included in the construction environmental management plan.

Operation and decommissioning

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

7.13 Cumulative Impact

7.13.1 Introduction

Proposed Development is co-located with the SWF and is located within the New England Renewable Energy Precinct. Other renewable energy projects within the New England Renewable Energy Precinct include:

- Glen Innes Wind Farm – approved;
- White Rock Wind Farm – operational;
- White Rock Solar Farm – under construction; and
- Sundown Solar Farm – SEARs issued, EIS under preparation.

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

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

The following sections provides an assessment of potential cumulative impacts associated with SSF

7.13.2 Existing environment

The Site is located north of the Gwydir Highway (B76) approximately halfway between Glen Innes and Inverell. Existing site access is from the Gwydir Highway via Woodstock Road and/or Waterloo Road, and immediate access to site via Waterloo Road and/or the Western Feeder Road.

The location and developmental stage of other developments in the New England Renewable Energy Precinct is provided in Table 7-58 and Table 7-59.

Table 7-58: Nearby renewable energy projects

Project	Distance to SSF	Shared Access with SSF
Sapphire Wind Farm	Co-located	Gwydir Highway, Waterloo Rd, Western Feeder Rd
Glen Innes Wind Fam	15 km	Gwydir Highway
White Rock Wind Farm	12 km	Gwydir Highway
White Rock Solar Farm	10 km	Gwydir Highway
Sundown Solar Farm	8 km	Gwydir Highway

Table 7-59. Development Phase of nearby renewable energy projects

Project	Development phase	Potential overlap with SSF
Sapphire Wind Farm	Construction	Construction of SSF will not commence until construction of SWF is complete. SWF will be operational during the construction of SSF. SWF and SSF will both be operational at the same time

Project	Development phase	Potential overlap with SSF
Glen Innes Wind Farm	Approved	Construction and/or operation of Glen Innes Wind Farm may coincide with construction and/or operation of SSF
White Rock Wind Farm	Operational	Construction of White Rock Wind Farm and SSF will not coincide. Operation of White Rock Wind Farm will coincide with construction and operation of SSF.
White Rock Solar Farm	Construction	Construction and /or operation of White Rock Solar Farm may coincide with construction and/or operation of SSF
Sundown Solar Farm	Planning	Construction of Sundown Solar Farm will not commence until construction of SSF is complete. SSF will be operational during the construction of Sundown Solar Farm. SSF and Sundown Solar Farm will both be operational at the same time

7.13.3 Potential impacts

Potential cumulative impacts with SSF have been considered for each issue assessed as part of the Environmental Assessment. Key potential cumulative impacts are discussed below:

Traffic

Traffic assessment indicated shared access arrangements between SWF and SSF. These access routes have been upgraded to accommodate the construction requirements of SWF and shall be maintained for the duration of SSF construction. It is noted that traffic modelling indicates a reduction in local road traffic volumes associated with the construction of SSF, relative to SWF.

Daily traffic flows recorded on Gwydir Highway are relatively low and well within the capacity of the road leaving ample spare capacity to accommodate additional traffic.

Visual impacts

Cumulative impact assessment undertaken by GBD (2011) indicates that, in the absence of local mitigating factors (i.e. vegetation), wind turbines will be visible from almost all locations assessed as part the current visual impact assessment.

However, wind turbines possess a very different visual presence to PV solar arrays, tending to rise above the existing landscape and to be visible over a far greater distance, whereas solar farms tend to integrate into the landscape and to be visible only within the local setting. Furthermore, wind turbines are typically located on elevated ridgelines, whereas PV arrays require flat areas generally associated with open valleys.

It is anticipated that these disparities in visual characteristics and setting will help to mitigate the potential for cumulative impacts involving the Proposed Development and nearby wind turbine generators. This impact may be further mitigated through the adoption of the identified mitigation strategies.

Based on topography and separation distances it is anticipated that there is limited potential for significant views of the Proposed Development and any other solar farm development. ZVI analyses prepared as part of the Preliminary Environmental Assessment to support an application for SEARs for Sundown Solar indicate

that this development will not be visible from any of the residences or public roads within 5 km of the Proposed Development.

Travellers on the Gwydir Highway may catch distant glimpses of each solar farm as they travel between Inverell and Glen Innes, however, these views will be of only one solar farm at any given time and of short duration.

7.13.4 Mitigation measures

To prevent potential cumulative impacts, construction phases of SWF and SSF shall not overlap.

The combined effect of temporal and spatial separation between SSF and other developments occurring, or proposed to occur, within the New England Renewable Energy Precinct, in conjunction with project specific mitigation measures are considered appropriate to satisfactorily mitigate potential cumulative impacts.

8 Environmental Management

8.1 Environmental Management Plans

Environmental management for the Proposed Development would be undertaken in accordance with appropriate management plans, which would be prepared to provide an overall framework for the management of environmental impacts that could potentially arise as a consequence of the Proposed Development. Mitigation measures identified throughout this EIS and summarised in Section 8.2 would be incorporated into the management plans, which would provide:

- An environmental manual for staff and contractors throughout the construction, operation and decommissioning of the Proposed Development;
- Identification of the potential impacts of the Proposed Development and the measures identified to mitigate these impacts as described in Section 8.2 of this EIS;
- Details of how environmental safeguards are to be implemented;
- Details of the timing of the implementation of the mitigation measures;
- Clearly defined allocations of environmental responsibilities for all staff members and contractors;
- Monitoring and reporting requirements to demonstrate compliance with licensing and approval requirements; and
- Procedures for review and updating of the management plans.

