9.2 WATER USE AND WATER QUALITY

9.2.1 Existing environment

Water use requirements

The Proposal Site is located in an area subject to the following water sharing plans:

- Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Source
- Water Sharing Plan for the Lachlan Regulated River Water Source.

Any requirement for additional groundwater or surface water entitlement would be obtained through purchase and trade in accordance with these plans. Water entitlements within the locality are held by JIL. This private corporation holds a Water Supply Work Approval and Water Use Approval licence under the *Water Management Act 2000.*

Up to 3.4 megalitres (ML) of non-potable water would be required during construction, namely for dust suppression and construction activities, but also for cleaning, on-site amenities and establishing landscaping. A proportion of this water may be sourced from a Jemalong Station bore located southeast of the Proposal Site. The water supply channel runs along the southern boundary of the Proposal Site, as such, a portion of the channel could be used a retention pond for road wetting water, and water trucks would be able to directly pump the water from the Proposal Site.

The water allocation for this bore is 1,000ML and is licensed to Twynam Pastoral Co Pty Ltd. Access to the bore water would require consultation with Office of Environment and Heritage (OEH). No new water entitlements or licences would be required.

Should bore water be unavailable and channel source water not be available for procurement, bulk water tankers would be used to supply non-potable water to site.

A small amount of potable (drinking) water (approximately 0.09 ML) would be imported to the site during the construction period.

During operation up to 250KL per year would be required for cleaning, likely sourced from collected rainwater, or bore water from adjacent paddocks, if water quality meets PV panel maintenance guidelines. Water for animal care (such as sheep grazing on site) and landscaping would be sourced from irrigation channels at present under the landowner's farm rights. A steel or concrete tank would be installed at the site to store water for bushfire protection and other non-potable water uses, with a minimum of 20,000 litres reserved for fire-fighting purposes.

Potable water would be required for staff using imported supplies or rain water collected from tanks beside site buildings.

Water resources and quality

The proposal is located in the Central West Local Land Services (formerly Lachlan Catchment Management Authority). The site is within the floodplain of the Lachlan River, which is located approximately 3.7 km to the north of the proposal. Thurumbidgee Lagoon is the closest waterway to the site, located approximately 400 m to the north of the Proposal Site. Other irrigation channels and canals are located in the area, supplying water to agricultural properties.

Thurumbidgee Lagoon is approximately 3 km long spanning east to west. The lagoon size varies substantially with rainfall. It is shallow lagoon and intermittently filled after moderate to heavy or prolonged rainfall. There are no drainage lines or other waterways that enter the lagoon, therefore

Strahler System is not applicable. During the site inspection, the western end of the lagoon retained ponds only and even these would be considered to dry up during drier periods. The eastern end was shallower in character and dry (Plate 9-1and Plate 9-2)

Thurumbidgee Lagoon has a history of being used for agriculture with the removal of vegetation and grazing within the lagoon. The water quality within the lagoon is expected to vary with the amount of water, being poor as it becomes shallower and receives runoff from agricultural activities (expected to contain fertilizers and pesticides).

Plate 9-1 Western end of Thurumbidgee Lagoon (NGH Environmental, 2014)

Plate 9-2 Eastern end of Thurumbidgee Lagoon (NGH Environmental, 2014)

Groundwater

There are a number of bores within the local area, and one specifically within the Proposal Site, near the Hallidays Farm House (refer to Figure 9-1). No new bores are currently proposed as part of the solar plant proposal.

The soil and Groundwater survey conducted by ARUP (refer section 9.1), included drilling of two bores at the Proposal Site (Refer to Appendix I for test bore locations). Encountered groundwater levels were between 7m and 10m, such levels are not unexpected given the proximity of the site to a lagoon and the Proposal Site being within a flood plain.

Table 9-3: Encountered depths of groundwater

Location ID	**Groundwater Type**	**Depth (mbgl)**	**Reduced Level (m AHD)**
BH101	Ingress	7.0	208.1
BH101	Standing level in standpipe	5.9	209.2
BH102	Ingress	10.0	206.9

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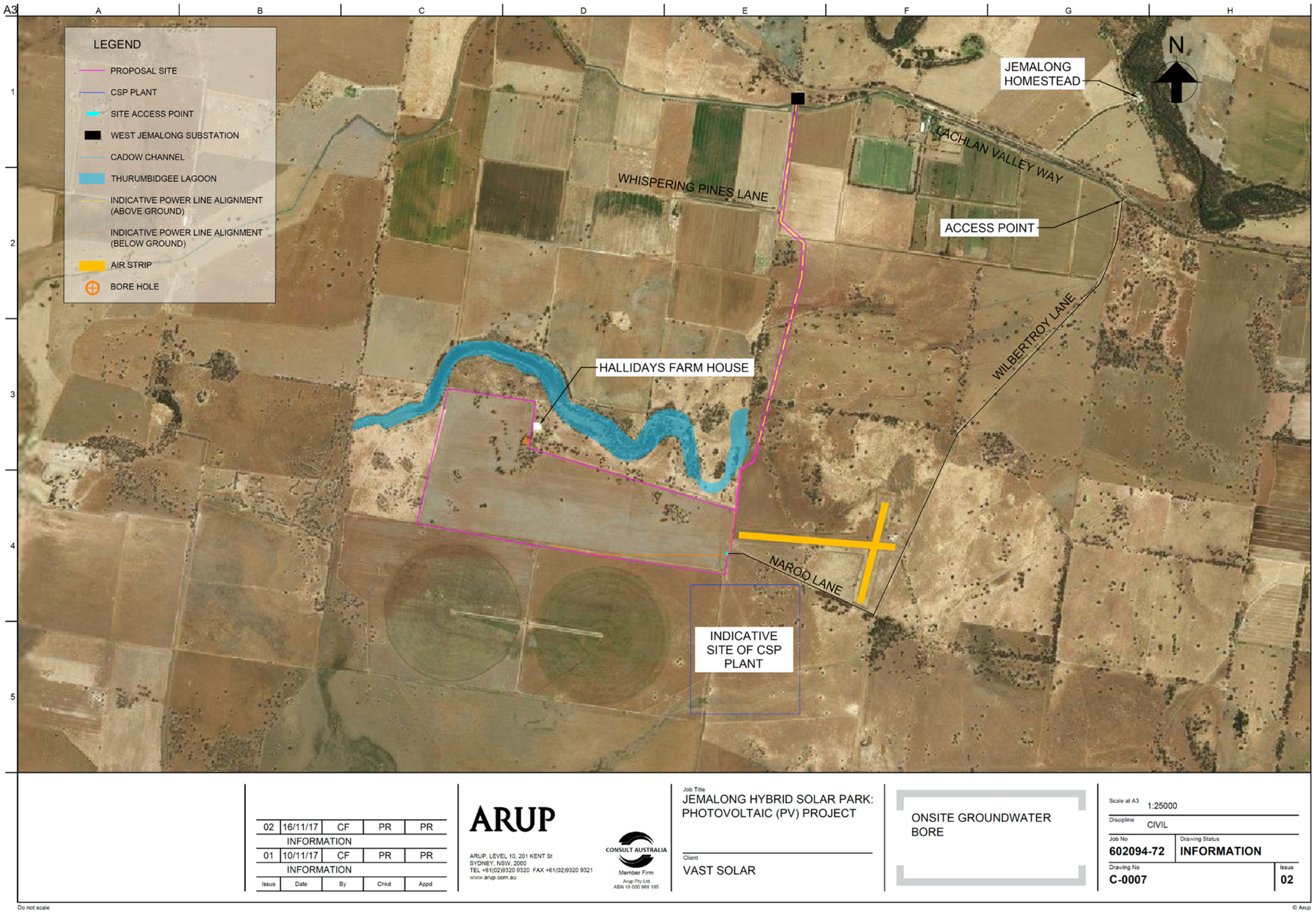


Figure 9-1 On-Site Groundwater bore

9.2.2 Potential impacts

Construction and decommissioning

Water use

Water usage during construction would be minimal, about 3.4 ML mainly for road bed preparation and dust suppression on unsealed roads. This water requirement is likely to vary depending on weather conditions. It is not proposed that concrete batching would be undertaken onsite.

This water is proposed to be sourced from a bore adjacent to the Proposal Site, with an allocation of 1,000ML, which is part of the existing 33,000 ML per annum Twynam Pastoral Co Pty Ltd allocation. Twynam Pastoral Co Pty Ltd are involved in the proposal.

Under normal conditions, there would be no stresses on the supply. During drought conditions water use may increase slightly, particularly with increased requirement for dust management. However there is unlikely to be material impact on the aquifer which is the source of the Twynam Pastoral Co Pty Ltd supply. Given the construction period of 12 months and minimal water use required for construction, this is considered low risk. Chemical dust suppression can be used as an alternative to water trucks if required, but is not preferred by the proponent. In the event on-site water supply is insufficient during construction, water access can be secured through commercial arrangements with local water supply authorities.

Impacts on water use during decommissioning would be similar to those during constructed. They are considered low risk and manageable.

Pollution control measures provided in Section 9.1 and the proposal would generally comply with the requirements of Jemalong Station's Environmental Protection License (EPL) 5102.

Water quality

Construction activities at the site have minimal potential to degrade the water quality of Thurumbidgee Lagoon as the substation and associated facilities, which are sites of the main earthworks are downstream of the Lagoon. The disturbance of soils in the western part of the solar array area has some potential for sediment runoff to enter the lagoon. This has potential to occur from the following activities:

- Excavation of trenches for electrical cables
- Minor upgrades to unsealed access roads
- Post driving for steel posts of PV modules, installation of power poles and fencing
- Hydrocarbon spill risk from use and re-fuelling of construction vehicles and machinery
- Storage and use of paints, cleaning solvents and other chemicals
- Pesticide storage and use for pest plant and animal control
- Escape of fertilisers used for revegetation
- Runoff from waste materials.

However, the areas of disturbance would be small and sparsely distributed, and the surrounding groundcover would be retained, helping maintain sediments onsite. These risks are considered minimal and manageable with standard sediment and erosion control safeguards.

The use of fuels and other chemicals on site pose a risk of surface or groundwater contamination in the event of a spill. Chemicals used onsite would include solvents, fuels, lubricants (the majority by volume of

which will be contained within the utilities buildings) and limited herbicides. Contamination and spill risks would be managed using best practice and mitigation measures coordinated through the CEMP.

Groundwater

Considering the relatively shallow depth of local groundwater, local groundwater resources could be impacted by excavation at depth. Minimal excavation is proposed for slab footings, and the limited excavation depths involved in the PV Plant proposal (up to 2.4m) would avoid physical impacts to the groundwater resource. Similarity, contamination of groundwater would be highly unlikely given that chemicals and fuels would be appropriately stored, and spills procedures would be implemented (spill management is discussed in Section 9-1).

Subject to the implementation of the Blue Book measures and additional safeguards presented in section 9.1 and Table 9 4, the proposed works are not considered likely to significantly affect surface water quality at or downstream of the site, or groundwater quality in the shallow aquifer under the site.

Clearing of trees can impact on groundwater; saline groundwater can move up through the soil profile if there is a reduction in water uptake and transpiration by trees in the landscape, exacerbating salinity impacts. The clearing proposed during construction is very minor in this context. Most trees can be retained by the proposal. No operational impacts would affect groundwater at the site.

As the Proposal would not be altering the existing groundwater supplies within the solar plant site, it is considered that no impacts to Groundwater Dependent Ecosystems (GDE) would result from the Proposal. Additionally, it is noted that there are no High Priority GDEs as listed on Schedule 4 of the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Source 2012* regulation in proximity to the Proposal Site.

Impacts on groundwater during commissioning would be similar to those during construction. They are considered low risk.

Operation

Water use

Water use volumes during operation would be minimal. Requirements include:

- Staff amenities for up to four people at the control and maintenance building
- Cleaning of PV modules.

It is expected the total water requirement during operation, would be less than 250KL per annum. The water would be supplied from a 220 kL rainwater tank. Bore water from adjacent paddocks would also be sourced under existing water licences held by Twynam Pastoral Co Pty Ltd. This would be sufficient to the meet the projects water requirements during operation.

Water quality

Operation phase risks to hydrological values and water quality include:

- storage and use of hydrocarbons and other chemicals (pesticides, cleaning solvents, paints)
- increased runoff from impermeable surfaces (tracks, carparks, hardstand areas)
- spill risk from the substation (if oil-cooled).

There would be increased localised runoff from impermeable surfaces created at the site, including tracks, parking areas and hardstands surrounding facilities. Drainage from these structures would be

managed to prevent long distance or concentrated flows, and to discharge onto adjacent well developed groundcover vegetation. The increased runoff from these surfaces is likely to be offset by the enhanced infiltration and landscape function resulting from the establishment of perennial groundcover over the site.

No negative impacts to water quality in the lagoon or any downstream watercourses, wetlands, GDE's and Inflow Dependent Ecosystems are expected to result from the operation of the PV Plant.

The application of best practice and the mitigation measures provided in section and Table 9-4 would be adequate to manage risks to water values in the study area. Minimal operational impacts to water quality would occur. The proposal is likely to have a positive effect on the local groundwater table by reducing the amount of irrigation and water influx from sources other than precipitation (McMahon Earth Science 2017).

The impact of the proposal on flood risk in addressed in section 8-4.

Groundwater

No operational impacts would affect groundwater at the site.

Operational risks to water resources are considered highly manageable.

9.2.3 Mitigation measures

Mitigation measures to avoid and minimise impacts to water use and water quality are provided in Table 9-4 below. Many of the measures identified for soil protection in section 9.1 are also relevant for the protection of water values, and are not repeated here.

Table 9-4 Mitigation measures for hydrological values and water quality

Mitigation measures	Phase
The Spill and Contamination Response Plan prepared as part of the Emergency Response Plan would include measures to: • respond to the discovery of existing contaminants at the site (e.g. pesticide containers or asbestos), including stop work protocols and remediation and disposal requirements • manage the storage of any potential contaminants on-site • mitigate the effects of soil and water contamination by fuels or other chemicals (including emergency response and EPA notification procedures) • ensure that machinery and materials arrive on site in a clean and secure condition • prevent contaminants affecting adjacent pastures, irrigation channels, dams and native vegetation • monitor and maintain spill equipment • induct and train site staff.	Construction Operation Decommissioning
If the substation is oil-cooled, the layout, oil containment bunding and drainage would comply with the standards and guidelines in Ausgrid (2017) NS189 Oil Containment for Major Substations. The substation would be bunded with a capacity exceeding the volume of the cooling oil. The bund would be regularly inspected and cleaned, including removal of rainwater.	Pre-construction Construction Operation
The Proponent will consult with EPA to determine whether any changes are required to Jemalong Station's EPL 5102.	Construction

Mitigation measures	Phase
Road and carpark sealing works would not be undertaken if rain is anticipated within 24 hours of the completion of the works. Where possible, sealing works would be scheduled during fine, sunny, warm/hot conditions, avoiding wet, overcast, cool conditions.	Construction
All fuels, chemicals, and liquids would be stored at least 50m from any waterways or drainage lines, in an impervious bunded area. The refuelling of plant and maintenance would be undertaken in impervious bunded areas on hardstand areas only.	Construction Operation Decommissioning
All machinery on-site would contain spill kits to manage hydrocarbon spills. Machinery would be checked regularly to ensure there is no oil, fuel or other liquids leaking from the machinery.	Construction Operation Decommissioning
Any soils contaminated by hydrocarbons, chemicals or concrete during any phase of the project would be removed from the site and disposed of appropriately.	Construction Operation Decommissioning
Any soils, fill or track surfacing materials imported to the site would be clean and non-dispersing.	Construction
No detergents or other chemicals would be added to the solar panel cleaning water.	Construction Operation
Concrete washout shall be carried out offsite or in concrete washout areas described in the Soil and Water Management Plan and identified on the Erosion and Sediment Control Plan (ESCP)	Construction Decommissioning
Procedures for testing, treatment and discharge of construction waste water must be as described in the Soil and Water Management Plan.	Construction Decommissioning
Machinery would be checked daily to ensure there is no oil, fuel or other liquids leaking from the machinery. All staff would be appropriately trained through toolbox talks for the minimisation and management of accidental spills	Construction Operation Decommissioning
All staff would be appropriately trained through toolbox talks for the minimisation and management of accidental spills.	Construction Operation Decommissioning
A Groundwater Management Plan would be developed to manage impacts on groundwater. This would be informed by onsite geotechnical survey and include: • Pollution controls • Management of dewatering.	Pre-Construction

9.3 NOISE AND VIBRATION IMPACTS

9.3.1 Policy Setting

Construction noise

The NSW *Interim Construction Noise Guideline* (DECC, 2009) deals with managing construction noise impacts. According to the guideline, a quantitative assessment of noise impacts is warranted when works are likely to impact an individual or sensitive land use for more than three weeks in total.

The guideline specifies noise targets, or 'noise management levels', for residences and other noise sensitive receivers. For works undertaken during standard working hours, residences are considered noise affected when construction noise is 10 dB above the rating background level (RBL) and 'highly noise affected' when construction noise is above 75dB (A). For works undertaken outside standard working hours residences are considered noise affected when construction noise is 5 dB (A) above the RBL.

Operational noise

The NSW Industrial Noise Policy (INP) (EPA 2000) specifies noise criteria to protect the community from excessive intrusive noise. The assessment procedure in terms of the INP has two components:

- Controlling intrusive noise impacts in the short term for residences
- Maintaining noise level amenity for particular land uses for residences and other land uses.

According to the NSW INP, the intrusiveness of a mechanical noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the LAeq descriptor), measured over a 15-minute period, does not exceed the background noise level measured in the absence of the source by more than 5dB(A).

To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels for rural residential properties as detailed in the table below.