Adherence to the management plans would enable environmental safeguards and mitigation measures to be effectively implemented and sustainable work practices adopted throughout the duration of the Proposed Development.

This would demonstrate the Proponent's intent to comply with conditions of consent, relevant environmental legislation, prevent environmental pollution and minimise the impact of the Proposed Development on the environment.

8.2 Statement of Commitments

A final design of the Proposed Development (Final Layout Plan) would be submitted to DPE prior to the commencement of construction. Based on the final layout, environmental safeguards outlined in this document are to be incorporated into the management plans. Each plan will be prepared prior to each stage of development commencing and submitted to the DPE for approval. The safeguards will minimise any potential adverse impacts arising from the proposed works on the surrounding environment. The safeguards and management measures are summarised in Table 8-1.

Table 8-1: Statement of commitments

Impact	Environmental safeguard	Commitment
Biodiversity	The solar arrays and associated infrastructures is located so as to minimise impacts upon EECs.	The management plans will incorporate a biodiversity management plan that will specify controls to reduce impacts including: ▪ An induction and awareness program for construction workers; ▪ Methodology for a two stage clearing process; ▪ Develop a plan for replanting and vegetation management; ▪ Develop a plan for on-going weed control; and ▪ Monitoring program focusing on on-going impacts, including erosion. The management plans will incorporate erosion and sediment control measures that will include provisions for the: ▪ Installation and maintenance of erosion controls for the duration of the construction phase; ▪ Requirements for regularly inspecting erosion and sediment controls, including maintaining a register; ▪ Machinery to arrive and leave site in a clean condition sediment tracking on sealed roads; ▪ Minimisation of areas to be cleared; ▪ Separation of topsoil and subsoil for stockpiling and the correct placement during backfill;
	Vegetation that is to be removed nearby to retained vegetation will be removed using a chain-saw rather than heavy machinery to avoid any additional impacts on adjacent vegetation.	
	Clearing of vegetation will be undertaken via a two stage clearing process. Clearing will not be undertaken until a pre-clearance assessment is conducted by qualified ecologists. Ecologists will be present for all vegetation clearing. Stage 1 of the clearing process involved marking of habitat features, and removal of all vegetation except habitat features. Stage 2 involves removal of habitat features under the supervision of ecologists to relocate resident fauna. .All clearing staff will be briefed about the two stage clearing process, and their responsibilities to minimise impacts to biodiversity.	
	Other measures to minimise the impacts of the project on biodiversity will be detailed within the CEMP. These measures will include at a minimum: ▪ Temporary fencing to delineate clearing boundaries; ▪ Marking of trees for retention within open areas; ▪ Cleaning of mobile plant prior to works to prevent the spread of weeds and pathogens; ▪ Sediment controls along drainage lines and creeks to prevent impacts downstream; and ▪ Signage within the works area to advise contractors and responsibilities.	
	Installation of sediment barriers, sediment ponds, stormwater management systems, delineation of works zones.	
	Construction works are to occur during standard construction hours to maximise daylight hours. Any request for an out of hours works protocol should address this indirect impact.	

Impact	Environmental safeguard	Commitment
	Temporary fencing to be installed prior to works, to delineate boundaries and protect retained vegetation	▪ Appropriately handling and stockpiling soil to minimise weed infestation and maintain soil structure and microbial activity; and ▪ Protocol to be followed for heavy rainfall event predictions. Weed management strategies will be included in the management plans and include strategies to prevent and minimise the spread of weeds, including: ▪ Management protocols for any declared priority weeds according to the stipulations of the Biosecurity Act; and ▪ Protocols for weed hygiene in relation to plant and machinery entering and leaving the Site, and the importation of fill.
	A weed management plan will be included within the biodiversity management plan for the Infrastructure Footprint which will include cleaning and inspection of light vehicles and mobile plant.	
	A monitoring program will be considered within the BMP to measure infrequent and cumulative impacts of the project. The monitoring program will include baseline data capture to measure any effects of the project over time. Given the low biodiversity values at the Site, the monitoring program should focus on likely ongoing impacts of the development such as erosion.	
	Fences will be placed around key biodiversity areas to prevent rubbish dumping by contractors. Appropriate security measures will also be in place to reduce illegal dumping.	
	Nest boxes will be considered as a measure to minimise impacts to arboreal or avian species. The necessity, number and locations will be resolved during the CEMP process.	
Heritage	*Aboriginal Cultural Heritage*	
	No further archaeological investigations are required in respect of the proposal. No areas were identified that could be characterised as places with a high probability of possessing subsurface Aboriginal objects with high potential conservation value. Accordingly, archaeological test excavation has not been undertaken in respect of the proposal as it could not be justified (cf. NSW DECCW 2010a: 24).	A cultural heritage management plan will be prepared in consultation with the project archaeologist, the registered Aboriginal parties and OEH and incorporated into the relevant management plans following the detailed design of the Proposed Development (post consent). The plan will: ▪ Indicate were avoidance is possible and where impacts are unavoidable ▪ Detail how heritage items and artefacts will be identified and protected during construction;
	It is recommended that additional archaeological assessment is conducted in any areas which are proposed for impacts that have not been surveyed during the current assessment. It is predicted that significant Aboriginal objects can occur anywhere in the landscape and, accordingly, they need to be identified and impact mitigation strategies implemented prior to impacts. The assessment may be conducted by predictive modelling, if appropriate (Note: Up to 100 m allowance for micro-siting has been allowed for in original survey. Additional surveys only necessary beyond this allowance).	

Impact	Environmental safeguard	Commitment
	Personnel involved in the construction and management phases of the project should be trained in procedures to implement recommendations relating to cultural heritage, as necessary.	▪ Include a cultural awareness program for all works developed in consultation with a selection of RAPs; ▪ The few artefacts requiring AHIPs will be managed and re-patriated; ▪ Show buffer and exclusion zones; ▪ Detail procedure for dealing with un-expected archaeological finds; and ▪ Detail the long-term management of protected heritage items.
	Cultural heritage should be included within any environmental audit of impacts proposed to be undertaken during the construction phase of the development	
	The SU13/L1 should be salvaged prior to construction.	
	If the layout changes and impacts are likely, the following artefacts should be salvaged: ▪ SU6/L1; ▪ SU6L2; ▪ SU6/Tree; ▪ SU13/L2; and ▪ SU17/L2.	
	Historic Heritage	
	In the event potential historic heritage items are found during construction activities, works in that area shall cease until an assessment is made by an appropriately qualified archaeologist and OEH has been consulted. Contractors and staff will be advised of this requirement through Site induction and toolbox talks.	A cultural heritage management plan will be prepared and incorporated into the relevant management plans following the detailed design of the Proposed Development (post consent). The plan will: ▪ Indicate were avoidance is possible and where impacts are unavoidable; and ▪ Detail procedure for dealing with un-expected archaeological finds.
Land and Soils	Construction and/or installation of erosion and sediment control structures shall be in accordance with the specifications provided in the Blue Book.	The management plans will incorporate erosion and sediment control measures that will include provisions for the: ▪ Installation and maintenance of erosion controls for the duration of the construction phase; ▪ Requirements for regularly inspecting erosion and sediment controls, including maintaining a register;
	Regular inspection and programmed maintenance of erosion and sedimentation controls will be undertaken and documented in a register of inspections and actions.	
	Cable trenches will be constructed in accordance with relevant regulations and ground conditions. Trenches will be excavated and filled progressively to ensure they are left open for the shortest period possible. Surface conditions will be returned to pre-	

Impact	Environmental safeguard	Commitment
	disturbance conditions and groundcover rehabilitated as soon as practicable to prevent the formation of preferential flow pathways.	▪ Machinery to arrive and leave site in a clean condition to minimise contamination and sediment tracking on sealed roads; ▪ Minimisation of areas to be cleared; ▪ Separation of topsoil and subsoil for stockpiling and the correct placement during backfill; ▪ Appropriately handling and stockpiling soil to minimise weed infestation and maintain soil structure and microbial activity; and ▪ Protocol to be followed for heavy rainfall event predictions. The management plans will incorporate a spill response procedure that will include: ▪ Protocols for the storage of any potential contaminants on site; and ▪ Processes to mitigate any soil contamination that occurs on site, including the emergency response and EPA notification procedures. Weed management strategies will be included in the construction management plan and include strategies to prevent and minimise the spread of weeds, including: ▪ Management protocols for any declared priority weeds according to the stipulations of the Biosecurity Act; and ▪ Protocols for weed hygiene in relation to plant and machinery entering and leaving the Site, and the importation of fill.
	Underground cables will be buried to a depth greater than 500 mm in any land with a cropping history or is identified as land with a capability for cropping.	
	Where practicable, the existing pasture composition will be retained. Where establishment fails in disturbed areas agronomic advice will be sought to determine alternative management options for groundcover to protect soil from erosion in addition to the above erosion measures.	
	Management of erosion generated by traffic shall include a driving code of practice, installation of appropriate drainage controls, inspection and maintenance of unsealed road surfaces and dust management strategies.	
	Appropriate stockpile management to ensure air and water erosion is minimised, soil health, organic matter and structure are retained and weed infestation minimised.	
	Account for climatic events during construction; ▪ If heavy rainfall is predicted the site should be stabilised and works modified to prevent erosion for the duration of the wet period; and ▪ Works methods shall be modified during high wind conditions if excess dust is generated.	
	Where sodic soils are identified in areas to be disturbed by trenching activities, Gypsum shall be applied at a minimum 10t/ha or as guided by soil testing results	
	To avoid release to the environment, all hazardous materials (fuels, lubricants, herbicides, etc.) will be disposed of site in accordance with NSW EPA guidelines.	
	Onsite refuelling shall occur in an area that is located greater than 100 m from the nearest drainage line and within an impervious bunded area.	
	Machinery will be inspected regularly to ensure no oil, fuel or lubricants are leaking from the machinery	

Impact	Environmental safeguard	Commitment
	Potential soil contamination will be managed by the implementation of a spill response procedure.	The management plans will incorporate an air quality management plan that will: ▪ Define designated access and travel routes; ▪ Set onsite speed limits; ▪ Adopt trip management protocols to avoid unnecessary trips e.g. car-pooling for construction staff; ▪ Management protocols for identify, minimise and treat dust emissions; and Development a complaints procedure to promptly identify and respond to issues generating complaints.
	Maintaining access tracks in good condition and ensuring that associated drains and/or sedimentation traps are monitored and maintained will ensure that the potential erosion associated with the tracks is minimised.	
	Maintaining the vegetation cover below the panels will assist in reducing the potential for scouring and erosion.	
	To minimise the potential for erosion in the areas beneath the panels an inspection program following significant rainfall events would implemented and stabilisation works would be undertaken as required.	
	Weed management strategies will be implemented aim at preventing and minimising the spread of weeds to and from, and within the Site.	
	Modify working practices by limiting construction activities during periods of high winds (greater than 20 km/hour).	
	Modify activities if dust is observed leaving the Site towards nearby sensitive receptors.	
	Limit the extent of clearing and excavation.	
	Stage clearing and excavation activities to minimise total areas of cleared ground.	
	Minimise the number and volume of stockpiles on-site and the number of work faces on stockpiles.	
	Implement progressive groundcover rehabilitation and revegetation.	
	All infrastructure, including underground cables to a depth of 500 mm and internal access tracks will be removed upon decommissioning.	
Heritage	*Aboriginal Cultural Heritage*	
	No further archaeological investigations are required in respect of the proposal. No areas were identified that could be characterised as places with a high probability of possessing subsurface Aboriginal objects with high potential conservation value.	A cultural heritage management plan will be prepared in consultation with the project archaeologist, the registered Aboriginal parties and OEH and incorporated into the