Table 9-5 NSW Industrial Noise Policy amenity goals

Receiver type	Indicative noise amenity area	Time of day	Recommended L_{Aeq} Noise Level dB(A)	
			Acceptable	Recommended maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45

9.3.2 Existing environment

In terms of existing noise levels, land uses surrounding the proposed work areas are generally limited to sheep and cattle grazing land on improved irrigated pastures and irrigated horticulture. Noise generating equipment would include large harvesters (often operating during harvest late into the night), large grain haulage trucks (double or triple bogey), irrigation systems including pumps as well as tractors, quad bikes and 4WD vehicles. These land uses are frequent but intermittent and would create limited background

noise within the area. Noise levels are likely to be concentrated at particular times, determined by farm activities, rather than continuous.

Residential properties are sparsely distributed in the locality (Figure 9-2). Properties in the locality are known to utilise generators and on demand pump pressurised domestic water systems, generating low levels of background noise. The nearest non-involved (in the proposal) residential dwelling is approximately 1.7km north of the solar plant boundary (construction activity 1) and 350 m from the transmission line and road works (construction activity 2).

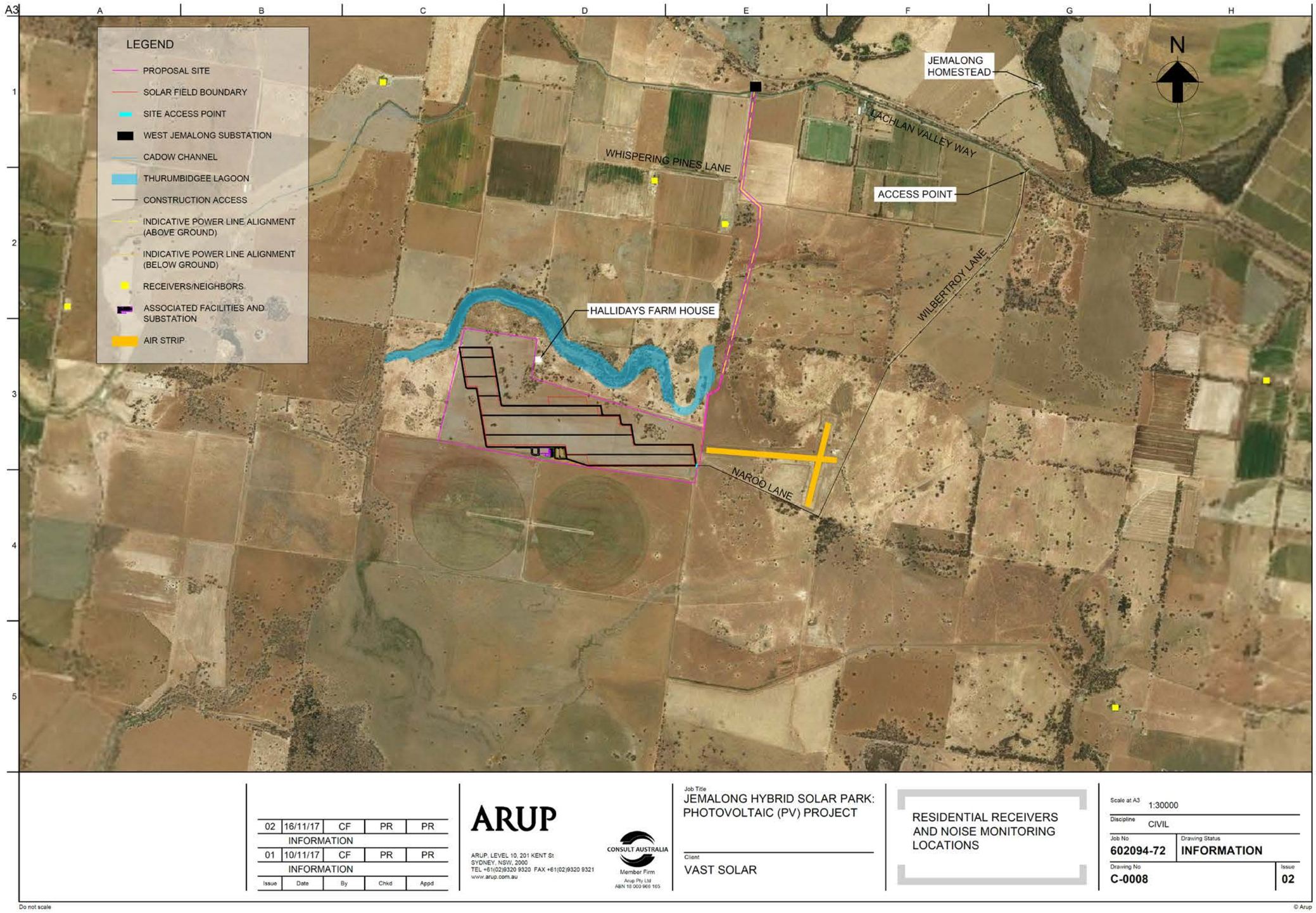


Figure 9-2 Residential receivers and noise monitoring locations adjacent to the Proposal Site

9.3.3 Noise monitoring

Noise monitoring locations

Background noise monitoring was carried out at six residential locations (Figure 9-2) within the study area on 8 October 2014. All noise measurement instrumentation used in the surveys was designed to comply with the requirements of AS 1259.2-1990 "Acoustics - Sound Level Meters. Part 2: Integrating - Averaging" and carried appropriate and current calibration certificates. The equipment utilised for the noise surveys comprised of a SoundPro SE DL Noise Monitor, fitted with a microphone wind shield.

The noise monitoring results were used to characterise the existing noise environment at the sensitive receivers and to establish the noise management levels for the proposal. The monitoring locations were selected based on discussions with Vast Solar and a detailed inspection of the residential locations potentially affected by the proposal. The aim was to select a representative number of closest non-involved receivers surrounding the Proposal Site.

Background noise monitoring results

The recorded background noise levels (RBL) at each of the six receivers ranged between 36.8 and 50.9 dBA (L_{A90} (15min)). Based upon the background noise levels at each receiver, the noise management level (NML) for day timeworks were identified as being between 46.8 and 60.9 dBA (Table 9-6). Noise management levels have been calculated using Table 2 of the NSW *Interim Construction Noise Guideline* (DECC, 2009a).

Table 9-6 Results of background noise monitoring and noise management levels

Receiver	Distance (km) from closest proposal boundary Solar Plant and construction (Approximate)	Distance (km) from closest proposed transmission line and road works (Approximate)	RBL/LA90 (15 min)	Daytime NML (dBA) (+10 dBA)
1	1.70	0.90	50.9	60.9
2	1.90	0.35	45.5	55.5
3	4.30	4.30	41.8	51.8
4	5.20	4.80	36.8	46.8
5	2.45	3.00	45.9	55.9
6	3.60	6.20	45.4	55.4

9.3.4 Potential impacts

Construction noise impacts

Noise impact predictions on each sensitive receiver were conducted. The predictions have taken into account the typical noise levels of construction equipment likely to be used for the construction phase. Two construction activities were assessed, using the sound power levels in Table 9-6, construction noise levels have been predicted at the nearest receivers for the construction of the solar plant (scenario 1) and for the construction of the transmission line and road works (scenario 2).

Table 9-7 Construction equipment sound power levels

Equipment used	Sound power level (-dBA) LAeq (Data sourced from the RMS construction noise estimator)
Scenario 1 – Solar plant	
Fixed Crane	113
Small pile driver	114
Front End Loader	113
Grader	110
Vibratory Roller	109
Concrete Truck	109
Delivery Truck	108
Water Cart	107
Concrete Pump	105
Backhoe	111
Power Generator	103
Concrete Vibrator	103
Light vehicles (eg 4WD)	103
Scenario 2 – transmission line and road works	
Front End Loader	113
Grader	110
Vibratory Roller	109
Delivery Truck	108
Water Cart	107
Light vehicles (eg 4WD)	103

The noise predictions at the nearest receivers were calculated based on the RMS 2016 Construction Noise Estimator. The selected ground type was R0: undeveloped green fields (rural areas with isolated dwelling) and does not take into account weather conditions which can influence the level of noise perceived. Furthermore, noise has been predicted based on all construction plant working concurrently, (worst case scenario).

The predicted noise levels from the proposed works at the nearest sensitive receiver, with all construction plant working concurrently for scenario 1, would vary between 13 and 33 dBA for receivers 1,2 and 5. With regards to Receivers 3,4 and 6, the RMS 2016 noise estimator returned N/A values, indicating the receivers would be too far to be affected by the construction noise. Based on the 2016 RMS noise estimator, the construction activities are unlikely to exceed the NML for standard work hours at all receivers for scenario 1 (Construction of solar plant) (Table 9-7).

Table 9-8 Predicted noise levels at each receiver, scenario 1 (Construction of solar plant)

Receiver	Distance (km) from project boundary (Approximate)	LA90 (15 min)	Predicted Construction Noise Level (dBA) Worst case scenario with all plant working simultaneously	Daytime NML (dBA) (+10 dBA)	Daytime NML based on R0 2016 RMS Estimator (+10dBA)
1	1.70	50.9	33 dBA	60.9	40
2	1.90	45.5	31 dBA	55.5	
3	4.30	41.8	No perceived noise	51.8	
4	5.20	36.8	No perceived noise	46.8	
5	2.45	45.9	13 dBA	55.9	
6	3.60	45.4	No perceived noise	55.4	

Based on the 2016 RMS noise estimator the construction activities are unlikely to exceed the NML for standard work hours at all receivers for scenario 2 (Construction of transmission line and road).

Table 9-9 Predicted noise levels at each receiver, scenario 2 (Construction of transmission line and road)

Receiver	Distance (km) from proposed road and transmission line (Approximate)	LA90 (15 min)	Predicted Construction Noise Level (dBA) Worst case scenario with all plant working simultaneously	Daytime NML (dBA) (+10 dBA)	Daytime NML based on R0 2016 RMS Estimator (+10dBA)
1	0.90	50.9	36 dBA	60.9	40
2	0.35	45.5	49 dBA	55.5	
3	4.30	41.8	No perceived noise	51.8	
4	4.80	36.8	No perceived noise	46.8	
5	3.00	45.9	7 dBA	55.9	
6	6.20	45.4	No perceived noise	55.4	

Works would be undertaken in a rural environment where there is a low level of background noise. Construction activities that are likely to result in noise generation include earthmoving equipment and truck deliveries. The works are likely to generate a small amount of short-term local noise pollution from the operation of machinery and plant, and the unloading of trucks with construction materials. The works would be undertaken during normal working hours and are not likely to cause undue concern to sensitive noise receivers due to distance from construction activities. None of the sensitive receivers have been assessed as being potentially impacted during the construction of the transmission line and PV Plant.

Construction vibration impacts

The NSW guideline Assessing Vibration: A Technical Guideline (DEC, 2006) is designed to be used in evaluating and assessing the effects on amenity of vibration emissions from industry, transportation and

machinery. Sources of vibration covered in this guideline include construction and excavation equipment, rail and road traffic, and industrial machinery.

Vibration generating activities would occur only during the construction phase of the project. However, as the nearest identified receivers are in excess of 100m from the Proposal Site and there are no high vibration producing plant items to be used, structural damage and impacts to human comfort due to vibration are not expected.

Operational noise impacts

In accordance with the INP, noise impact should be assessed in terms of both intrusiveness and amenity.

According to the NSW INP, the intrusiveness of a mechanical noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the LAeq descriptor), measured over a 15-minute period, does not exceed the background noise level measured in the absence of the source by more than 5dB(A). Based on the monitored background noise levels, the intrusiveness noise criteria would be 36.8 + 5 = 41.8 dB(A) for day, evening and night.

To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels for rural residential properties as detailed in Table 9.4

Comparing the amenity and the intrusiveness criteria shows that the intrusiveness criteria are more stringent for day, evening and night periods. Compliance with the intrusiveness criteria would result in compliance with the amenity criteria. Therefore, the intrusiveness criteria would be assessed from herein.

The proposed PV Plant at Jemalong would operate 170,000 solar panels, which may be installed on single-axis trackers. Tracking systems involve the panels being driven by motors to track the arc of the sun to maximise the solar effect. Therefore, the tracking motors are a potential source of mechanical noise and are included in this assessment. Up to a total of 16,750 tracking motors (NexTracker or equivalent) will be employed to drive the solar panels and are to be evenly distributed across the Proposal Site. The tracking motors would turn no more than five (5) degrees every 15 minutes and would operate no more than one (1) minute out of every 15 minute period.

In addition to the trackers, the site will require the operation of up to 22 PCUs distributed evenly across the Proposal Site. Each PCU will contain a transformer, inverters, HV switchgear, communications and ancillary equipment. Sound power levels have been based on previous similar projects implementing an Ingecon Inverter (model 1640TL B630).

A new substation is also proposed within the subdivided portion of land on the southern boundary of the park, containing one main transformer, associated switchgear, and control and protection equipment.

Based on the above, Table 9-10 lists associated plant and equipment likely to be used for the operation of the proposed PV Plant and their corresponding sound power levels.

Table 9-10 Typical Operational Plant and Equipment and Sound Power Levels

Plant description	**L_{Aeq} Sound Power Levels, dB(A) re. 1pW**

Tracker motor	78 (each)
PV Plant PCU	88 (each)
Substation	83
Light vehicle	88 (each)

The closest sensitive receptor is approximately 1.7km north from the Proposal Site. It is expected that the sound power output from each facility would not exceed 88dBA. Based on a distance attenuation model, the predicted noise level at the closest property (1,700m north of the solar plant) would be 28 dBA, which is below the intrusiveness noise of 41.8 dB(A) and complies with the NSW INP criteria.

Three to four staff would be required on site to operate and maintain the solar plant. Road noise from maintenance vehicle access would be infrequent with up to four vehicles accessing the site per day (up to 10 vehicle movements). Noise from the maintenance works would be infrequent and conducted inside the prefabricated steel maintenance building. Furthermore, any maintenance works would occur during the day period only. Given the large distance from the site to the surrounding receivers, noise from most scheduled maintenance works would be well below the NSW INP criteria.

To provide an indicative assessment example of a worst case maintenance activity, based on the RMS Construction Noise Estimator noise from a concrete saw (with a sound power level of 117 dBA) would result in a level of 26 dBA at the nearest residential receptor, which is below the corresponding background noise level.

Transmission line

Noise emissions from operational transmission lines can include aeolian and corona discharge noise. In the context of the proposal, aeolian noise could be generated when wind passes over transmission poles or lines. This type of noise is generally infrequent and is dependent on wind direction and velocity. Wind must be steady and perpendicular to the line to cause aeolian vibration. Given the distance to the nearest sensitive receiver (1.7 km), aeolian noise impacts are expected to be negligible.

SLR Consulting have previously measured corona noise (reference GEHA Report 045-109/2 dated 9 November 2004, pers. comm. I. Fricker December 2012) at a site near Officer in outer Melbourne, Victoria. SLR found it possible to measure corona noise at close distances, at high frequencies only, as other noise sources, namely traffic and birds, caused some interference at times. A 500 kV line was measured during damp foggy conditions.

At a distance of 30m along the ground from the line a L_{eq} noise level of approximately 44 dBA was measured. At a distance of 100 m the corona noise was calculated to be approximately 39 dBA. Assuming a minimum night time RBL value of 30 dBA, the minimum intrusive criteria as determined by the NSW INP would be 35 dBA. SLR therefore conservatively estimates that the minimum criteria level of 35 dBA would be complied with at a distance of 240 m. The proposed transmission route is further than this distance from receiver 2 (350 m) and hence any occasional corona noise would comply with the NSW INP minimum limit at all residential receivers.

Vibration

No operational ground vibration sources from the proposal have been identified that are likely to generate ground vibration impacts at the nearest residential dwellings (350 m). Potential vibration impacts are therefore not assessed any further.

9.3.5 Mitigation measures

Table 9-11 Mitigation measures for noise impacts

Mitigation measures	Phase
Noise control measures, such as those suggested in Australian Standard 2436-2010 "Guide to Noise Control on Construction, Demolition and Maintenance Sites" should be implemented to reduce predicted construction noise levels. Reference to Australian Standard 2436-2010, Appendix C, Table C1 suggests possible remedies and alternatives to reduce noise emission levels from typical construction equipment. Table C2 in Appendix C presents typical examples of noise reductions achievable after treatment of various noise sources. Table C3 in Appendix C presents the relative effectiveness of various forms of noise control treatment.	Construction
In addition to physical noise controls, the following general noise management measures should be followed: • Plant and equipment should be properly maintained. • Provide special attention to the use and maintenance of 'noise control' or 'silencing' kits fitted to machines to ensure they perform as intended. • Avoid any unnecessary noise when carrying out manual operations and when operating plant. • Any equipment not in use for extended periods during construction work should be switched off. • In addition to the noise mitigation measures outlined above, a management procedure would need to be put in place to deal with noise complaints that may arise from construction activities. Each complaint would need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences, where the noise in question is in excess of allowable limits. • Good relations with people living and working in the vicinity of a construction site should be established at the beginning of a project and be maintained throughout the project, as this is of paramount importance. Keeping people informed of progress and taking complaints seriously and dealing with them expeditiously is critical. The person selected to liaise with the community should be adequately trained and experienced in such matters.	Construction
Where noise level exceedances cannot be avoided, then time restrictions and/or providing periods of repose for residents, must be considered where feasible and reasonable. That is, daily periods of respite from noisy activities may also be scheduled for building occupants during construction hours.	Construction
Some items of plant may exceed noise limits even after noise treatment is applied. To	Construction

Mitigation measures	Phase
reduce the overall noise impact, the use of noisy plant may be restricted to within certain time periods, where feasible and reasonable and to be negotiated with Council and the residents. Allowing the construction activities to proceed, despite the noise exceedance may be the preferred method in order to complete the works expeditiously.	
A letter box drop would be prepared and provided to residences within 2km of the site. The letter would contain details of the proposal including timing and duration of construction and a contact details for a person for any enquiries or complaints. Plant would be operated in an effective manner to minimise noise such as by turning off plant which is not being used.	Construction Operation

9.4 SOCIAL AND ECONOMIC IMPACTS

Large developments can produce social and economic impacts on local communities. These can be positive, such as the provision of employment and increased retail trade. They can also produce unintended or adverse impacts, such as creating strains on existing infrastructure (such as public transport or accommodation facilities during construction), including social infrastructure (volunteer services, social ties and networks). This section investigates the socio-economic profile of the region to understand the impact of the proposal on socioeconomics and the community.

9.4.1 Existing environment

Socio-economic profile

The Forbes LGA has a population of 10,500 people (2016 Census), which has been rising since 2011 (FS 2017). The percentage of people of Indigenous origin (9.6 per cent in 2011) is very high compared to the Australian average (2.5 per cent in 2011). The overseas immigrant population is small; 91 per cent of the population were born in Australia compared to the Australian average of 69.8 per cent (ABS 2011).

The local economy is based on irrigated and dryland agriculture, including broadacre cropping and sheep and cattle production. Sheep, beef cattle and grain farming involve 14.0 per cent of the population. Other sectors that support the economy include wholesale trade, health care, manufacturing, finance, education and government (RDA Central West, 2012).

The unemployment rate for Forbes LGA is similar to the broader population at 5.3 per cent, compared to the national rate of 5.2 per cent (ABS 2011).

Forbes is a service centre for the area:

- Accommodation options in the township of Forbes include eight motels, four caravan parks, one hotel and six bed and breakfasts (Forbes Shire Council 2015).
- Educational facilities within the Forbes Shire includes two high schools, five primary schools, five pre-schools, TAFE campus, Conservatorium of Music and Jemalong Regional Education Centre (Forbes Shire Council 2015; RDA Central West 2012).
- Forbes Hospital provides facilities for accident/emergency, medical, surgical, maternity, paediatric, aged care, health promotion and district nurses. Which is complimented by the Forbes Community Health Centre (Forbes Shire Counci, 2015).
- Recreational and sporting facilities in Forbes include facilities for bowls, golf, tennis, basketball, equestrian activities, go-karting racing, swimming, rugby, AFL, squash, shooting, cricket (indoor/outdoor), netball (indoor/outdoor), gliding, hockey, archery, polocrosse and pony club (Forbes Shire Council 2015).
- Tourist attractions within the Forbes LGA include: the Lachlan River, Gum Swamp and Bird Hide, Forbes and Districts Historical Museum, Central West Livestock Exchange, and Lake Forbes (Forbes Shire Council 2015).
- Contribution to tourism development in the Forbes region (the Parkes Radio-telescope has demonstrated the potential of scientific and engineering projects to provide an anchor for tourism business over the long term).
- Provide a high value added use of a small portion of the Jemalong Station property.
  The value of energy produced from the proposal for each hectare of land used would be many multiples of the value produced from grazing or cropping uses; value that can be achieved

without materially affecting the agricultural viability of Jemalong Station or the overall productivity of the property for food production.

Community attitudes to renewable energy

OEH (Newspoll) Survey

The Office of Environment and Heritage (OEH) commissioned research from Newspoll on community attitudes to renewable energy in NSW (OEH 2015). The survey found very strong support for the use of renewable energy; nine out of 10 respondents strongly supported (49%) or supported (43%) electricity generation from renewables. 83% of respondents wanted more electricity generated from renewable sources over the next 5 years.

People generally agreed on the environmental benefits of renewables but there were mixed views about the costs, efficiency and reliability of renewable energy. The principal advantages people saw in renewables were environmental benefits (80%), and reduced cost, at least in the long run (37%). The principal disadvantages people saw were higher cost, particularly in the set-up stage (39%), and concerns about efficiency and reliability (18%). About four-in-ten people believed there were no disadvantages to renewables, or could not think of any.

Awareness of commercial solar parks was lower than wind power; 97% were aware of wind farms, 66% said they had heard of the idea of commercial solar parks. 91% of respondents outside the Sydney, Newcastle and Illawarra metro areas supported solar park development within NSW, 84% supported solar within the local region and 78% supported solar within 1–2 km of where they lived.

Most respondents who supported solar parks in their local area had no concerns (59%). Some said that lack of information or knowledge was a barrier to their acceptance of solar parks (13%). The small group of respondents who opposed solar parks being located near their homes gave a cluster of reasons including unsuitability of their area (33%), the amount of space required (16%), environmental impacts (16%) and visual impacts (20%).

In the South West region (sample size 250 respondents), total awareness of solar parks and levels of support for solar park development in NSW, in the local region and within 1–2 km of home were similar to the state-wide figures.

IPSOS Survey

The Australian Renewable Energy Agency (ARENA) funded research by the Ipsos Social Research Institute which set out the preconditions and best practice principles for establishing the social licence operate large scale solar facilities in Australia (Ipsos 2015). ‘Social licence’ reflects community acceptance of and support for a development, and is considered critical for the long term sustainability of a development.

The Ipsos findings are generally consistent with the results of the OEH (2015) study.

Ipsos found that a high percentage (77%) of Australians believe that large scale solar parks could supply a significant source of Australia’s energy requirements. 63% believe that increasing the number of large scale solar facilities would reduce Australia’s carbon emissions, and 53% agree that large scale solar facilities have a positive environmental impact. 14% thought that solar parks would have a negative impact on local ecosystems, 34% thought they wouldn’t, and 53% neither agreed nor disagreed or didn’t know.

Almost half of Australians (48%) view large scale solar facilities as beneficial for local economies, however, a further 46% neither agreed nor disagreed, or didn’t know.

Almost half (47%) neither agreed nor disagreed, or didn't know if large scale solar facilities could have a negative effect on the health of the people living nearby. 40% disagreed that large scale solar has a harmful impact, and 13% agreed.

Attitudes are divided about the visual impacts of large scale solar parks; 30% agree and 26% disagree that large-scale solar parks have a negative visual impact.

Attitudes towards renewable energy proposals can vary significantly from community to community, often based on the availability of information about solar parks (IPSOS 2015).

Consultation and Participation

Public attitudes to renewable energy developments are also influenced by the nature of the planning and development approval process; the more open and participatory, the greater the level of public support (Birnie *et al.* 1999; Khan 2003, cited in Warren *et al.* 2005). The OEH (2015) and Ipsos (2015) research points to the prime importance of targeted and accessible information, effective and meaningful community engagement and a transparent, participatory assessment and approval process.

Lessons learnt from the development of Moree Solar park include the need to engage the community early, openly and effectively, and provide fit-for-purpose consultation and regular status updates (FRV nd).

Proposal consultation activities and results

Community feedback on the proposal has been through feedback forms, discussions at presentations and statements of support from nearby neighbours (refer to community consultation and community draft Community Liaison Plan for the proposed PV solar plant, Section 6 and Appendix D). Consultation with the community has been ongoing and is proposed to continue for the life to the project.

Consultation with Forbes Shire Council has also been ongoing. Council has been and remains supportive of the proposal and has indicated strong support for the proposal in light of the potential employment, business and tourism benefits as well as helping build Forbes as a regional centre for specialist research, medical and high skill services.

Messages received from formal consultation in November 2014, and from subsequent and ongoing consultation and informal liaison and meetings with neighbours and Council present a comprehenisvie overview of key issues raised in relation to the proposal to develop a "solar" facility at the site. They include:

- Interest in local employment opportunities expressed by neighbours
- Exciting development for the local area
- Accessibility issues during times of extreme flooding
- Potential to create a hub for renewable energy in the area.
- Financial benefits anticipated for local suppliers.
- Potential for employment, through construction and operation.
- Creation of an image of sustainability that would be linked to the area.
- Demonstration of the areas suitability for other similar projects.
- Tourism potential.
- Potential environmental benefits for the broader society.
- Compatibility with existing industries in the area, including agriculture and mining.
- Suited to the area's climate.

9.4.2 Potential impacts

Construction and Decommissioning

Large scale solar plants can create polarised reactions in communities; some may see it as a large change to existing land use, lifestyles and land character. This feature alone can generate uncertainty, stress or opposition to the development. Others may see it as a positive contribution and sign of progress and may derive some direct benefit.

The local area has few large scale industries and would be a large change to the character of the site. It is not highly visible to the public however and in this way the impact would be contained. It is located 36km from the nearest town and 3.2 km from the nearest sealed road and major transport corridor.

The proposal would provide a new less polluting form of electricity generation. It demonstrates the potential of the area to host other such plants and to be a part of this positive contribution to reducing man made impacts on climate change.

The proposal would represent a local economic and direct economic benefit to some. The construction of the proposal would utilise up to 100 staff at peak construction. Many of these could be drawn from the local area. Additional workers moving to the area temporarily may stimulate local economic activity. Accommodation and retail services would be stimulated. Conversely, the temporary influx may place pressures on local services such as schools and health services. Additional demands for accommodation and additional traffic may present an adverse effect on local tourism, if coinciding with local festivals for example. Additional traffic may be noticeable. Additional hazards accompany construction traffic (refer to Section 9.5). Mitigation strategies to address these impacts centre on consultation with the community, so that benefits can be maximised and conflicts resolved where possible.

Decommissioning is likely to require less staff onsite than for construction. It would offer similar economic benefits to construction in terms of opportunities for local staff and industries. It may also include local recycling of infrastructure components. As such, minimal impacts are anticipated during decommissioning

Operation

During operation, maintenance staffing and activities would be at low levels. The additional accommodation and traffic impacts of three to four operational staff are not likely to be noticeable.

Agricultural production and farm employment

The proposal would displace irrigated cropping at the site for the life of the PV Plant (around 30 years). The relevant agricultural production quantities and returns and the significance of foregone production resulting from the proposal have been assessed in section 9.10. The reduction in crop production would be a small percentage of local and regional production, and would be potentially offset by increased productivity on other properties held by the landowner.

The purchase of farm inputs such as fertilisers from local suppliers may decline during the life of the PV Plant, at least partially offset by increased production on other properties, and by purchases to maintain the PV Plant and property.

The area affected by the operational footprint, including the new transmission line, would be 165 ha. The loss of this amount of agricultural land in the region for a period of 30 years, is not considered a significant loss either in the locality or for the Twynam Pastoral Co Pty Ltd, who, as an involved landowner, would be compensated financially for these losses from the operation of the proposal.

Land Values

Background land values are influenced by prevailing and permitted land uses, economic conditions, access and proximity to markets and workplaces, lifestyle opportunities and a range of other factors.

A recent solar park impact assessment (Kirkland Appraisals 2016) examined the likely impact on adjoining property values of a solar park proposed to be constructed on approximately 22 hectares of land in a low density residential and agricultural uses area in North Carolina, United States. The study involved background research, extensive consultation with real estate professionals and a series of matched pair analyses.

In relation to common criteria for making downward adjustments on property values, the study noted that:

- the PV Plant would not produce hazardous wastes
- PV Plants do not produce any noticeable odour
- noise emissions are limited to a barely audible hum
- additional traffic generated by the operating PV Plant would be insignificant
- there is no stigma associated with PV Plants and people generally respond favourably
- PV Plants are a passive land use in keeping with a rural/residential area
- visual impact would be similar to a large greenhouse, and less than residential development.

The study found that the proposed PV Plant would be in harmony with the surrounding low density residential/rural area. The matched pair analysis showed no impact in home values and no impact to adjacent vacant residential or agricultural land. The study concluded that the proposed PV Plant would maintain or enhance the value of adjoining properties.

Visual and landscape character impacts have been assessed in detail in section 8.3, which concludes that the proposal is unlikely to result in significant impact to receivers in the local area. The noise emissions from the operating PV Plant would be minimal and would not affect neighbours. There would be no off-site impacts to water or air quality, fire risk or human health. With the implementation of mitigation measures identified in the EIS, including the establishment of screening vegetation where required, the PV Plant is not considered likely to affect land values at and around the Proposal Site.

Property subdivision

The proposal would require the subdivision of the property to accommodate the substation, the PV Plant lot and residue lot; refer section 4.3. At the end of the life of the PV Plant the excised lot would be reconsolidated back into the residual lot. The subdivision would not result in social and economic impacts at the site or in the locality, including any restriction on future land use potential or land use planning options.

9.4.3 Mitigation measures

Table 9-12 Mitigation measures for social and economic impacts

Mitigation measures	Phase
The Community Consultation Plan would continue to be implemented throughout the planning, assessment and construction phases of the project, and would include: • regular community updates about the progress of the proposal and findings of the assessments	Preconstruction Construction

Mitigation measures	Phase
• consultation and notification of local residents and other relevant stakeholders regarding the timing of major deliveries and other activities which may produce particular social and economic impacts • an accessible complaints process with a timely response protocol.	
Neighbours of the Jemalong PV Park property would be consulted and notified regarding the timing of major deliveries which may require traffic control and disrupt access.	Construction Decommissioning
Local businesses would be used to supply good and services during all phases of the project wherever possible, as a first priority. The proponent would actively liaise with local industry representatives to maximise and coordinate the use of local contractors, manufacturing facilities and goods and materials suppliers, and to minimise adverse impacts to local supplies, services and tourism.	Construction Operation Decommissioning
Local representatives would be consulted regarding accommodation options for staff, to minimise adverse impacts on local services	Construction Operation Decommissioning
Large deliveries involving oversize or overmass loads or vehicles requiring traffic control which may inconvenience road users on Lachlan Valley Way would not be scheduled during festivals or other major tourism activities. Local tourism industry representatives would be consulted to manage potential timing conflicts with local events.	Construction Decommissioning

9.5 TRAFFIC, TRANSPORT AND ROAD SAFETY

For the proposed solar plant, key traffic and transport impacts relate to haulage during construction. Increased vehicle numbers, particularly heavy vehicles, can equate to increased traffic collision risk, cause damage to roads and indirect impacts such as noise and dust to other motorists and nearby receivers.

RMS identified issues relating to traffic, transport and road safety as important during the development of the SEARs for the proposal (Section 1). Specific issues raised are addressed in this section.

9.5.1 Existing Environment

Regional Road network

Where possible, goods and services for the PV Plant would be sourced locally. Items such as solar panels, posts and racking systems which can't be sourced locally will likely come by road from either Melbourne or Sydney. While a detailed haulage plan has not yet been developed, it is expected that the project's components would be delivered by road from Sydney, via either:

- Sydney, Bathurst, Cowra, Forbes:

  Great Western Highway, Mitchell Highway, Mid Western Highway, Lachlan Valley Way.

- Sydney, Bathurst, Orange, Parkes, Forbes:

  Great Western Highway, Mitchell Highway, The Escort Way, Orange Road, Newell Highway, Lachlan Valley Way.

These major roads are administered by Roads and Maritime Services. In terms of capacity:

- The Newell Highway (National Highway 39) is an important road link connecting NSW with Queensland's and Victoria's borders. In the proposal area the Newell Highway is the main road transport route connecting Forbes with Parkes in the north and West Wyalong in the South. Annual Average Daily Traffic (AADT) levels at the Forbes Shire boundary on the Newell Highway, were 4597 in 2005 (Roads and Maritime, 2014).
- The Lachlan Valley Way connects Forbes to the east through Cowra and west through Condobolin. The road is expected to carry medium volumes of traffic which are likely to increase during periods of grain harvest. AADT levels are not currently available. The Lachlan Valley Way is a bus route for Forbes. There are no other bus routes or public transportation along the route.
- The Escort Way Annual Average Daily Traffic (AADT) is 1605 (in 2010) which is relatively low. Traffic around the locality would mostly be a result of industry and rural activities.

Local road network

The Proposal Site is located approximately 3.2 km south of the Lachlan Valley Way. From this point, the site would be accessed via Wilbertroy Lane and then Naroo Lane. Where it intersects Wilbertroy Lane, the Lachlan Valley Way is a two lane sealed road with a posted speed limit of 100 km per hour. Both Wilbertroy and Naroo Lanes are unsealed Council administered public roads. They contain sharp corners and are not 'all weather' roads; during high periods of rainfall they are impassable. Wilbertroy Lane, Naroo Lane and Lachlan Valley Way are infrequently affected by flooding.

Forbes Shire Council, provided traffic counts data from five survey periods spanning 2002 to 2016. The traffic counts were conducted at location MR377W-7km west of Warroo. This location includes the

Lachlan Valley Way out from the Newell Highway and Wilbertroy Lane turnoff is about 26 km along this route. As such the data covers the main haulage road for the proposed construction and operation phase of the Proposal.

Table 9-2 summarises the traffic counts.