Impact	Environmental safeguard	Commitment
	Accordingly, archaeological test excavation has not been undertaken in respect of the proposal as it could not be justified (cf. NSW DECCW 2010a: 24).	relevant management plans following the detailed design of the Proposed Development (post consent). The plan will: ▪ Indicate were avoidance is possible and where impacts are unavoidable ▪ Detail how heritage items and artefacts will be identified and protected during construction; ▪ Include a cultural awareness program for all works developed in consultation with a selection of RAPs; ▪ The few artefacts requiring AHIPs will be managed and re-patriated; ▪ Show buffer and exclusion zones; ▪ Detail procedure for dealing with un-expected archaeological finds; and ▪ Detail the long-term management of protected heritage items.
	It is recommended that additional archaeological assessment is conducted in any areas which are proposed for impacts that have not been surveyed during the current assessment. It is predicted that significant Aboriginal objects can occur anywhere in the landscape and, accordingly, they need to be identified and impact mitigation strategies implemented prior to impacts. The assessment may be conducted by predictive modelling, if appropriate (Note: Up to 100 m allowance for micro-siting has been allowed for in original survey. Additional surveys only necessary beyond this allowance).	
	Personnel involved in the construction and management phases of the project should be trained in procedures to implement recommendations relating to cultural heritage, as necessary.	
	Cultural heritage should be included within any environmental audit of impacts proposed to be undertaken during the construction phase of the development	
	The SU13/L1 should be salvaged prior to construction.	
	If the layout changes and impacts are likely, the following artefacts should be salvaged: ▪ SU6/L1; ▪ SU6L2; ▪ SU6/Tree; ▪ SU13/L2; and ▪ SU17/L2.	
	Historic Heritage	
	In the event potential historic heritage items are found during construction activities, works in that area shall cease until an assessment is made by an appropriately qualified archaeologist and OEH has been consulted. Contractors and staff will be advised of this requirement through Site induction and toolbox talks.	A cultural heritage management plan will be prepared and incorporated into the relevant management plans following the detailed design of the Proposed Development (post consent). The plan will: ▪ Indicate were avoidance is possible and where impacts are unavoidable; and

Impact	Environmental safeguard	Commitment
		▪ Detail procedure for dealing with un-expected archaeological finds.
Visual amenity	Minimise vegetation clearing and earthworks and rehabilitate bare earth progressively.	The need for landscaping plans will be guided by ongoing consultation with Council and landholders and shall be determined post construction based on actual visual impacts at R019 and R030, and Waterloo Road. These plans will include: ▪ Need for request for screening commensurate with the impact; ▪ Evaluation of local endemic species selection; ▪ Preparation of a vegetation buffer; and ▪ Procedures to follow if planting fails or does not achieve objectives, including alternative species.
	Post-construction, consult with Council regarding the benefits associated with a vegetation buffer to help screen views and reflections from Waterloo Road.	
	Continued consultation with landholders at R019 and R030 will be undertaken to identify, where possible, the location of mutually agreeable vegetation screening both pre and post construction.	
	Use muted, low contrast colours for all supporting infrastructure, so that they blend into the landscape as far as possible.	
	Select infrastructure to minimise potential for reflectivity and glare.	
	As designed, maintain locations of proposed battery facilities away from visual receptors and apply visual screening if necessary.	
	Minimise night lighting to the support buildings area.	
Noise and Vibration	Where practicable, use mobile noise barriers/enclosures during certain construction work, such as around stationary work activities and plant.	The relevant management plan will incorporate a construction noise and vibration management plan that will: ▪ Define hours of work in accordance with construction noise guidelines; ▪ Specify the requirement for noise management and selection of mobile plant; ▪ Include noise awareness training and induction for workers; ▪ Consider adverse weather conditions; ▪ Detail communication with the community as required;
	Informing and consulting residents and interested parties, as far as practicable, regarding impending or current events that may cause high levels of noise and how long they are expected to take. This may take the form of letter drops, or community notices.	
	Provide a complaints telephone number prominently displayed where the works are taking place and on any letter drops or community notices.	
	Respite hours agreed with residents when noisy works will not take place if necessary.	
	Investigate complaints when received to establish the cause, and where possible implement a corrective action such as, provide a respite period or other practical measure.	