Table 9-13 Traffic count at location MR 377W. Survey periods: 2002, 2007, 2013, 2015 and 2016

CLASS	DESCRIPTION	No. VEHICLES									
		2001-2002 45.85 Days	**%**	**2007 13.8days**	**%**	**2013 7.3 days**	**%**	**2015 9.94 days**	**%**	**2016 6.94 days**	**%**
1	Standard Vehicle	6023	79.04%	3963	76.92%	2068	57.50%	3578	69.76%	1021	59.22%
2	Standard Vehicle - Towing	144	1.89%	296	5.75%	153	4.25%	191	3.72%	72	4.18%
3	Two Axle Truck or Bus	1165	15.29%	391	7.59%	481.8	13.40%	955	18.62%	397	23.03%
4	Three Axle Truck or Bus	67	0.88%	100	1.94%	115.2	3.20%	104	2.03%	37	2.15%
5	Four Axle Truck	12	0.16%	11	0.21%	26	0.72%	10	0.19%	0	0.00%
6	Three Axle Articulated Truck	48	0.63%	21	0.41%	24	0.67%	40	0.78%	22	1.28%
7	Four Axle Articulated Truck	51	0.67%	32	0.62%	75.6	2.10%	58	1.13%	27	1.57%
8	Five Axle Articulated Truck	29	0.38%	44	0.85%	59.8	1.66%	15	0.29%	17	0.99%
9	Six Axle Articulated Truck	64	0.84%	212	4.11%	296.7	8.25%	113	2.20%	67	3.89%
10	B Double Truck	11	0.14%	80	1.55%	168.3	4.68%	61	1.19%	58	3.36%
11	Double Road Train	4	0.05%	2	0.04%	128	3.56%	4	0.08%	6	0.35%
12	Triple Road Train	2	0.03%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
		7620	**19.07%**	**5152**	**17.33%**	**3596**	**38.24%**	**5129**	**26.52%**	**1724**	**36.60%**
AADT:		**175.53**		**371.22**		**492.47**		**515.84**		**301.67**	
Veh/Lane/Day:		**87.77**		**185.61**		**246.24**		**257.92**		**150.83**	
Percentage Of Heavy Vehicles:		**19.07%**		**17.33%**		**38.24%**		**26.52%**		**36.60%**	

The data show that traffic volumes along Lachlan Valley have increased over the survey period, with a peak of 515.84 annual average daily trips (AADT), in 2015. Concurrently, the proportion of heavy vehicles to light vehicles has increased over the last 3 monitoring periods from a low of 17.33% in 2007 to high of 38.24% in 2013. The average number of heavy vehicles using the monitored section of road is 371.35AADT over the survey period. The average proportion of heavy vehicles in the surveyed period is 27.55%.

During the harvest season, large grain haulage trucks (double or triple bogey) will use the above listed roads to transfer harvest crops to town. During a typical harvest year at Jemalong about 3,000ha would be under cultivation and produce around 3 tonnes per ha. This would be moved off the farm over a four week period in trucks carrying 42 tonne per truck. Which would equate to 215 round trips to the silos at Forbes, or 50 trips per week, 7.7 trips per day if working 7 days a week. There would also be crew vehicles bringing the harvest workers on-site. A harvest crew is about 10 people total.

Finally, the Lachlan Valley Way is a school bus route for Forbes and surrounding areas such as Jemalong. There are no other bus routes or public transportation along this section of local road networks

9.5.2 Potential impacts

Construction and decommissioning

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

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

Traffic movements

Access requirements can be separated into the following categories:

- Cars –the largest proportion of vehicles that would be used by project management staff and site workers to access the site. Up to 20 cars on average are anticipated during construction. Three – twelve cars are expected during normal operation.
- Utilities – would be required to transport equipment and materials around the site and for local pick up of materials. Approximately five utilities would be used on a daily basis at the site during construction.
- Trucks – would also be used to transport equipment and materials around the site and for local pick up of materials. Larger sized deliveries would be undertaken by trucks as opposed to utilities. Approximately 16 trucks would be used on a daily basis at the site during construction.
- Standard articulated trucks – would be used to transport 68m^3 containers from point of origin. A few large components, such as the pallets of PV panels, would require large trucks and may require special convoy arrangements. These trucks would be similar in scale to large grain-haulage trucks (multi-bogey) used in grain haulage operations. Heavier

trucks would deliver components such as the switch station components and transmission line poles. It is anticipated that the delivery of the PV panels wold occur over a 40 day period, as such approximately 3standard articulated trucks per day would travel along the local network.

Vehicles would travel around the site via constructed access tracks to the following locations:

- Solar array module clusters.
- Construction equipment laydown area.
- Around the perimeter of the solar plant.
- Along the transmission line corridor.

Wilbertroy Lane, Naroo Lane and internal access tracks would remain unsealed but may be re-sheeted with gravel to maintain their condition during the construction phase.

Approximately 30 employees would be required during the first month with up to 100 employees during the peak construction period (approximately nine months). Following installation of the solar array modules, the employee numbers would reduce toward the end of the 12 month construction programme. Temporary car parking during construction would accommodate approximately 30 vehicles. There would also be an area to park buses. It is proposed employees would be transported by bus from Parkes and Forbes area.

During operation, there would be three to twelve maintenance personal employed. Parking would be available within the site.

Table 9-14 provides an indication of the total one-way traffic movements during the construction period. Over an entire year, there would be an average of 2.49 Heavy Goods Vehicle movements and 12.93 light vehicle movements per day (average daily total 15.42 movements). During the nine month peak construction period this would rise to a daily average of 3.4 Heavy Goods Vehicle movements and 17 light vehicle movements (average daily total 20.4 movements).

These figures assume rock and concrete would be imported but water used for dust suppression would be sourced from the site. Should construction take place during a period when the water allocation is heavily restricted and insufficient water is available, water would be tanked to the site. A worst case (and highly unlikely) scenario would require 125 tanker movements to deliver water for dust suppression over the 12 month construction period.

Where possible staff movements would be rationalised using minibus or bus transport, or car pooling. A special convoy and a 50T (or larger) mobile crane may be required for offloading the PCUs. Traffic would largely be confined to standard site working hours.

Table 9-14 Traffic volumes and requirements for the PV Plant

Phase	Purpose	Vehicle	Est no. of traffic movements
Heavy goods vehicles			
Site Set-Up	Portacabins, generators, water & fuel tanks plus associated machinery	Low loader	15
Road & Hard standings	Stone for access tracks and compounds	Truck and dog	300
Foundations	Foundation for inverters, and substation	Mixer truck	30
Piles and Mounting Frames	Material	Semi-trailer	128
Solar Panel Modules	Material	Semi-trailer	125

Grid Connection Building	Material & Equipment	Semi-trailer, crane	3
Cabling	Material	Semi-trailer	39
Termination boxes	Material	Flatbed lorry	3
Inverters & Transformers	Equipment	Semi-trailer, crane	12
CCTV & Fencing	Equipment	Semi-trailer	20
Potable water	Staff drinking water	Tanker	6
Screening planting	Material	Semi-trailer	25
Waste Removal	Removal of skips (recycling and septic tank emptying)	Skip lorry, tanker	190
Site Demobilisation	Portacabins, generators, water & fuel tanks plus associated machinery	Low loader	15
	Total HGVs		**911**
Cars and light vehicles			
	Staff	Cars and minivans	4320
	Deliveries of small consumables	Vans	400
	Total cars and light vehicles		**4720**
	Total vehicles		**5631**

Haulage program

Based on the Forbes Council traffic data discussed in the preceding section, the relative contribution of heavy vehicle trucks to the daily movements along the designate haulage route would be considered insignificant. The additional traffic would be a small component of the existing loads. No substantive increased collision risks, damage to road infrastructure, noise or dust impacts, disruption to existing services or reduced level of level of service is expected to accompany construction. This outcome would be ensured by the preparation of a detailed haulage plan, to manage the haulage process.

Equally, as noted previously during a typical harvest season, grain trucks would use the local road network to transport harvested crops to the town, at an average of 7.7 trips per day, compared to the planned 3.4 trips per day in the peak construction period.

The haulage network is of sufficient capacity to accommodate the haulage of components required for the construction of the PV Plant and transmission line.

A large proportion of project components, including solar panels, mounting and tracking systems, and fencing, are expected to be assembled onsite within Jemalong Station.

Given the high level of usage of local road networks by large grain haulage vehicles during grain harvesting operations, it is not anticipated that upgrades would be required to the Wilbertroy Lane and Lachlan Valley Way intersection commonly used by these vehicles. Consultation would be undertaken with RMS and Forbes Shire Council to ensure adequate and safe entry and exit of the unsealed Wilbertroy Lane.

Onsite and local traffic

Increased vehicle numbers

Local vehicle movements could be reduced by organising carpooling and bus services, including shuttle buses from Parkes and Forbes to transport the majority of up to 100 construction personnel required onsite, during peak periods. Assuming an 80 per cent uptake rate and 50 person capacity, up to three bus trips would be required per day during the construction program. During non-peak periods approximately half as many shuttle buses are expected to be required.

In addition, it is estimated that 10-20 trips would be required per day by standard or 4WD vehicles, during the construction program. During non-peak periods approximately half as many would be expected.

Traffic impacts would largely be confined to standard hours of construction. Exceptions would occur as staff arrive and leave the site, before and after shifts; some of this traffic may occur outside the standard construction hours. Additionally, the delivery of large components may take place outside normal working hours.

Delivery times of components can be scheduled with the haulage contractors so that "platooning" of large vehicles on the highways does not occur. This outcome would be ensured by the preparation of a detailed TMP to manage traffic and access in the local area throughout the construction phase.

Increased collision risks

The increased collision risk would be mainly limited to the construction period and relates primarily to traffic entering and exiting Wilbertroy Lane from Lachlan Valley Way. This relates to both oncoming traffic and traffic following turning vehicles. Necessity of any change to the main access road intersection with the Lachlan Valley Way would be determined in consultation with RMS. Slowing vehicles may present a risk to through traffic, however it likely these risks can be mitigated by increased signage in the advances to the intersection, to warn motorists of potential vehicle movements and the construction time frames. Equally, all construction staff would be inducted with the Driver Behaviour Code, which will be developed by Vast Solar, in line with their corporate statement policy on employee safety.

Access to the Proposal Site follows the course of a school bus route (Jemalong – Forbes). The proposal may increase risk to students boarding and exiting the bus on the Lachlan Valley Way, and crossing the road along transport routes with higher traffic volumes. Consultation with bus companies (which are intended to be used for worker transport to and from the Proposal Site) would be undertaken. The nearest school bus stop is over 1 km in either direction from the intersection, however a further potential risk mitigations could be required move any existing stops further away from the intersection.

Damage to road infrastructure

The increase in traffic and heavy vehicle movement could impact the condition of roads on the haulage network. Along the Lachlan Valley Way the impact is expected to be negligible, due to the existing capacity of the road network, but the impact of turning traffic at the intersection to Wilbertroy Lane would require monitoring to ensure it remains within the expected peak hourly volumes.

Wilbertroy Road and Naroo Lane would remain unsealed but may be re-sheeted with gravel to maintain their condition during the construction phase. Damage to Wilbertroy Lane and Naroo Lane would be increased during wet conditions. These roadways would need to be monitored and restored at end of the construction period.

While closure due to flooding may occur at times, Vast Solar would manage construction impacts on Wilbertroy Road and Naroo Lane trafficability such that other road users are not inconvenienced or put at greater danger of collision during construction. This may require periodic road improvements and lane closures to preserve traffic flow.

Associated noise and dust

Construction of the proposal may result in increased noise and dust, particularly on unsealed roads, though all such roads are within the Jemalong Station property. Impact from dust generated from the proposed activity, including that associated with increased traffic, is considered in Section 6.5. During

construction, water would be used to minimise dust generation on the unsealed lanes and internal site tracks.

The DECCW (2011) *NSW Road Noise Policy* (NSW RNP) has been used to evaluate impacts from road traffic noise. This policy outlines a range of measures required to minimise road traffic noise and its impacts, including noise generated by developments that generate additional traffic on existing roads.

The criteria for various road categories and land uses are presented in Section 2.3 of the NSW RNP. Those criteria are presented in Table 6-11.

Table 9-15 Applicable NSW Road Noise Policy (DECCW 2011) noise criteria

Type of project/land use	Assessment criteria – dB(A)	
	Day (7am – 10pm)	Night (7am – 10pm)
Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	LAeq, (15 hour) 60 (external)	LAeq, (9 hour) 50 (external)
Existing residences affected by additional traffic on existing local roads generated by land use developments	LAeq, (1 hour) 55 (external)	LAeq, (1 hour) 50 (external)

The nearest non-involved residence is 1.7 km from the traffic access route to the Proposal Site. The area is flat but vegetation screening is present. The residence is also currently affected by the Lachlan Valley Way traffic noise, exceedance of these levels is considered unlikely. In the event a noise complaint is received during construction, mitigation including monitoring may be undertaken.

Disruption to existing services

The increase in traffic volumes and slow turning vehicles may have a minimal effect on bus movements, including the school bus (Jemalong to Forbes on school days), but would have no impact on scheduled services. Consultation with bus providers, to ensure there is no disruption to the bus schedule or to the location of stops will mitigate potential risk. There are no Countrylink bus services along this section of Lachlan Valley Way.

Local traffic in Forbes and Parkes would be minimally affected by increased vehicles from staff seeking accommodation and services, and conducting commercial activities related to the solar plant. This would extend outside construction hours but would be insignificant in the context of traffic movements in these major regional centres.

Operation

Vehicles would use the designated road network to access the site and travel within the site during the operational phase (30 year period). Activities undertaken during the operation phase would include travelling to the site office or maintenance building and carrying out maintenance activities on the solar plant. Operational staff would be confined to designated parking areas and access roads/tracks within the Proposal Site.

During heavy rainfall periods and flooding access to the site would be restricted for personnel. Wilbertroy Lane and Naroo Lane would be impassable. This may be an issue during emergencies at the site. The implementation of an emergency protocol would ensure the safety of people and the environment.

During operation, three-four full time equivalent staff would be based at the Proposal Site, primarily using standard light vehicles (4WD). Security personnel may also access the site. During major outages, up to 50 vehicles may be present at any one time. The anticipated volume of staff (<10) would result in a

very minimal increase in traffic flow on the Lachlan Valley Highway. It is considered highly unlikely that operational traffic would obstruct public or private access. Risks to road safety from operational traffic would be very minimal. Vast Solar will develop a Driver Behaviour Code in line with their corporate statement policy for employee safety. All construction and operation staff would be inducted to the Driver Behaviour Code.

Decommissioning

Decommissioning impacts are likely to follow a similar pattern as construction, with components dismantled and removed, over a lesser time period.

Cumulative

The construction of the Jemalong Hybrid Solar Park would occur in phases and not concurrently. The development of the CSP Plant is separate and consequent to the development of the Solar PV Plant. Consequently, the cumulative impacts of additional light and heavy vehicles using the local road network during the construction period is assessed as insignificant, given the comparative number of daily trips during the harvest from large grain haulage trucks.

Once the Jemalong Hybrid Solar Park is operational, the total number of permanent employees working at both solar facilities are unlikely to exceed twenty people. Such an increase in light traffic vehicles numbers is not significant in comparison to the total number of light and heavy vehicles traveling on the local road network. The cumulative impact is negligible.

9.5.3 Mitigation measures

Traffic, transport and road safety impacts would be managed by implementing the mitigation measures provided in Table 9-16.

Table 9-16 Mitigation measures for traffic, transport and road safety impacts

Mitigation measures	Phase
A Traffic Management Plan would be developed as part of the CEMP and DEMP, in consultation with Forbes Shire Council and RMS. The plan would include: • confirmation of designated routes for construction and haulage traffic • evaluation of any road or intersection upgrade requirements and associated traffic controls, in consultation with Forbes Shire Council and RMS (and consistent with Austroads Guides and Roads and Maritime Services supplements) • scheduling of deliveries • carpooling/shuttle bus arrangements to minimise staff vehicle movements • consultation and notification arrangements regarding traffic impacts for nearby residents and local road users, particularly when traffic delays are expected • arrangements and locations for traffic controls (speed limits, signage, stop/go) • procedure to monitor traffic impacts and adapt controls (where required) to reduce the impacts • provision of a contact phone number for stakeholders and the public to obtain information and to enable rapid response to any issues or concerns • assessment of road condition prior to construction on all local roads that would be	Preconstruction Construction Decommissioning

Mitigation measures	Phase
utilised, and a road condition monitoring program • Avoiding use of Naroo Lane and Wilbertroy Lane during floods or after heavy periods of rain.	
The proponent would ensure the approval of Forbes Shire Council prior to the selection of the final construction access route on local roads.	Construction
The proponent would consult with RMS/Forbes Shire Council in regard to use of the Wilbertroy Lane / Lachlan Valley Way intersection and requirement for upgrades, if any.	Construction Decommissioning
Vast Solar to develop a Driver Behaviour Code in line with their corporate statement policy for employee safety. All construction and operation staff would be inducted to the Driver Behaviour Code.	Construction Operation Decommissioning
Consultation with stakeholders including Roads and Maritime Services, Forbes Shire Council, local landholders and emergency services would continue during construction and decommissioning to advise of any changes to road use and conditions.	Construction Decommissioning
Where possible, large deliveries requiring stop/go traffic controls would not be scheduled during peak tourism periods (such as during local festivals), and morning and evening commuting or school bus operating periods. The proponent would aim to restrict traffic delays to a maximum of 10 minutes.	Preconstruction Construction Decommissioning
Prior to construction, a pre-condition survey of the relevant sections of the existing road network would be undertaken, in consultation with Forbes Shire Council. During construction the road network would be monitored and maintained to ensure continued safe use by all road users, any faults attributed to construction of the PV Plant would be rectified. At the end of construction a post-condition survey would be undertaken to ensure the road network is left in the same state as at the start of construction. This approach would also be applied during the decommissioning phase.	Preconstruction Construction Decommissioning

9.6 HAZARDS

An environmental hazard is a thing or situation which can threaten the environment or human health. Hazards may be natural or artificial, or result from the interaction between human activity and the natural environment. Hazards relevant to the proposal and Proposal Site include risks associated with electromagnetic fields and glint and glare.

Note the risks of flooding and fire are specifically addressed in the relevant Sections 8.4 and 9.7.

9.6.1 Electromagnetic fields

Background

Electromagnetic fields (EMFs) consist of electric and magnetic fields and are produced whenever electricity is used. EMFs also occur naturally in the environment, such as the Earth's magnetic field and discharges during thunderstorms (WHO 2012).

Electric fields are produced by voltage and magnetic fields are produced by current. When electricity flows, EMFs exist close to the wires that carry electricity and close to operating electrical devices and appliances (WHO 2007). Electric and magnetic field strength reduces rapidly with distance from the source, and while electric fields are insulated by air and insulation material, magnetic fields are not.