Impact	Environmental safeguard	Commitment
	Minimising the operating noise of machinery brought on to the Site.	▪ Be used as a working document on-site by contractors and subcontractors to ensure everyone is aware of their responsibilities; and ▪ Development of combined noise management agreement in conjunction with neighbouring renewable projects should construction overlap.
	Where appropriate, obtaining acoustic test certificates for machinery brought on to the Site.	
	Undertake noise monitoring at the start of a new noisy activity so noise levels can be investigated should a complaint be received.	
	If there is excessive noise from any process, that process will be stopped and if possible that noise attenuated to acceptable levels. Where there is no alternative the process will be rescheduled to non-sensitive hours.	
	Ensuring that plant is not left idling when not in use.	
	Ensuring that plant is well maintained and in good working order and not causing unnecessary noise, such as damaged mufflers on plant, and ensuring plant is not left idling when not in use.	
	All access hatches for plant to be kept closed.	
	Where residential dwellings are located within 100 m of construction works and a 10 tonne vibratory/foot roller is expected to be used, it is recommended a smaller vibratory/foot roller that suits the buffer distance is used.	
	Driver actions and behaviours to minimise traffic noise impacts will be included in the traffic management plan.	
	Site inductions will include traffic management requirements relating to noise mitigation.	
	Designated on-site parking areas will be located away from NSRs and car-pooling will be encouraged.	
	The operator will maintain effective relationships with NSRs and work in a proactive manner to minimise operational noise impacts.	
Traffic and Transport	To prevent cumulative impacts, the construction phases of SWF and SSF shall not overlap.	The construction environmental management plan will incorporate a traffic management plan that will detail:

Impact	Environmental safeguard	Commitment
		▪ All site access for construction workers and delivery vehicles; ▪ Any temporary road safety requirements during the construction; ▪ All permanent road safety requirements; ▪ Carpooling arrangements to minimise vehicle numbers during construction; ▪ Procedures to monitor traffic impacts and adapt controls as required; ▪ How inspections and regular safety checks will be completed; and ▪ Include a code of conduct for transport drivers to and from site.
Water Resources	As a result of a design philosophy that, in the first instance, seeks to avoid impacts, the following environmental protections apply: o Exclusion of 3rd order and higher streams from the Development Footprint (except internal access across Kings Plains Creek); o Application of a 30 m (from stream centreline) buffer zone for 3rd order and higher riparian zones; o Avoidance of footings and pilings within 1st and 2nd drainage lines where practicable; o Minimisation of creek crossings for within site access and electrical cabling; o Sourcing of non-potable, construction and operational water from rainwater tanks and existing farm dams; o Sourcing from offsite all potable water requirements.	The environmental management plans will incorporate an Erosion and Sediment Control Management that will include provisions for the: ▪ Installation and maintenance of erosion controls for the duration of the construction phase; ▪ Requirements for regularly inspecting erosion and sediment controls, including maintaining a register; ▪ Machinery to arrive and leave site in a clean condition to minimise contamination and sediment tracking on sealed roads; ▪ Separation of topsoil and subsoil for stockpiling and the correct placement during backfill; ▪ Appropriately handling and stockpiling soil to minimise weed infestation and maintain soil structure and microbial activity;
	To avoid release to the environment, all hazardous materials (fuels, lubricants, herbicides, etc.) will be disposed of offsite in accordance with EPA guidelines.	

Impact	Environmental safeguard	Commitment
	Onsite refuelling shall occur in an area that is located greater than 100 m from the nearest drainage line and within an impervious bunded area.	▪ Minimisation of areas to be cleared; and ▪ Protocol to be followed for heavy rainfall event predictions. The environmental management plans will incorporate a spill response procedure that will include: ▪ Protocols for the storage of any potential contaminants on site; and ▪ Processes to mitigate any soil contamination that occurs on site, including the emergency response and EPA notification procedures. The operation environmental management plan will assess and identify appropriate operational protocols to ensure the: ▪ Protection of surface and groundwater quality; ▪ Maintenance of water supplies and rights of access; and ▪ Maintenance and protection of riparian, aquatic and groundwater dependent ecosystems.
	Machinery will be inspected daily to ensure no oil, fuel or lubricants are leaking from the machinery.	
	All contractors and staff will participate in toolbox talks to prevent, minimise and manage accidental spill, and be trained regarding appropriate spill response strategies.	
	All hazardous materials will be classified and appropriately stored away from any flood prone areas and drainage lines	
	Activities with the potential for adverse water quality impacts would be managed through the development of site specific sediment control plans and spill controls.	
	Establish and maintain groundcover across the Site. Groundcover species selection and management will balance grazing and bushfire management objectives to avoid build-up of combustible material.	
	Access tracks will be maintained in good condition, ensuring associated drains and sedimentation traps are monitored to ensure effectiveness is maintained.	
	Culverts on Kings Plains Creek will be designed as per the *Policy and Guidelines for Fish Friendly Waterway Crossings* (NSW DPI 2004) and *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge 2003).	
	Installation of cables across Kings Plains Creek will follow relevant design considerations as per the NSW Office of Water's *Controlled Activities: Guidelines for laying pipes and cables in watercourses.*	
	Potable water will be sourced off-site, via registered water suppliers. Non-potable construction water requirements will be sourced either off-site or from existing farm dams within the lease area. Rainwater tanks installed to support buildings provide an additional source of non-potable construction water and a climate independent firefighting source.	
	The Proponent will source no more than 10% of the total surface water from existing surface water dams located within the Site.	