Fields of different frequencies interact with the body in different ways. EMF field sources to which people may be exposed are predominantly in three frequency ranges. The Extremely Low Frequency (ELF) range of 0-300 Hz incorporates the 50 and 60 Hz frequencies of the electric power supply and of electric and magnetic fields generated by transmission lines and other electrical devices and infrastructure (Repacholi 2003).

Over decades of EMF research, no major public health risks have emerged but uncertainties remain (WHO nd). While it is accepted that short-term exposure to very high levels of electromagnetic fields can be harmful to health, the International EMF Project, established by the World Health Organisation, has thus far concluded that there are no substantive health consequences from exposure to ELF *electric* fields at the low levels generally encountered by the public (WHO 2007), such as those that would be produced by electricity generation at the proposed PV Plant.

Exposure to ELF magnetic fields is mostly considered to be harmless, however, a policy of prudent avoidance has been taken to account for any uncertainty. The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA 2015) advises that 'the scientific evidence does not establish that exposure to ELF EMF found near power lines is a hazard to human health'.

The International Commission on Non-Ionizing Radiation Protection (ICNPR) published *Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300GHz)* in 1998. The guidelines were updated in 2010. The objective of the paper was to establish guidelines for limiting EMF exposure that will provide protection against known adverse health effects. To prevent health-relevant interactions with Low Frequency fields, ICNIRP recommends limiting exposure to these fields so that the threshold at which the interactions between the body and the external electric and magnetic field causes adverse effects inside the body is never reached.

The exposure limits, called basic restrictions, are related to the threshold showing adverse effects, with an additional reduction factor to consider scientific uncertainties pertaining to the determination of the threshold. They are expressed in terms of the induced internal electric field strength in V/m. The exposure limits outside the body, called reference levels, are derived from the basic restrictions using

worst-case exposure assumptions, in such a way that remaining below the reference levels (in the air) implies that the basic restrictions will also be met (in the body) (ICNIRP 2016). Reference levels for occupational and general public exposure are shown in Table 9-17.

Table 9-17 ICNIRP reference levels (ICNIRP 2010)

Exposure characteristics	Electric field strength (kVolts per metre - kV/m)	Magnetic flux density (microteslas - µT)
Occupational	10	1000
General public	5	200

Research into electric and magnetic fields undertaken at utility scale photovoltaic installations in California[1] by Chang and Jennings (1994), indicated that magnetic fields were significantly less for solar arrays than for household applications. Chang and Jennings (1994) found magnetic fields from solar arrays were not distinguishable from background levels at the site boundary, suggesting the health risk of EMFs from solar arrays is minimal.

Potential impacts

The assessment focuses on the potential for health impacts. The EMFs emitted by the PV Plant would not be likely to interfere with local mobile phone, radio or television reception. These devices operate at a much higher frequency than the AC electrical equipment that would be used at the PV Plants, and any EMFs produced would dissipate rapidly with distance from the source.

Receivers

There are two uninvolved residences within two kilometres of the Proposal Site (refer Table 9-5). The closest residence is approximately 0.35km to the east of the proposal powerline. The PV Plant would be fenced, with no public access. During the operation phase, the PV Plant would require a small number of maintenance personnel (three to four full time equivalent staff) to attend the site. Property owners or farm managers may access the site for short periods for maintenance and stock management.

EMF sources and levels

Potential for EMF impacts occurs only during the operational phase of the solar facility when electrical infrastructure is capable of generating EMFs. In relation to potential occupational exposure for PV Plant personnel, the electromagnetic fields would vary in different locations at the site. The proposal includes the following components that could generate EMFs:

- underground 22-33kV cables
- approximately 22PCUs up to 5MW capacity
- a 66kV substation
- the solar array (up to 1.5kV DC).

Typical and maximum EMF levels for these types of infrastructure are discussed below. As noted above, strength attenuates with distance from the infrastructure.

[1] Note the U.S.A electricity supply operates at 60 Hz frequency.

Overhead powerlines

Figure 9-3 displays the typical electric fields emitted from different voltage overhead powerlines. The Proposal Site has existing 132kV and 66kV powerlines. Most cabling installed for the proposal would be buried and located along the access tracks. A short section of overhead electrical cabling would be used to connect the substation to the existing TransGrid 132kV powerline. The existing and proposed overhead powerlines are less than the recommended 5kV/m and 10kV/m limits.

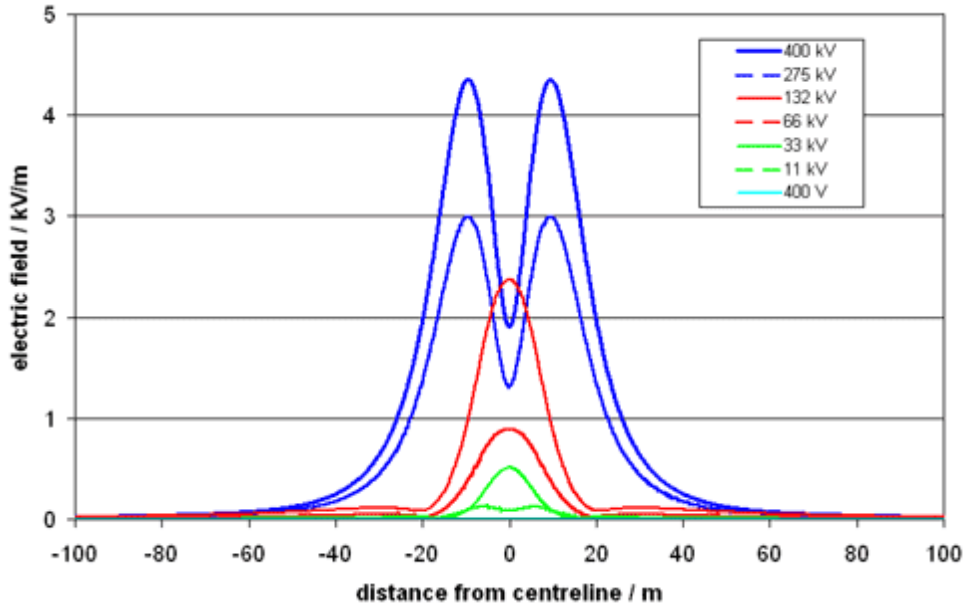


Figure 9-3 Typical electric fields from overhead powerlines (EMFs.info 2017)

Figure 9-4 and Table 9-18 show a range of magnetic field levels measured by the ARPANSA around powerlines and substations. The existing and proposed overhead powerlines are less than the recommended 200µT and 1000µT limits, even if directly underneath the powerline.

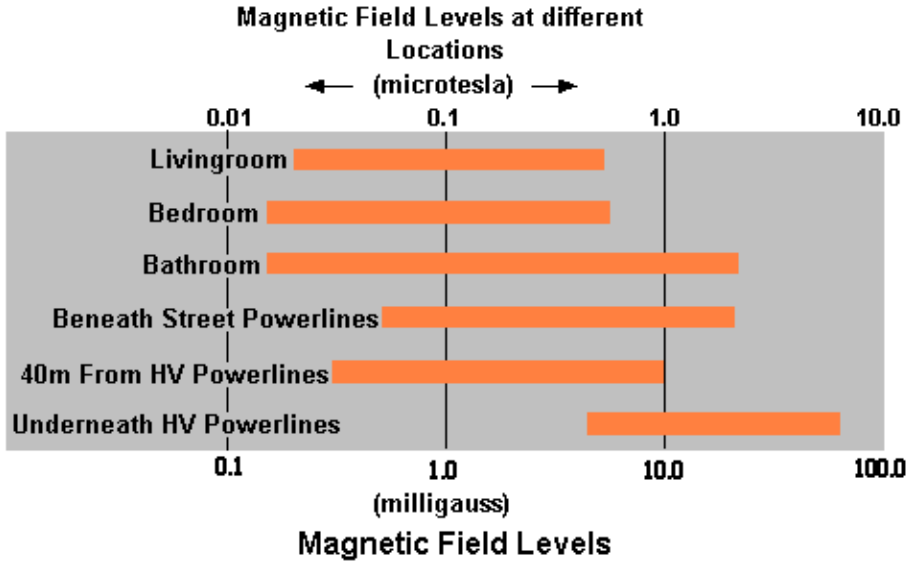


Figure 9-4 Magnetic field levels at different locations (ARPANSA 2015)

Table 9-18 Typical magnetic fields near overhead powerlines and substations

Source	Location of measurement	Range of measurement	
		(mG)	(μT)[2]
Transmission line	Directly underneath	10 - 200	1 - 20
Transmission line	At edge of easement	2 - 50	0.2 - 5
Substation	At substation fence	1 - 8	0.1 – 0.8

Underground cabling

External electric fields from underground cables are shielded by the soil. EMFs.info (2016) provides typical magnetic field data for a single 33kV underground cable at 0.5m depth. Magnetic fields for this cabling would be under the recommended limits of 200 μT and 1000 μT.

Table 9-19 Magnetic field levels from underground 33kV cabling

Magnetic Field (μT) at distance from centreline			
0 m	**5 m**	**10 m**	**20 m**
1.00	0.29	0.15	0.07

The PV Plant proposal would require the installation of internal reticulated 22kV or 33 kV cabling. Cables used in the on-site reticulation cabling would typically contain three core conductors in trefoil (three lobed) arrangements to reduce the effects of magnetic fields from adjacent conductors. During detailed design and construction, the electric and magnetic fields produced by the cable would be maintained at much lower levels than the ICNIRP reference levels for the general public.

Power Conversion Units

Based on current design, approximately 22 PCUs, comprising inverters and transformer unit on either an open skid or in a metal container, would be installed across the site. The PCUs would have a total output of up to around 210 MW (AC). The inverters would typically have an AC power frequency range between 47 and 63 Hz and fall into the Extremely Low Frequency (ELF) range of 0-300 Hz. Within this range, EMFs are not considered to be hazardous to human health. In addition, the PCUs would be located within the fenced PV Plant site with no public access and would be producing power only during the day time reducing the total time that EMFs are generated by the infrastructure.

Substation

For substations and transformers the magnetic fields at distances of five to ten metres are generally indistinguishable from typical background levels in a home. The fenced exclusion area around the substation components is sufficient to reduce EMF to negligible levels.

[2] Converted from mG where 1 mG = 0.1 μT.

Solar array

The PV Plant would require installation of DC wiring between panels and the PCUs. This cabling may be above ground or underground and would typically conduct less than 320A and 1500V. The potential for electromagnetic interference as a result of the aboveground and underground cable is considered to be negligible.

9.6.2 Aviation

Existing environment

The Forbes aerodrome (YFBS) is the closest public airfield at an approximate distance of 26 km, east-north-east of the site. The flight pattern around the aerodrome requires that aircraft approach with a minimum altitude of 0.915 km at distances between 14.8 and 27.8 km from the aerodrome. The runway at the aerodrome runs in an approximately east-west direction with the approach from the west.

A private air strip is located within a cleared flat paddock area, about 500 m to the east of the Proposal Site. The air strip comprises an east-west and north-south runway within a fenced off grassed paddock. The air strip is not used often, with only one to two flights per year operated by the property owner Twynam Pastoral Co Pty Ltd.

Potential impacts

Glint and glare

The identified potential risk to aviation from the PV Plant is glint and glare. Glint is a quick reflection that occurs when the sun is reflected on a smooth surface. Glare is a longer, sustained reflection. Infrastructure at the site that may cause glint or glare depending on the sun angle, include:

- solar panels
- metal array mounting (steel or aluminium)
- site buildings.

The potential for glint or glare associated with non-concentrating PV systems which do not involve mirrors or lenses is relatively limited. PV solar panels are designed to absorb as much solar energy as possible in order to maximise electricity generation. As such, they reflect only around 2% of the received light (Spaven Consulting 2011). The panels would also have an anti-reflective coating to further reduce the potential for glare and glint.

A comparative reflection analysis against other surfaces is shown in Figure 9-5. The figure shows that in relation to water and snow, a solar panel (with a reflectivity coating) reflects a much lower percentage of light. The Department of Planning (2010) discussion paper on planning for renewable energy generation confirmed that solar panels will not generally create noticeable glare compared with an existing roof or building surfaces.

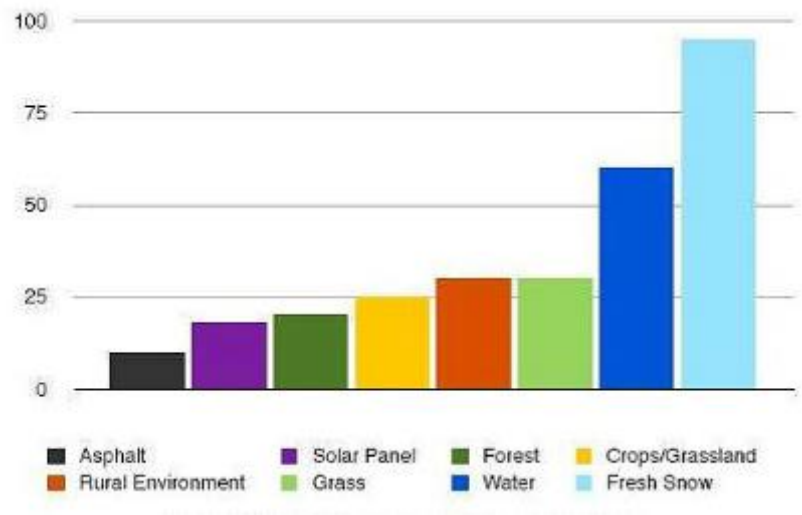


Figure 9-5 Comparative reflection analysis (Spaven 2011)

For other infrastructure such as the buildings and steel support posts, impacts from glint and glare is considered minor due to their small size and low surface area. Careful design and colour schemes can further reduce any potential reflection problems.

The visual assessment undertaken for the proposal provided in J and summarised in section 8.3 found that glint and glare impacts on aviation would be minor and can be effectively managed with the implementation of identified mitigation measures. The largest glare hazard for aviation remains the sun (Spaven 2011). The US Federal Aviation Administration (FAA) Technical Guidance for Evaluating Selected Solar Technologies on Airports (FAA 2010) cites several case studies of operating solar facilities at large airports, including Denver International, Fresno Yosemite International and Albuquerque International Sunport. In their review of the FAA policies, the US Department of Energy's National Renewable Energy Laboratory (NREL)) found that, with proper planning, solar can be successfully installed at airports with minimal or no impacts (Kandt and Romero 2014). The report notes that successful solar systems have been installed at dozens of airports worldwide, noting examples in the United Kingdom, Greece, Italy and United States ranging between 45kW and 12.5 MW capacity.

As detailed in section 6, CASA and local agricultural aerial services companies did not raise any specific concerns regarding glare or glint.

Convection currents

Large scale PV Plants have the potential to create 'heat islands' which produce rising convection currents. PV Plants reduce albedo by making the land surface darker and less reflective, potentially leading to increased heat absorption. Panels are thin and have little heat capacity, but can be up to 20°C warmer than ambient temperatures during the day. The panels can also reduce soil cooling overnight; empirical studies have found temperatures over a PV plant with bare ground were 3-4°C warmer than semi-arid natural areas at night (Barron-Gafford *et al*. 2016).

This heat island effect would be at least partially offset at the Proposal Site by evaporative cooling from vegetation cover under the panels, shading by the panels and groundcover reducing soil heat absorption and the removal of energy during the electricity production process.

The risk of a 'thermal plume' affecting local aviation is likely to be very small, given the temperature differentials and offsetting factors. The widespread practice of siting large scale solar plants at airports suggests convection from solar panels is unlikely to be a safety problem for aviation. As noted above, the

FAA (2010) and the NREL (Kandt and Romero 2014) provide numerous case studies of operating solar facilities at airports.

9.6.3 Mitigation measures

Mitigation measures for flood and fire are discussed in Section 8.4 and 9.7. Potential hazard risks would be managed via the mitigation strategies in Table 9-20.

Table 9-20 Mitigation measures for the management of hazards at the site

Mitigation measures	Phase
An Emergency Response Plan, incorporating an Evacuation Plan, Fire Response Plan, Flood Response Plan and Spill and Contamination Response Plan, would be developed prior to commissioning the PV Plant. A copy of the plan would be kept on site in a prominent position adjacent to the site entry point at all times.	Preconstruction Construction Operation Decommissioning
EMF	
All electrical equipment would be designed in accordance with relevant codes and industry best practice standards in Australia.	Preconstruction Construction
All design and engineering would be undertaken by qualified and competent person/s with the support of specialists as required and would aim to minimise EMFs.	Preconstruction Construction
Aviation	
The materials and colour of on-site infrastructure will, where practical, be non-reflective and in keeping with the materials and colouring of the local landscape.	Preconstruction Construction

9.7 FIRE AND BUSH FIRE ISSUES AND IMPACTS

Bush fire presents a threat to human life and assets and can deliver adverse ecological impacts. Bush fire risk can be considered in terms of environmental factors that increase the risk of fire:

- Fuel quantity and type.
- Topography.
- Weather patterns specific activities (such as hot works) or infrastructure that exacerbate combustion or ignition risks (such as transmission lines and other electrical components).

9.7.1 Background

The Proposal Site is flat, located in a low lying area of the Lachlan Catchment and has been levelled for agricultural activities. The site has been cleared and cropped with little to no overstorey or shrub story present, except for isolated remnants and tree clusters. Thurumbidgee Lagoon is located 400m north of the Proposal Site which contains more overstorey and groundcover. The northern and western boundaries of the site are treed.

The proposed transmission line runs east along the southern border of the solar field for 1.3 km, before heading north for 3.8km to meet the west Jemalong station. It has been sited in cleared areas with little to none overstorey or shrubs. There are patches of vegetation where overstorey and groundcover are present adjacent to the proposed transmission line route. The vegetation is adjacent to Thurumbidgee Lagoon which connects to trees running along the fenceline of the paddocks the transmission line occupies. The trees along the fence line run for approximately 1.3 km from Thurumbidgee Lagoon with a width of 50 m. A larger patch of vegetation (220 m by 200 m is approximately 1.8 km north of the Proposal Site. Between this patch and the West Jemalong Substation are no patches with overstorey.