Impact	Environmental safeguard	Commitment
	Installation of cables across Kings Plains Creek will follow relevant design considerations as per the NSW Office of Water's *Controlled Activities: Guidelines for laying pipes and cables in watercourses.*	
	Solar arrays will be designed and installed so as to not impede overland flow.	
	Construction and operational structures will not be located within flood prone land.	
Hazards and Risks	Battery storage containers will be separated by the minimum distance specified by the supplier. If no distance is specified, containers will be installed with a 2 m minimum clearance on all sides.	The emergency response procedure will: ▪ Detail the mitigation of and response to electrical and bush fires; and ▪ Be provided to NSW Rural Fire Service and NSW Fire and Rescue. The management plans will provide safety protocols, including but not limited to: ▪ Basic training of all staff in the use of firefighting equipment on site; ▪ Firefighting equipment lists will be detailed in the Work Method Statements; ▪ Management procedures for hot works, smoking, vehicle use off formal access tracks, and the use and storage of fuel and flammable chemicals; and ▪ Daily monitoring of the Fire Danger Rating, and communication of any further mitigation measures required to all staff and contractors. A health and safety plan will be developed in accordance with the *Work Health and Safety Act 2011* and incorporated into the management plans. The plan will include details relating to exposure limits to EMFs for
	Establish a 20 m buffer groundcover of non-combustible material (e.g. gravel) surrounding the battery system. This area will be fenced to prevent unauthorised access and animal ingress.	
	Grassland surrounding the battery storage containers will be kept well grazed/slashed to a distance of 200 m.	
	A pressure release valve will be installed in each container to direct an explosion to a designated space/direction.	
	A HVAC system capable of air cycling in addition to thermal control will be installed in each container.	
	Where practicable, a redundant HVAC system as backup in addition to back up power will be installed in each container.	
	A variety of additional BMS/Control System solutions to reduce electrical abuse that leads to gassing of battery cell and to reduce thermal runaway events will be implemented.	
	Appropriate physical overcharge protection e.g. breakers) will be installed at system, rack, battery and cell level.	
	Clear operating procedures are to be provided to maintenance staff and fire fighters	
	Water incursion will be prevented with an appropriate IP rated container.	

Impact	Environmental safeguard	Commitment
	Humidity build up will be prevented with appropriate HVAC selection and if required a humidifier.	contractors and staff working on the substation, inverters and within vicinity of the overhead transmission lines.
	Subject to detailed design, consideration should be given to separating the DC cable running from the battery units back to the first overcharge circuit breaker to prevent escalation in case of short circuit.	
	A fire suppression system will be installed in each battery storage facility.	
	Gas sensors will be installed in each facility to protect maintenance staff.	
	Battery racking will appropriate for the battery pack and certified, and install in accordance with supplier specification and installation standards.	
	Bund crash walls will be constructed between access roads and battery storage containers.	
	Battery system specific maintenance and fire fighting training will be provided to maintenance workers to reduce the risks associated with toxic liquid, flammable liquid, fire, toxic gas and crush hazards.	
	Undertake a Bushfire Risk Assessment and develop a bushfire management plan prior to commencing construction activities to manage site specific risks.	
	Electrical equipment selected for the 25 year life span of the Proposed Development would be designed to minimise potential for ignition and certified to comply with relevant Australian Standards.	
	Chemical storage will be in accordance with MSDS requirements and consider potential fire hazards (the use of fire cupboards for storage of chemicals.	
	A 20,000 litre water tank will be provided in the support buildings area for the sole use of fire protection in line with the RFS standards.	

Impact	Environmental safeguard	Commitment
	Appropriate emergency vehicle access will be provided across the entire site, including access to inverters and between the rows of the solar array. This will be designed and constructed in compliance with RSF standards.	
	The fuel load across the Proposed Development will be monitored, and will be mechanically slashed, grazed or ploughed to reduce the risk of a grass fires starting within the Site and ensuring that fires originating from outside the Site do not intensify as a consequence of entering the site.	
	Asset protection zones would also be designed and maintained around buildings and infrastructure to reduce the risk of fuel loads building up around sensitive assets	
	An emergency response plan will be prepared and provided to the RFS and Fire and Rescue NSW.	
	In limiting exposure to EMFs, following advice from the International Commission on Non-Ionizing Radiation Protection, priority will be given to engineering and access controls (ICNIRP, 2010). This means that: o The final design of the Proposed Development would be undertaken by qualified and competent persons; o Design would meet relevant Australian standards, ensuring EMFs would be minimised as far as possible; and o Access to electrical equipment would be limited to qualified personnel only.	
	To reduce the potential for chronic or acute exposure to EMFs, no unsupervised public access to the Proposed Development would be permitted.	
	The landholder or its employees would not have access to the substation or inverters.	
	Electrical equipment commissioned as part of the Proposed Development would be designed to reduce possible interference in line with Australian Standards.	
Waste and resource use	To encourage the efficient use of resources, reduce costs and environmental impacts, waste will be managed according to the following hierarchy: 1. Reduce waste production;	A waste management plan will be prepared and included in the relevant environmental management plans, and will provide:

Impact	Environmental safeguard	Commitment
	2. Recover resources (including reuse, reprocessing, recycling and energy recovery); and 3. Dispose of waste appropriately.	▪ Protocols to identify opportunities to follow the waste hierarchy - to ensure that waste is minimised, recovered, and disposed of appropriately, and also to ensure a culture of responsible waste management is upheld by staff; ▪ Quantification, classification, and tracking of all waste streams - to encourage waste reduction and minimise inter-contamination of waste streams; ▪ Controls on the disposal methods of all waste streams; ▪ Provision of recycling facilities onsite to reduce waste streams; ▪ Provision of a dedicated waste management area onsite; and ▪ Protocols on the transportation of waste, for example covered loads.
	Wastes will be classified in accordance with the NSW Environment Protection Authority (EPA) *Waste Classification Guidelines – Part 1: classifying waste* (EPA 2014) and *addendum* (EPA 2016), and disposed of lawfully at a licensed waste facility.	
	Opportunities for recycling will be investigated during both the construction and decommissioning phases.	
Socio-economic	Continued consultation with the community and relevant stakeholders during the construction phase.	Prepare and implement a Community Engagement Plan (CEP) that will include the protocols to: ▪ Update the community on project progress; ▪ Update relevant stakeholders of the timing of any potentially adverse impacts; and ▪ Resolved any complaints received. Require EPC company to ensure local contractors/suppliers/workers are provided with timely information regarding potential opportunities.
	Construction staff, where possible, are recruited from local areas.	
	An informal 'buy local' practice applies, where goods and services are purchased from local businesses provided that they are competitive in terms of quality and price.	
	The Proponent and eventual EPC company will liaise with the local tourism industry to minimise any potential conflicts arising from demand for accommodation and related services.	