The local bush fire season generally occurs between October and March. The local area experiences hot dry summers, generally with very low humidity during this time. Hot north-westerly winds are common with high daytime temperatures, which increases bush fire risk. Dry lightning storms are frequent during the bush fire season. Historically, the Mid Lachlan Valley Bush Fire Management Committee (MLVBMC) area has experienced 150 bush fires on average per year, including approximately one major fire per year. The MLVBMC (2008) identifies the main ignition sources as lightning, storm activity, ignition from farming machinery during harvest times, vehicle accidents along major roads, powerlines and the storage of hay.

The MLVBRMP, prepared in accordance with the *Rural Fires Act 1997*, sets out a five year strategic management plan to reduce bush fire risk on private and public land within several areas of Mid Lachlan Valley including the Forbes LGA. The proposal area does not lie within any of the bush fire management Zones identified in this plan.

The proposal includes transmission lines and switchyard components, with a risk of exacerbating or causing fire. The nearest Rural Fire Service station is located in Forbes, at 26 Union Street.

Planning for Bushfire Protection Guidelines

According to the Planning for Bushfire Protection (PBP) guidelines (RFS 2006), an acceptable level of protection from bushfires is achieved for developments through a combination of strategies which:

- *control the types of development permissible in bush fire prone areas*

- *minimise the impact of radiant heat and direct flame contact by separating the development from the bush fire hazard*
- *reduce the rate of heat output (intensity) of a bush fire close to a development through control of fuel levels*
- *minimise the vulnerability of buildings to ignition from radiation and ember attack*
- *enable relatively safe access for the public and facilitate fire-fighting operations*
- *provide adequate water supplies for bush fire suppression operations*
- *implement community education programs, focusing on property preparedness, including emergency planning and property maintenance requirements*
- *facilitate the maintenance of APZs, fire trails, access for firefighting and on-site equipment for fire suppression.*

The PBP guidelines provide six key Bush Fire Protection Measures for developments:

a) the provision of clear separation of buildings and bush fire hazards, in the form of fuel reduced APZ (comprising inner and outer protection areas and defendable space)

b) construction standards and design

c) appropriate access standards for residents, fire fighters, emergency service workers and those involved in evacuation

d) adequate water supply and pressure

e) emergency management arrangements for fire protection and/or evacuation

f) suitable landscaping, to limit fire spreading to a building.

Draft Planning for Bush Fire Protection 2017

The draft revised Planning for Bush Fire Protection (RFS 2017b) provides the following bushfire management objectives for National Construction Code Class 5 to 8 buildings (including commercial and industrial facilities) and Class 10 non-habitable buildings and structures (such as garages and fences):

- *to provide safe access to/from the public road system for firefighters providing property protection during a bush fire and for occupant egress with evacuation*
- *to provide adequate services of water for the protection of buildings during and after the passage of bush fire, and to locate gas and electricity so as not to contribute to the risk of fire to a building*
- *to provide suitable emergency and evacuation (and relocation) arrangements for occupants of the development and consideration of storage of hazardous materials away from the hazard wherever possible.*

The draft guidelines do not specifically address solar parks but, in relation to wind farms, provide for a 10 metre Asset Protection Zone (APZ) from structures, and adequate firefighting access. The draft guidelines require a bush fire emergency management and operation plan, covering; the suspension of work involving risk of ignition during total fire bans, the availability of fire-suppression equipment, storage and maintenance of flammable materials, notification of the local NSW RFS Fire Control Centre for any works during the fire danger period that have the potential to ignite surrounding vegetation, and bush fire emergency management planning.

Potential impacts

Bushfire and Structural Fire Risks

Potential bushfire (including grass fire) hazards relate to the risk of the development causing a bushfire and the risk of any bushfires affecting the PV Plant facility. Potential ignition sources associated with construction and decommissioning include:

- earthworks and slashing machinery causing sparks
- hot works activities such as welding, soldering, grinding and use of a blow torch
- sparks and contact ignition from vehicles in long combustible vegetation
- smoking and careless disposal of cigarettes
- use of petrol powered tools
- operating plant fitted with power hydraulics on land containing combustible material
- electrical faults during testing and commissioning
- storage of chemicals and hazardous materials.

Construction fire risks are manageable with standard best practice, and the implementation of additional mitigation measures outlined below. The construction works would take place on flat land in a low fuel environment, in cleared paddocks formerly used for cropping.

The operation phase of the solar PV Plant carries the following potential bushfire risks:

- powerline failure or contact with vegetation within clearances
- overheating in the substation
- grass fire ignition from vehicles and maintenance machinery.

The PV Plant buildings will be constructed of low combustibility or non-combustible materials suitable for buildings of class 5 to 8 and 10 of the Building Code of Australia (BCA). All electrical components would be designed and managed to minimise potential for ignition. The solar array, which would occupy the majority of the site, would be largely constructed of glass, silicon, steel and aluminium and would have very low flammability.

Bushfire and structural fire risks during operation of the PV Plant are considered manageable subject to the control of grass fuels at the site, the appropriate maintenance of equipment, adoption of applicable best practice and technical standards and the implementation of safeguards provided below. Potential ignition sources not associated with the PV Plant site would continue to present bushfire risks in the locality, including lightning, machinery, discarded cigarette butts from public road traffic, powerlines and local stubble burn escapes.

In view of the likely fire hazards and risks, the proposal is not considered likely to present a substantial bushfire ignition and structural fire threat, or to represent an unacceptable hazard in the event of a bushfire affecting the site.

Compliance with PBP Guidelines

Asset Protection Zones

Appendix 2 of the PBP guidelines provides minimum Asset Protection Zone (APZ) requirements for habitable buildings in residential developments designated as bush fire prone. While the proposal is not

residential, these APZ prescriptions would be applied to the PV Plant infrastructure to provide defendable space and to manage heat intensities at the infrastructure interface.

The PBP guidelines indicate a minimum APZ width of 10m for grassy woodlands (total fuel load 15 tonnes/hectare) and semi-arid woodlands (total fuel load 18 tonnes/hectare) on flat ground in the Mid Lachlan Valley with a Fire Danger Rating of 80. This setback is based on the need to conform to Level 3 construction (AS 3959 – 1999) for a building of Class 1 or 2 under the BCA.

The draft revised Planning for Bush Fire Protection (RFS 2017b) specifies the following minimum APZ widths for residential subdivisions on flat ground in FDI 80 areas:

Grassy woodlands	11 metres
Semi-arid woodlands (grassy)	6 metres.

An APZ of minimum width of 10m would be provided around the PV Plant buildings, substation, and around the outside perimeter of the solar array. The 10 metre APZ setback requirement would also be applied to any woody vegetation plantings undertaken around the perimeter of the PV Plant. All of the APZ would be managed as an Inner Protection Area.

Fuel hazard management

According to the PBP guidelines, the APZ should provide a tree canopy cover of less than 15% located greater than 2m from any part of the roofline of a dwelling, and should not overhang any building. Trees should have lower limbs removed up to a height of two metres above the ground. The understorey should be managed (mowed) to treat all shrubs and grasses on an annual basis in advance of the fire season.

There would be no trees or shrubs within the APZ established for the PV Plant, or within the solar array area. Grassland Fuel Hazard is a function of grass height and cover, with variation according to curing and species fuel characteristics. Grass fuel would be monitored and managed using stock grazing or mowing to maintain safe fuel levels. Grass height within the APZ would be maintained at or below five centimetres throughout the October-April fire season. Grass height outside the APZ, including beneath the solar array, would be maintained at or below 15 centimetres throughout the fire season.

The overhead powerlines at the site would be managed by maintaining appropriate vegetation clearances to minimise potential ignition risks, in accordance with the ISSC 3 Guideline for Managing Vegetation Near Power Lines.

Access

Safe and efficient access (suitable for firefighting appliances) would be established and maintained over the PV Plant site. The APZ around the perimeter of the site would incorporate a four metre wide gravel access track. The perimeter track would comply with the requirements for Fire Trails in section 4.1.3 of the PBP guidelines, including:

- a minimum carriageway width of four metres with an additional one metre wide strip on each side of the trail clear of bushes and long grass
- minimum vertical clearance of four metres
- capacity for passing using reversing bays and/or passing bays every 200m suitable for fire tankers
- connection to the property access road and/or to the through road system at frequent intervals of 200m or less.

The turn radius and swept path clearance on access roads would be suitable for Category 1 Tankers (Medium Rigid Vehicle).

Fire-fighting resources and preparedness

A steel or concrete water storage tank would be installed adjoining the main internal access road for fire-fighting and other non-potable water uses, with a 65 mm Storz outlet, a metal valve and a minimum of 20,000 litres reserved for fire-fighting purposes. Rainwater tanks installed beside site buildings for staff amenities would also enable RFS connectivity. Suitable fire extinguishers and PPE would be maintained at site buildings.

A Fire Management Plan would be developed prior to commissioning in consultation with the local NSW RFS District Fire Control Centre to manage fire risks, resources and preparedness. An Emergency Response Plan, including an Evacuation Plan, Fire Response Plan and Spill and Contamination Response Plan would also be developed to enable rapid, safe and effective incident response.

9.7.2 Potential impacts

Construction and decommissioning

Activities associated with construction that may cause or increase the risk of bush fire include:

- Smoking and careless disposal of cigarettes on site.
- Site maintenance activities such as mowing, slashing and using other petrol powered tools.
- Welding and soldering activities.
- Operating a petrol, LPG or diesel powered motor vehicle over land containing combustible material.
- Operating plant fitted with power hydraulics on land containing combustible material.

Considering the sparse vegetation cover over the proposed site and other factors discussed above, it is considered unlikely that project would pose a significant bush fire risk. Site access would be formalised at the beginning of the construction stage during civil works, which would increase the ability to access and suppress any fire onsite or on adjoining sites.

The bush fire hazard associated with the activities listed above is considered highly manageable. Risks would be minimised through the implementation of fire and bush fire mitigation measures outlined in Section 9.7.3.

Potential impacts from decommissioning activities would be similar to those for construction. As for construction and operation activities (below), any bush fire risk associated with decommissioning of the project would be highly manageable.

Operation

As well as the activities listed above, which also apply to operation, repairs and maintenance activities during project operation could increase bush fire risk.

All electrical components would be designed to minimise potential for ignition.

Asset protection Zones would also be maintained around buildings at the site.

It is anticipated that Essential Energy would maintain the transmission line infrastructure to minimise bush fire ignition risks, once constructed.

Bush fire risks during operation of the solar plant and connection infrastructure is considered highly manageable.

9.7.3 Mitigation measures

Fire risks would be addressed via the following mitigation measures.

Table 9-21 Safeguards and mitigation measures for fire and bush fire

Fire	
The Fire Management Plan would be developed in consultation with the local RFS District Fire Control Centre, and include: • specific management of activities with a risk of fire ignition (hot works, vehicle use, smoking, use of flammable materials, blasting) • incorporation of fire safety and response in staff and contractor induction, training, OHS procedures and Work Method Statements • dedicated staff training on the use and maintenance of fire-fighting equipment and resources • designation of a staff safety officer tasked with ensuring implementation of the plan and regular liaison with firefighting agencies • document all firefighting resources maintained at the site with an inspection and maintenance schedule • monitoring and management of vegetation fuel loads • identification of Asset Protection Zones (APZs) and key access routes • a communications strategy incorporating use of mobile phones, radio use (type, channels and call-signs), Fire Danger Warning signs located at the entrance to the site compounds, emergency services agency contacts • activation triggers for the Emergency Response Plan and Fire Response Plan.	Preconstruction Construction Operation Decommissioning
In developing the Fire Management Plan, NSW RFS would be consulted on the volume and location of water supplies, fire-fighting equipment maintained on-site, fire truck connectivity requirements, proposed APZ and access arrangements, communications, vegetation fuel levels and hazard reduction measures.	Preconstruction
An APZ of minimum 10m would be maintained between remnant or planted woody vegetation and PV Plant infrastructure. The APZ around the perimeter of the site would incorporate a 4 metre wide gravel access track.	Preconstruction Construction
Average grass height within the APZ would be maintained at or below 5 centimetres throughout the October-April fire season. Average grass height outside the APZ, including beneath the solar array, would be maintained at or below 15 centimetres throughout the fire season.	Construction Operation Decommissioning
The overhead powerlines at the site would be managed by maintaining appropriate vegetation clearance limits to minimise potential ignition risks, in accordance with the ISSC 3 Guideline for Managing Vegetation Near Power Lines.	Operation
Landscaping around buildings at the site would comply with Appendix 5 Bush Fire Provisions - Landscaping and Property Maintenance in the PBP guidelines.	Construction Operation

Appropriate fire-fighting equipment would be held on site to respond to any fires that may occur at the site during construction. This equipment will include fire extinguishers, a 1000 litre water cart retained on site on a precautionary basis, particularly during any welding operations. Equipment lists would be detailed in Work Method Statements.	Construction
A steel or concrete water storage tank would be installed adjoining the main internal access road for fire-fighting and other non-potable water uses, with a 65 mm Storz outlet, a metal valve and a minimum of 20,000 litres reserved for fire-fighting purposes.	Preconstruction Construction Operation Decommissioning
The NSW RFS and Fire and Rescue would be provided with a contact point for the PV Plant, during construction and operation.	Construction Operation
Following commissioning of the PV Plant, the local RFS and Fire and Rescue brigades would be invited to an information and orientation day covering access, infrastructure, firefighting resources on-site, fire control strategies and risks/hazards at the site.	Operation
The substation will be cooled with silicone or mineral oil (5000L), oil containment and fire safety measures outlined in Ausgrid (2017) NS189 Oil Containment for Major Substations would be implemented.	Preconstruction Construction
The perimeter access track would comply with the requirements for Fire Trails in the PBP guidelines. All access and egress tracks on the site would be maintained and kept free of parked vehicles to enable rapid response for firefighting crews and to avoid entrapment of staff in the case of bush fire emergencies. Access tracks would be constructed as through roads as far as possible. Dead end tracks would be signposted and include provision for turning fire trucks.	Construction Operation Decommissioning
Machinery capable of causing an ignition would not be used during bushfire danger weather, including Total Fire Ban days.	Construction Operation Decommissioning
A Hot Works Permit system would be applied to ensure that adequate safety measures are in place. Fire extinguishers would be present during all hot works. Where possible hot works would be carried out in specific safe areas (such as the Construction Compound temporary workshop areas).	Construction Operation Decommissioning

9.8 HISTORIC HERITAGE

9.8.1 Approach

A desktop study was undertaken to identify any historic heritage (non-indigenous) items or places in proximity to the study area, with a particular focus on the Proposal Site (solar plant site and surrounding landscape). Several heritage databases were searched between in September 2017 as part of this assessment. These included:

- The NSW State Heritage Inventory (SHI) (includes items on the State Heritage Register and items listed by state agencies and local government) to identify any items currently listed within or adjacent to the Proposal Site. The area searched was the Forbes LGA.
- The Australian Heritage Database (includes items on the National and Commonwealth Heritage Lists) to identify any items that are currently listed within or adjacent to the Proposal Site.
- The heritage schedule of the Forbes LEP for locally listed heritage items that are within or adjacent to the Proposal Site.

Many councils across NSW have not listed their local heritage schedule on the NSW SHI. In this instance the Forbes LEP was the main source for local heritage items as these are yet to be included in the SHI. Most of the identified heritage items were listed as a result of the 2006 Forbes Community Heritage Study recommendations.

9.8.2 Existing environment

The results of the heritage searches listed above indicate that no known historic items or places occur on the site. A summary of the results of the heritage searches are illustrated in Table 9-22. Details of listed items are provided below.

Table 9-22 Summary of heritage listings in the Forbes LGA

Name of register	Number of listings
World Heritage List	0
National Heritage List	0
Commonwealth Heritage List	1
NSW State Heritage Register	5
NSW State Agency Heritage Register (section 170)	18
Forbes Local Environment Plan (LEP) 2013	161

Commonwealth Heritage list

One item is listed on the Commonwealth Heritage List. This is the:

- Forbes Post Office (Australia Post).

The Commonwealth and National Heritage Lists are established and maintained under the EPBC Act 1999.

State Heritage Register

A search of the NSW State Heritage Register within the Forbes LGA indicated five listings. These included (owner in parentheses):

- Forbes Post Office (Australia Post).
- Forbes Railway Station Group (Australian Rail Track Corporation).
- The Ben Hall Sites – Ben Hall's Death Site (private).
- The Ben Hall Sites – Grave of Ben Hall (Forbes Shire Council).
- The Ben Hall Sites (Collectively) (various).

These items are listed under the *NSW Heritage Act 1977*. None of these items are located within the Jemalong area.

NSW State Agency Heritage Register (Section 170)

A search of the NSW State Agency Heritage Register within the Forbes Shire LGA indicated 18 listings. These included (owner in brackets):

- Mulyandry Creek Bridge (Roads and Maritime Services).
- Paytens Bridge Over Lachlan River at Colletts Crossing (Roads and Maritime Services).
- Iron Bridge Over Lachlan River at Forbes (Roads and Maritime Services).
- Forbes Courthouse (Attorney General's Department).
- Forbes District Ambulance Station (NSW Department of Health).
- Main building and Mortuary, Berkley Street, Forbes (NSW Department of Health).
- Forbes Official Residence 1, 6 Victoria Lane, Forbes (NSW Police).
- Forbes Police Station, 8 Victoria Lane, Forbes (NSW Police).
- Forbes Railway Station (Australian Rail Track Corporation).
- Bumbuggan Creek Weir (State Water Corporation).
- Cottons Weir (Forbes) (State Water Corporation).
- Island Creek Weir (State Water Corporation).
- Jemalong Regulator and Offtake (State Water Corporation).
- Jemalong Weir (State Water Corporation).
- Jemalong Weir Control House (State Water Corporation).
- Forbes Fire Station (NSW Fire Brigades).
- Warroo Bridge Over The Lachlan River (RMS).
- Camp Street Bridge (RMS)

The above items are listed by State Agencies under s.170 of the *Heritage Act 1977*. Three of the above items are located within the Jemalong area, 12km north east of the Proposal Site. They are:

- Jemalong Regulator and Offtake.
- Jemalong Weir.
- Jemalong Weir Control House.