9 Project Justification

9.1 Introduction

As a conclusion to the environmental assessment, the construction, operation and decommissioning of the Proposed Development is evaluated and justified through the consideration of its potential impacts against triple-bottom-line considerations (environment/community/economics) and its potential benefits to the local, regional and NSW community.

9.2 Residual environmental risks and impacts

The *Australian New Zealand Risk Management Standard (AS/NZS ISO 31000:2009*) defines risk management as the "*coordinated activities to direct and control an organisation with regard to risk*" (Standards Australia 2009). Risk arises in all aspects of the project life cycle and offers both opportunity and threat, and must therefore be managed appropriately. Risk management involves establishing an appropriate risk management culture, and applying logical and systematic risk management processes to all stages in the life cycle of any activity, function or operation.

This EIS adopts an environmental impact assessment methodology aligned to the *AS/NZS ISO 31000:2009* standard:

- Potential risks (environmental impacts) have been identified through the Environmental Assessment (Section 7);
- Strategies and actions are identified to mitigate the impact of the risk (Section 7);
- An assessment is made of the likelihood of the risk occurring and the consequence if the risk were to occur:
    - the likelihood of the risk occurring is described as *very unlikely, unlikely*, *possible*, *likely*, or *almost certain* to occur; and
    - the consequences or potential impact if the risk event occurred are described as *minor*, *major, severe, critical* or *catastrophic*.

The risk matrix below (Table 9-1) determines a risk rating of low, medium, high or extreme.

Table 9-1: Residual environmental risk assessment

Risk Assessment Matrix		Consequence				
Likelihood		Minor	Major	Severe	Critical	Catastrophic
		A	B	C	D	E
Very Unlikely	1	Low	Low	Medium	Medium	Medium
Unlikely	2	Low	Low	Medium	Medium	High
Possible	3	Low	Medium	High	High	High
Likely	4	Medium	Medium	High	High	Extreme
Almost Certain	5	Medium	High	High	Extreme	Extreme

In each case the likelihood and consequence is independently assessed in order to assign a mitigate risk score (Table 9-2).

Table 9-2: Residual risks for all impacts identified in the environmental assessment

Factor	Receptor	Potential Impact	Mitigated Likelihood	Mitigated Consequence	Mitigated Risk
Biodiversity	Plant communities	Disturbance/loss of habitat	5	A	Medium
	Flora and fauna	Injury and mortality	2	A	Low
	Terrestrial and aquatic	Introduction/spread of weeds	2	A	Low
		Introduction/spread of pests	2	A	Low
		Sedimentation and erosion	2	A	Low
		Soil and water pollution	2	A	Low
		Indirect impacts of proposal e.g. light, noise, dust	2	A	Low
Heritage	Aboriginal heritage	Impacts on mitigated artefacts/values	1	B	Low
		Impacts on unmitigated artefacts/values	3	A	Low
		Impacts on unknown artefacts/values	2	B	Low
	Historic heritage	Impacts on known artefacts/values	1	A	Low
		Impacts on unknown artefacts/values	1	A	Low
Land resources	Proposed Development site	Disturbance and erosion of soils and productive topsoil	2	A	Low
		Soil compaction leading to concentrated runoff and erosion	2	A	Low
		Soil contamination due to spills	2	A	Low
		Introduction/spread of weeds	2	A	Low

Factor	Receptor	Potential Impact	Mitigated Likelihood	Mitigated Consequence	Mitigated Risk
	Nearby properties	Reduced agricultural viability	1	A	Low
		Dust deposition	2	A	Low
Visual amenity	Landscape	Altered landscape character	3	A	Low
	Nearby residences	Reduction in visual amenity	3	A	Low
	Adjoining landscape	Reduction in visual amenity	2	B	Low
Noise	Nearby residences	Nuisance noise levels during construction	3	A	Low
		Nuisance noise levels during operation	2	A	Low
	Adjoining environment	Disturbance	3	A	Low
Traffic and transport	Existing road network	Significant increase in traffic volumes	2	A	Low
		Increased traffic risks and/or reduced safety	1	D	Medium
Water resources	Surface water	Degradation of water quality	2	A	Low
		Reduction in water quantity	1	A	Low
		Flooding	2	A	Low
	Groundwater	Degradation of water quality	1	A	Low
		Reduction in water quantity	1	A	Low
	Aquatic Ecosystems	Direct Impacts	2	A	Low
		Indirect Impacts	2	A	Low
Hazard and risks	Development Footprint	Bushfire Fire and Electrical Fire	1	A	Low
	Adjoining environment	Electromagnetic interference	1	A	Low
Waste management		Contamination of land and water	1	B	Low