Local Heritage Schedule

A search of the Forbes LEP resulted in a total of 161 local heritage items being recorded within the Forbes LGA. The majority of these items (including one conservation area) are concentrated in the main town of Forbes with the remainder located in the smaller towns, villages and rural areas of the LGA. A narrower analysis of all local heritage items identified four items that are within the Jemalong area. These are:

- Jemalong Range Fossils, 7123 Newell Highway.
- Riversleigh Homestead, 1476 South Condobolin Road (now Lachlan Valley Way).
- Jemalong Homestead, 2728 South Condobolin Road (now Lachlan Valley Way).
- Yawarra Rabbit Trap, 402 Specks lane.

The Jemalong Homestead complex is located on the northern side of the Lachlan Valley Way with access down a gravel road. The proposed solar station would be located at least 4 km from the homestead. Heavy vehicle transport during construction would be located approximately 800 m from the homestead when turning off the Lachlan Valley Way.

Unlisted Heritage Items

Although no listed items were identified within the site, it is acknowledged that there may be unlisted items of historic significance on the subject site. No additional potential heritage items were identified within the Proposal Site during the site inspection for historic heritage.

9.8.3 Potential impacts

A number of heritage items were identified from the desktop study, outlined above. A high percentage of these items are found in Forbes and other towns and villages, although some are scattered throughout the rural parts of the Forbes LGA. A total of seven items were identified as being either within the general Jemalong area. However, none of those items are found within the study area for the solar station proposed site, or adjacent.

The transport of heavy vehicles on roads passing near identified heritage items may increase levels of dust and vibration. Given the site's distance from the identified heritage items (approximately 800 m to Jemalong Homestead being the closest), the capacity of haulage routes to handle large loads and the temporary nature of works, dust and vibration generated from heavy trucks is not expected to be an issue.

The proposal is not considered likely to have a significant impact in accordance with the NSW *Heritage Act 1977*, the EP&A Act, or the EPBC Act, in terms of heritage. No impacts are considered likely during the construction or decommissioning phases. No heritage approvals are required.

Potential for impacts to heritage items during operational activities would be substantially less than for construction and decommissioning activities. No impacts are considered likely during the operational phase. No heritage approvals are required.

9.8.4 Mitigation measures

Measures to avoid and minimise impacts to historic heritage items which may be present at the Proposal Site are provided in Table 9-23.

Table 9-23 Mitigation measures for historic heritage values

Mitigation measures	Phase
Should an item of historic heritage be identified during construction, the Heritage Division (OEH) would be contacted prior to further work being carried out in the vicinity.	Construction

9.9 AIR QUALITY AND CLIMATE

Air quality can be affected by dust caused by soil disturbance and emissions from vehicles and machinery. These impacts can be a nuisance to nearby receivers (residences, farm workers). At worst they can interfere with plant growth, degrade ecosystems, represent human health risks and contribute to greenhouse gas emissions and anthropogenic climate change.

9.9.1 Existing environment

Air quality

The Proposal Site is located within the South Western Slopes Bioregion. The South Western Slopes is dominated by a sub-humid climate with hot summers and no dry season (NSW National Parks and Wildlife Service, 2003). The closest Bureau of Meteorology Automatic Weather Station (AWS) to the site is Forbes Airport, approximately 26 km north east. The average annual minimum temperature is 9.6˚C and the maximum annual average temperature is 24.4 ˚C. The average annual rainfall is 499.1mm, with most rain falling in December, February and June (Weatherzone, 2017; Figure 9-6). Winds speeds are greatest during spring and summer. During these warmer months the strong winds (>40 km per hour) come from the north. In the coolers months the strong winds (>40 km per hour) originate from the south east (BOM, 2017b). The highest periods of air quality are during spring and summer where drier periods of high temperatures are associated with strong winds.

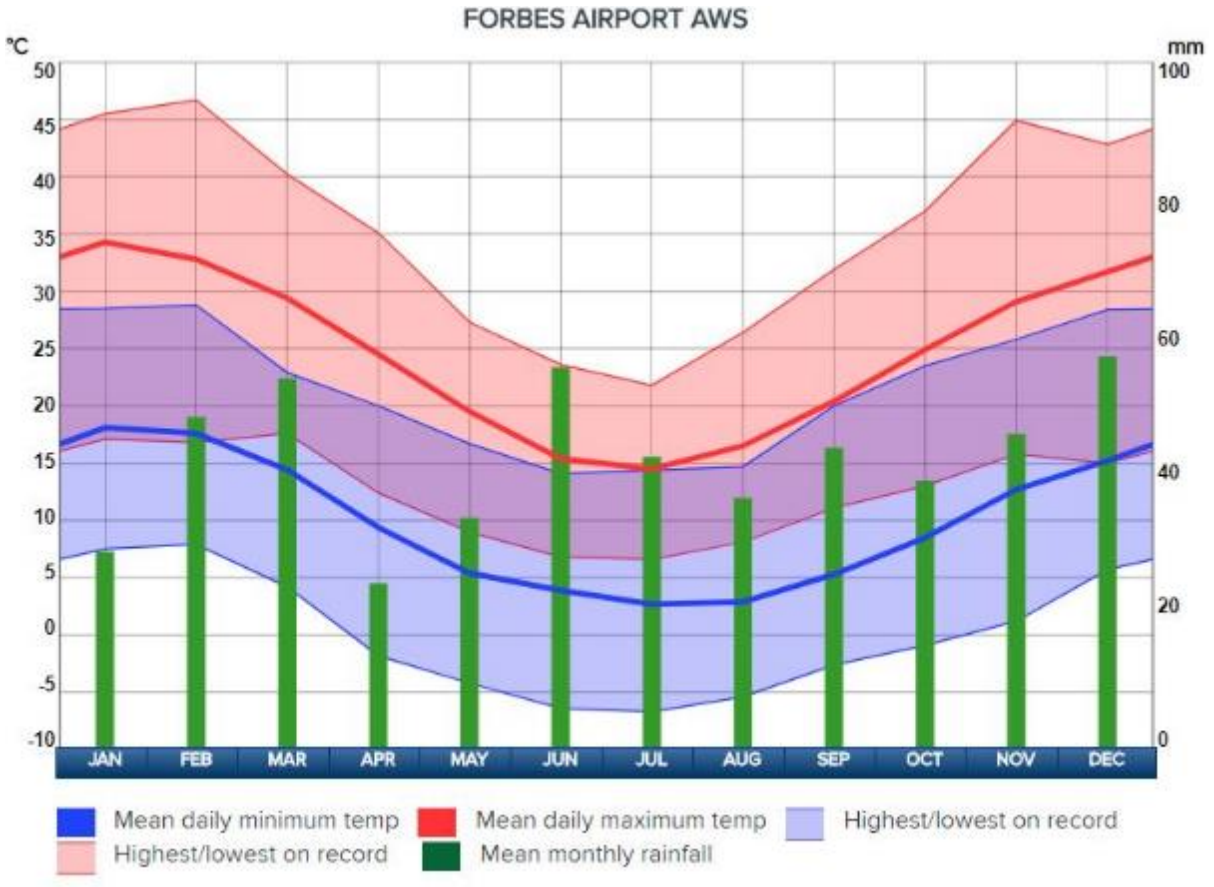


Figure 9-6 Forbes Airport AWS monthly climate statistics (Weatherzone, 2017)

The Forbes Shire Management Plan 2008-2009 State of the Environment Report (Forbes Shire Council, 2009) identifies that the Forbes area enjoys good air quality due to its rural setting in NSW. This is owing

to the relatively low population and distance from industrial pollution sources. Local air quality can be affected by traffic fumes, dust during dry periods, agricultural practices and industrial activities. During colder months, there would be a minimal increase in air contaminants due to smoke from the operation of solid fuel heating.

Two major polluters occur in the local region, Forbes Depot and Kaloola Piggery, which are located 34km and 11 km from the Proposal Site, respectively. Emissions from the Forbes Depot is benzene, Toluene, cyclohexane, Xylenes and Volatile Organic Compounds. The Kaloola Piggery emissions are in regards to livestock include ammonium (DoE, 2015).

Settlement within proximity of the site is considered sparse (refer 3). The closest non-involved receiver is approximately 1.7 km to the west of the Proposal Site. Several other residences are located to the west and north west within 5 km of the Proposal Site. Topography of the proposal area is flat.

Criteria

The POEO Act requires that no vehicle shall have continuous smoky emissions for more than ten seconds. Limits on dust emission of less than 4mg/m/m2 are also specified.

Climate change

Climate change refers to the warming temperatures and altered climatic conditions associated with the increased concentration of greenhouse gases in the atmosphere. Climate change projections for Australia includes more frequent and hotter hot days and fewer frost days, rainfall declines in southern Australia and more extreme weather events including intense rainfall, severe drought and harsher fires (CSIRO, 2015). 2016 was Australia's fourth-warmest year on record, and March and autumn as a whole were the warmest on record (BOM 2017e). At the global level, 2016 was the hottest year on record, and the third hottest year in a row (Steffan *et al.* 2017). The annual mean air temperature in Australia is projected to increase by 2.8-5.1°C by 2090 (above the 1986-2005 period) (CSIRO 2015).

Rural and regional communities are disproportionately affected by the impacts of climate change, through worsening extreme weather events and impacts to capacity, productivity and resilience in some rural industries (Climate Council 2016). A significant proportion of Australian exports are agricultural products that are sensitive to global warming impacts (AGO 2003). Some incremental adaptations in agricultural enterprises will be straightforward, but the more transformational adaptive changes may be risky and expensive, especially for individual farmers (Climate Council 2016).

It is now generally accepted that the release of certain gases including, most notably carbon dioxide, contribute to global climate change. These gases are collectively referred to as 'greenhouse gases'. Construction and maintenance activities where plant and equipment uses diesel, gasoline and other hydrocarbons, result in greenhouse gas emissions and are likely to contribute to climate change. The construction, operation and decommission of the proposed PV Plant project assessed in this EIS would produce minimal CO_2 emissions. This is compared to conventional coal and gas fired powered stations outlined in Table 9-24.

Table 9-24 Comparison of CO_2 equivalent emissions produced per kilowatt hour

Generation method	Emissions produced (grams CO2 equivalent per kWh)	Source
Solar PV plant	**19-59**	**Wright and Hearps (2010)**
Coal-fired power station	800-1000	Wright and Hearps (2010)
Combined cycle gas turbine	400	Alsema *et al*. (2006)

The operation of the proposal would help reduce greenhouse gas emissions and move towards cleaner electricity generation. Based on 109,500 MWh, the proposal would offset the equivalent of 36 kilotonnes per annum of CO_2 emissions for Brown Coal, 75 kilotonnes per annum of CO_2 emissions for Black Coal and power the equivalent of 18,250 NSW homes (emission calculation based on 2013 NTNDP emission intensity values averaged across the power stations).

9.9.2 Potential impacts

Construction and decommissioning

Dust generation would accompany excavation and other earthworks as well as the movement of trucks and work vehicles along unsealed access roads during construction and decommissioning of the proposed solar plant. Air emissions would also be produced from equipment and vehicle exhaust fumes. Dust and emissions can be a nuisance, interfere with visibility when driving or lead to adverse health impacts where severe or prolonged.

The construction phase is expected to last 12 months with a peak period lasting approximately nine months. During this time, emissions would be generated from earth-moving equipment, diesel generators, trucks, cranes and pile driving equipment. Vehicles accessing the site would include the construction labour force, largely using shared (bus) transport, (approximately 100 construction personnel during the peak period) and haulage traffic delivering construction components (detailed further in Section 9.5).

Dust and emissions would be expected to attenuate with a very limited distance from the site. Given that the closest non-involved residential dwelling to the proposed solar plant is approximately 1.7 km from the Proposal Site, substantive air quality impacts are not anticipated. Furthermore, the proposed solar plant site is well screened to most receivers, by vegetation which placing a barrier between the works and receivers, trapping dust and reducing potential for emissions to affect these receivers. The transmission line construction works would be closer to receivers but this stage of works would be much shorter in duration and works would move progressively such that there would not be any sustained close proximity works. These works also involved mainly piling equipment, involving minimal earth-moving.

Greenhouse gas emissions would be generated during construction and decommissioning. These emissions would contribute to climate change at a global level, but are offset many times over by the benefits of carbon reduction delivered from the electricity produced by the proposal over its operational life. Construction related emissions would not impact materially on the local climate.

Mitigation strategies include a formal community consultation and engagement system, and complaints mechanisms, whereby the sources of complaints are promptly identified and addressed, and appropriate application of a suite of dust and emission reduction measures.

The construction of the proposal is not anticipated to have a significant impact on air quality. Identified impacts are highly manageable.

No air quality impacts in addition to those mentioned for construction are anticipated during the decommissioning phase. Impacts during decommissioning would be less in extent, given the concrete foundations for the power island would be retained in place and traffic requirements would be similar in type but of shorter duration than that required for the construction phase.

Due to the existing activities surrounding agricultural activities and the minimal impacts on air quality during construction and decommissioning, the cumulative impact is expected to be not significant. Cumulative impacts are discussed further in Section 6.12.

Operation

Unlike fossil fuel power generation, PV Plants have very low air emissions of air pollutants including sulfur dioxide, nitrogen oxides, carbon monoxide and carbon dioxide during the operation phase.

Maintenance activities during operation would result in some localised, intermittent vehicle emissions and potentially some generation of dust from vehicles travelling on the unsealed access roads and tracks. The impacts on local and regional air quality are expected to be negligible during normal operation; two to five vehicles are expected to be required at the site during normal operation. During major maintenance operations, this number could increase to 10-15 vehicles at any one time for a limited period.

Limited amounts of fuels would be required for maintenance vehicles during operation of the solar plant. The proposal would also reduce local exhaust emissions from farm machinery, as a result of the change in land use.

During operation, the proposal would have a significantly positive impact on global climate by assisting to reduce Australia's reliance on fossil fuels for electricity generation (discussed in Section2.11).

The proposal would, as part of the transition to renewable energy sources, contribute to reduced greenhouse gas emissions and mitigation of the negative effects of climate change. The PV Plant would generate around 109,500 MWh per year, saving approximately 36,530 tonnes of carbon dioxide per year (refer section 2).

Due to the existing activities surrounding the site and the minimal impacts on air quality during operation, the cumulative impact is expected to be not significant. Cumulative impacts are discussed further in Section 6.11.

9.9.3 Mitigation measures

Mitigation measures for air quality and climate impacts are identified in Table 9-25.

Table 9-25 Mitigation measures for air quality and climate impacts

Mitigation measures	Phase
The Community Consultation Plan would continue to be implemented throughout the planning, assessment and construction phases of the project, and would include: • consultation and notification of local residents and other relevant stakeholders regarding the timing of major deliveries and other activities which may affect local air quality • an accessible complaints process with a timely response protocol.	Preconstruction Construction Decommissioning

Mitigation measures	Phase
Dust generation by vehicles accessing the site and earthworks at the site would be suppressed using water applications or other means as required.	Construction Decommissioning
Vehicle loads of material which may create dust or litter would be covered while using the public road system.	Construction Decommissioning
All vehicles and machinery used at the site would be in good condition, fitted with appropriate emission controls and comply with the requirements of the POEO Act, relevant Australian standards and manufacturer's operating recommendations. Plant would be operated efficiently and turned off when not in use.	Construction Decommissioning

9.10 LAND USE AND RESOURCES

The nature of a development would determine whether a permanent land use change occurs as a result of the development proceeding or whether the development is reversible and existing or alternative land uses can occur in future. As well as direct uses of the land, such as agriculture, electricity generation or mining, other impacts such as the degree of visual impact and traffic regimes can affect the compatibility of alternative land uses. These issues as they relate to the proposal are discussed below.

9.10.1 Approach and methods

The land use and resource values of the Proposal Site and locality, and potential impacts of the proposed PV Plant have been assessed with reference to the NSW land and soil capability assessment scheme, Primefact 1063 Infrastructure proposals on rural land, Biophysical Strategic Agricultural Land and Important Agricultural Land identification processes, Land Use Conflict Risk Assessment Guide, the Minview and Common Viewer databases and landholder, ABS and ABARES agricultural production and water use figures.

9.10.2 Existing environment

Agriculture

The soil and water characteristics of the Proposal Site are key to the existing land use. The Proposal Site and surrounding area is currently used for agriculture, primarily irrigated agriculture, grazing and cropping.

Agriculture is a significant land use in the local area, with over 679, 000 ha of land dedicated to agriculture within the Forbes LGA and a gross value of over $97.1 million in 2014 (ABS, 2011; RDA Central West, 2014).

The proposed solar plant is located within Jemalong Station which is 15, 478 ha of agricultural land managed by Twynam Pastoral Co Pty Ltd. Water entitlements within the locality are held by JIL. This private corporation holds a Water Supply Work Approval and Water Use Approval licence under the *Water Management Act 2000.* The station is also occupied by a polo field, an airstrip, woolsheds and rural residences.

The Proposal Site is located within the Hallidays paddock of Jemalong Station. Hallidays is a paddock previously used for pasture and cropping. The proposed 66Kv transmission line connecting the solar plant to the existing West Jemalong Substation would traverse other paddocks within Jemalong Station. It would avoid other private landholdings and Crown Land.