Factor	Receptor	Potential Impact	Mitigated Likelihood	Mitigated Consequence	Mitigated Risk
	Development site and adjoining areas	Resource wastage	2	A	Low
		Human and environmental health	2	B	Low
Socio-economic	Nearby properties	Altered property values	2	A	Low
	Local community	Reduced economic activity	1	B	Low

Most residual risks are assessed as low (Table 8-2). Medium residual risks are discussed below:

- Biodiversity – Clearing of native vegetation will be offset in accordance with the strategies outlined within the BOS;
- Traffic – The Proposed Development is considered highly unlikely to increase the likelihood of vehicular accidents, however, the potential for fatalities remains;

Based on these findings, environmental impacts associated with the construction, operation and decommissioning of the Proposed Development are compliant with the requirements for SSD under the *State Environmental Planning Policy (State and Regional Development) 2011* and Division 4.1 of the EP&A Act. Therefore, environmental impacts associated with the construction, operation and decommissioning of the Proposed Development, with the implementation of the mitigation strategies and management plans identified within this EIS, are deemed acceptable.

9.3 Ecologically Sustainable Development

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

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

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

Precautionary principle

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

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

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

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

- Potential impacts were assessed assuming the use of larger footprint areas than will ultimately be developed;
- Where potential threats to the environment have been identified, mitigation measures have been developed to minimise such impacts; and
- Monitoring will be undertaken, if required, as a precautionary measure to reduce the effect of any uncertainty regarding the potential for environmental damage.

Social equity in inter-generational equity

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

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

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

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

Conservation of biological diversity and maintenance of ecological integrity

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

The Proposed Development would require the clearing of up to 104.1 ha of native vegetation. This clearing has been assessed in Section 7.2 and, given its environmental context shall be fully offset in the proposed BioBanking Offset Strategy developed in accordance with the requirements of the Framework for Biodiversity Assessment methodology.

Areas of higher conservation value have been avoided during the evolution of the project design where possible, and where identified impacts are unavoidable these will be managed by the implementation of mitigation measures and ecosystem credits. At the conclusion of the 55 year development approval, the Proposed Development shall be fully decommissioned and rehabilitated.

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

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

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

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

9.4 Justification/need for the Proposal

9.4.1 Socio-economic

The construction and ongoing operation of the Proposed Development will have significant social and economic benefits to the local community and provide environmental benefits to the broader community.

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

The Proposed Development will provide income for the region through capital expenditure, the provision of wages and predicted flow-on benefits. There will be up to 10 full time operators stationed on site during the operational phase.
The environmental benefits of developing renewable energy sources and transitioning to a low carbon future are manifest, providing potential benefits to the entire community and helping to maintain quality of life.

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

9.4.2 Demand for products

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

Electricity supply from renewable sources currently provides 15% of the Australian electricity market (Department of the Environment and Energy, 2017), this is expected to grow to 23.5% by 2020 under the Australian Government's RET scheme.

9.5 Project Alternatives

9.5.1 Alternative land use

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

- Co-locating and sharing infrastructure with SWF;
- Designing and locating the Proposed Development in order to minimise impacts on biodiversity, native vegetation and the need for clearing; and
- Identifying environmental constraints associated with the Development Footprint and developing mitigation strategies to avoid or minimise impacts

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

9.5.2 Development of an alternative site

The co-location with SWF and design optimisation process has been fully documented and the outcomes of the environmental assessment indicate the suitability of the Site for the Proposed Development.

Developing an alternative site would likely have greater environmental impacts than the current proposal and would forgo connection to the existing capacity within the local electricity network.

9.5.3 Do Nothing

The "do nothing" option would negate all potential environmental impacts associated with the Proposed Development, but would forgo all environmental benefits associated with the project, such as:

- Access to renewable energy sources;
- Progress towards RETs and national and international carbon reduction commitments;
- Economic and social benefits to the community; and
- Biodiversity offsets protected in perpetuity.

10 Conclusion

The proposed utility-scale photovoltaic solar farm with battery storage is located at Kings Plains, within the Inverell Shire Local Government Area (LGA) 30 km east of Inverell in northern NSW. The Proposed Development would have an electricity generation capacity of approximately 180 megawatts (MW_{AC}) at the point of connection, producing enough energy (370 GWh) to power the equivalent of 66,000 average NSW households each year. Moreover, the addition of battery-based storage (c.100 MWh) will allow for the Proposed Development (along with the Sapphire Wind Farm (SWF)) to dispatch scheduled and reliable renewable energy generated power to the National Electricity Market (the NEM).

The Proposed Development is recognised as State Significant Development and is subject to assessment under Division 4.1 of the EP&A Act. This EIS has examined and taken into account all matters affecting or likely to impact the environment by reason of the Proposed Development, including consideration of Commonwealth EPBC Act listed Matters of National Environmental Significance.

Information about the Proposed Development has been extensively shared with local communities through a variety of consultation approaches. Issues raised during the community consultation process have been addressed through the evolution of the design.

Potential environmental impacts associated with the Proposed Development have been first avoided, and then reduced during the concept development process. In the absence of mitigation the Proposed Development would result in some impacts on biodiversity via vegetation clearing, soil and water via erosion, noise, visual amenity, dust and traffic via increased vehicle movements

Mitigation measures as detailed in this EIS would ameliorate or minimise these expected impacts to acceptable levels. The Proposed Development would also provide a number of employment opportunities and benefits to the local economy, while reducing carbon emissions by displacing up to 330,000 tonnes of CO_2 annually (Based on current NSW emission figures of 0.87 kg of CO_2-equivilent per kWh), and providing progress towards national and international environmental commitments.

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

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