Mining

In Forbes LGA, metallic mineral deposits include gold, iron and lead. The nearest known deposits are gold approximately 31 km west and south west of the Proposal Site (Department of Trade and Investment, 2015). These gold deposits are also part of the nearest operating mine to the Proposal Site, Cowal.

There are no current exploration licence applications held for the Proposal Site. The current mineral titles and exploration licence applications held in the Forbes region are illustrated in Figure 9-7.

Other land uses

The Proposal Site and all land immediately surrounding it is zoned RU1 Primary Production, with the exception of the Lachlan Valley Way zoned SP2 Infrastructure (Classified Road). The Proposal Site is not located on land proposed for rural residential development in local planning instruments, nor is it on land managed for forestry or conservation purposes. The nearest land zoned for conservation or forestry is approximately 4 km to the south. Crown Land is located adjacent to the Proposal Site to the west and south-west. No works are proposed on any land managed by Crown Lands.

The Proposal Site has a number of characteristics that make it suitable for development of a solar plant, including:

- High potential for solar energy production.
- Consistent solar access, with few to no obstructions shading the site.
- Nearby access to the electrical grid infrastructure.
- Flat site topography and geotechnical conditions that allow for a low impact module mounting structure and layout.
- Relatively distant location from sensitive receivers (approximately 1.7 km), reducing potential for noise and visual amenity impacts during all project phases.
- Low biodiversity values generally, and the ability to retain higher value areas, by careful siting of infrastructure and management prescriptions.

Further, the proposal is largely reversible; at the end of the project all above ground infrastructure would be removed and current agricultural land use activities could resume or other land uses could be considered.

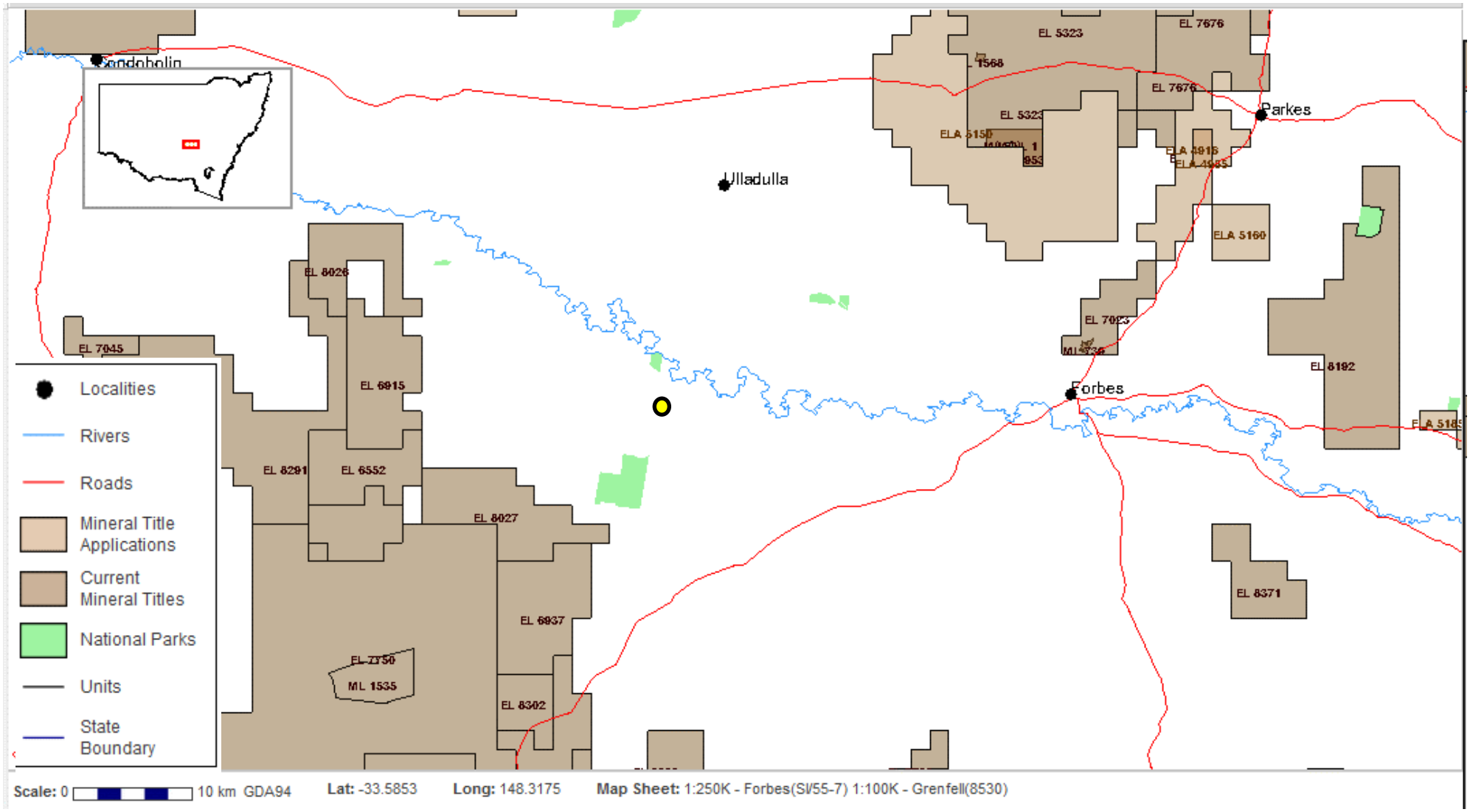


Figure 9-7 Mineral titles and applications within the locality of the Proposal Site (Department of Trade and Investment, 2015). *The Proposal Site is indicated by yellow circle*

Land and soil capability

Land capability is the inherent physical capacity of the land to sustain a range of land uses and management practices in the long term without degradation to soil, land, air and water resources (OEH 2012). The NSW land and soil capability assessment scheme (OEH 2012) describes and maps eight land and soil capability classes. The classification is based on the biophysical features of the land and soil (including landform position, slope gradient, drainage, climate, soil type and soil characteristics) and susceptibility to hazards (including water erosion, wind erosion, soil structure decline, soil acidification, salinity, waterlogging, shallow soils and mass movement).

The Proposal Site is located on land mapped in capability Classes 3. Refer Figure 9-8 and Table 9-25 for Class 3 description (OEH 2012).

The soil landscape within the Proposal Site corresponds to "Corinella, Scrubby Plains and Warroo Channel" mapped in the OEH eSPADE tool (OEH 2017), and discussed in Section 9.1.

Table 9-26 Land and soil capability class at the Proposal Site (OEH 2012)

Class 3
Moderate Limitations: Land capable of sustaining high impact land uses using more intensive, readily available and accepted management practices.

The State Government has mapped Biophysical Strategic Agricultural Land (BSAL) across the State; this is land which features the best quality soil and water resources and is capable of sustaining high levels of productivity. The Proposal Site is not located in an area mapped as BSAL. The site is also not likely to be considered 'Important Agricultural Land' as defined in Department of Primary Industries mapping as lands that are 'highly suitable for important agricultural industries at a local and regional scale'.

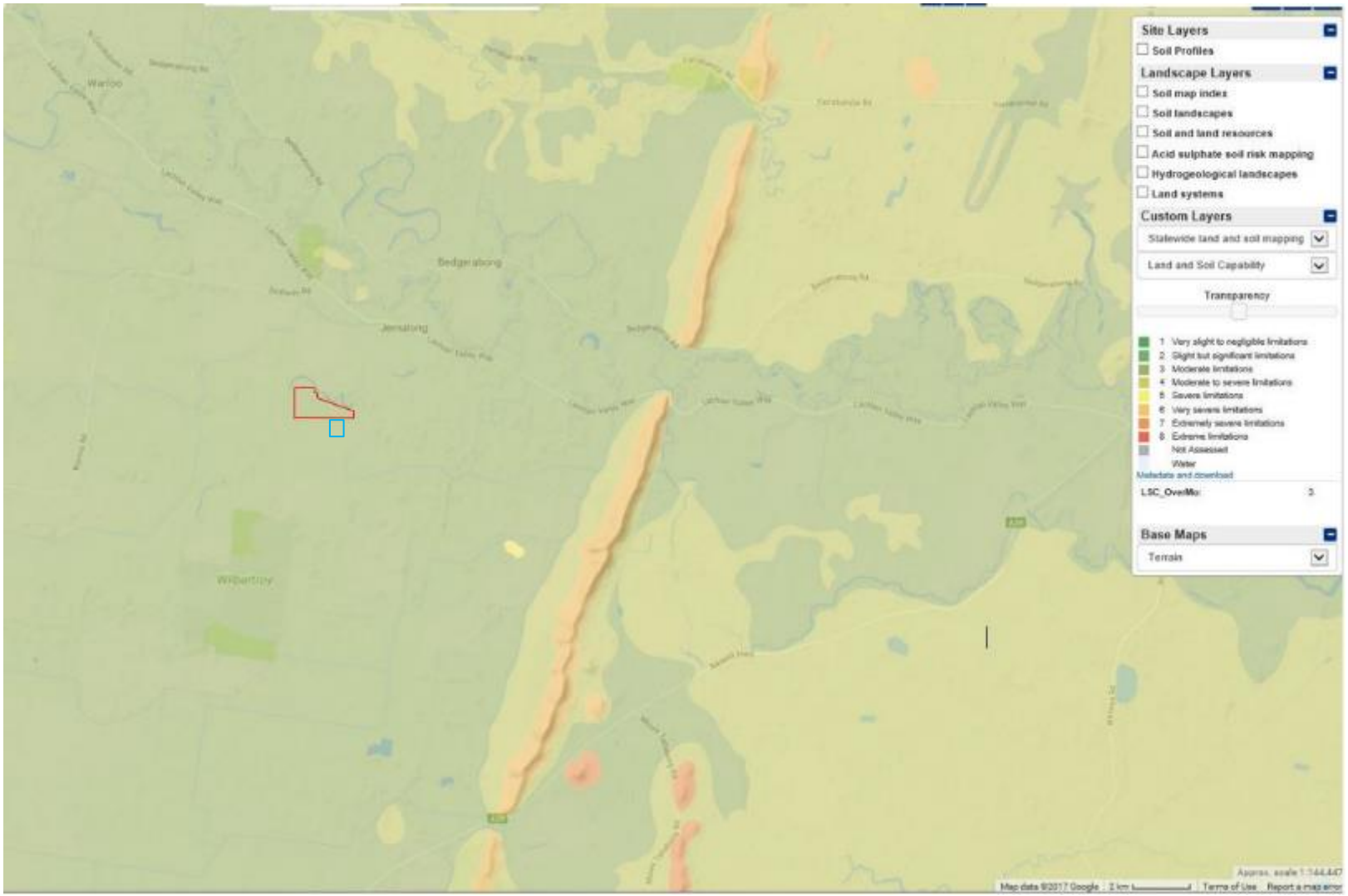


Figure 9-8 Land and soil capability classes in the vicinity of the Proposal Site

9.10.3 Potential impacts

Construction

During construction, agricultural activities would cease in areas required for access and construction of the proposal. Fencing would allow grazing within close proximity to the works areas, however collision risks from increased vehicle numbers may affect grazing nearby.

Construction of the transmission line would result in temporary loss of access to land along the transmission line easement during the construction period. Construction impacts would be short term and limited in extent.

No extraction of minerals or extraction licences would be impacted by the construction of the proposal.

No land use conflicts are foreseen during construction. The impacts would be temporary and mitigation strategies can reduce the level of impact on nearby agricultural activities.

Land and soil capability impacts

The proposal is not expected to adversely affect any of the biophysical factors or hazards which determine land and soil capability. During any broad area or trenchline excavations at the site, topsoil would be removed, stockpiled separately and replaced to restore the original soil profile. Topsoil salvaged from the construction of the access tracks and other works would also be securely stored for use in site rehabilitation. Following construction, a perennial cover would be established to protect soils, enhance landscape function and prevent wind and water erosion. Some soil nutrients are expected to run down over time with the cessation of the crop fertiliser regime. Soil impacts and mitigation measures are addressed in section 9.1. Soil restoration and treatments would be guided by the findings of a pre-works soil survey conducted at the site (refer section 9.1).

By maintaining perennial cover, the proposal would positively affect soils at the site by providing many of the benefits of long term fallow, including increasing soil moisture, building soil carbon levels, allowing structural recovery and improving conditions for soil biota. Depending on the results of soil testing, treatment for acidity may be required prior to the establishment of groundcover (refer section 9.1). No loss of productive potential is expected to result from the proposal.

Increased weed, biosecurity and bushfire risks

High biosecurity standards would be applied during the construction period, including pre-works weed treatment and maintaining high levels of weed and disease hygiene for construction vehicles, machinery and materials. A Weed Management Plan would be prepared for the construction and decommissioning phases. Similarly weeds and pest animals would be monitored and controlled as part of the continuing management of the PV Plant site (refer section 8.1). Impacts on flood risk, fire risk and aviation are assessed in section 9.6. These assessments conclude that the proposal would not be likely to adversely affect land uses or activities on neighbouring properties or elsewhere in the locality, subject to identified mitigation measures.

Resource impacts

The proposal would require approximately 18,000 m^3 of gravel to surface the access road and internal service track network and PCU and substation hardstand. Sand may be required for the bedding of underground cables, depending on the electrical design and ground conditions. Approximately 800 m^3 of

concrete would be required to construct the inverter, substation, CCTV. The availability of these resources is not declining or limited in the region.

Materials used in the fabrication and construction of the PV Plant infrastructure would include precast masonry products and concrete, steel, aluminium, copper and other metals, glass, plastics and fuels and lubricants. These are common industrial and construction materials. Silicon and silver are the major raw materials for crystalline silicon PV; resource availability is not limiting for these materials (Solar Power Europe 2017a). Most components would be reused or recycled when infrastructure is replaced or decommissioned (refer section 9.11).

In view of the nature of the resources, the limited quantities required and the opportunities for recycling, the proposal is unlikely to place significant pressure on the availability of local or regional resources.

It is estimated that approximately 3.4 ML of water would be required during construction, mostly for road bed preparation, but also for cleaning, concreting, on-site amenities and landscaping. The precise amount of water used during construction would be heavily affected by prevailing weather conditions and the need for watering to suppress dust generation.

A proportion of this water may be sourced from a Jemalong Station bore located southeast of the Proposal Site. The water supply channel runs along the southern boundary of the Proposal Site, as such, a portion of the channel could be used a retention pond for road wetting water, and water trucks would be able to directly pump the water from the Proposal Site.

Should bore water be unavailable, an allocation may be able to be purchased from Jemalong Irrigation Limited and delivered to the site via the Jemalong No 1 Channel. If that was not possible then bulk water tankers would be used to supply non-potable water to site. Based on a typical 27.5KL truck capacity, approximately 125 truck-trips would be required over the course of construction.

A small amount of potable (drinking) water (approximately 0.09 ML) would be imported to the site during the construction period. The potable water supply would be augmented by rainwater collection in tanks installed beside site buildings as constructed. Any requirement for potable water would be limited, confined to the construction phase and would not place pressure on local drinking water supplies.

Operation

Land use impacts

Primefact 1063 Infrastructure proposals on rural land

Primefact 1063 Infrastructure proposals on rural land (DPI 2013) provides the following guidelines to minimise impacts on agricultural resources and enterprises (summarised):

- proposals should be clearly justified in a regional context and merits and community benefits identified
- agricultural resource lands should be identified and avoided
- land use conflicts should be minimised
- landholders should be effectively consulted during planning, construction and rehabilitation works and the expectations of local communities should be managed
- development proposals should identify suitable mitigatory/remediation responses for all likely agricultural impacts.

This EIS has strategically justified the proposal and identified community benefits (sections 2 and 11). The proposal would result in reduced agricultural production for the life over the PV Plant, but would not affect long term capability or use options. A Community Consultation Plan has been developed to inform the community and respond to concerns (section 6). Neighbours in particular have been consulted to avoid land use conflict. The landholder would lease the property to the proponent and has been involved in the development of lease terms and proposal plans. A comprehensive set of mitigation measures has been developed to avoid impacts to long term land use capability (section 10.2).

The potential sustainable agriculture impacts identified in the Primefact are addressed below in relation to the current proposal.

Resource loss and fragmentation

While there are no resource exploration or mining applications, licences or leases indicated for the site in the relevant databases, the proposal would be likely to preclude the extraction of mineral resources from the site for the life of the PV Plant. The proposal would not prevent future resource exploitation following decommissioning of the PV Plant.

Impacts on farming operations and livestock

During operation, the Proposal Site would change from agricultural land use to power generation. Trees and tall shrubs would be suppressed under the transmission line to assist maintenance of infrastructure. However, grazing within the easement would be possible.

The area affected by the operational footprint, including the new transmission line, would be 187.17 ha. The duration of the project would be 30 years. The loss of this amount of agricultural land in the region for this period is not considered a significant loss either in the locality or for the Twynam Pastoral Co Pty Ltd, who, as an involved landowner, would be compensated financially for these losses from the operation of the proposal.

Best practice waste and wastewater management, fuel storage and re-fuelling and chemical handling would be stringently applied to prevent soil and water pollution (refer section 9.2). Construction noise and traffic would be managed to minimise impacts to landholders around the site and along the access route (refer section 9.3).

Impacts on soils and erosion risk are assessed in section 9.1, impacts on downstream water quality are assessed in section 9.2 and impacts on local air quality are assessed in section 9.9. These assessments conclude that the proposal would not be likely to adversely affect land uses or activities on neighbouring properties or elsewhere in the locality, subject to identified mitigation measures.

LUCRA assessment

The DPI Land Use Conflict Risk Assessment (LUCRA) system is intended to identify and assess the potential for land use conflict between neighbouring land uses. The environmental assessment presented in this EIS is consistent with the LUCRA approach, by defining the development, site and locality characteristics, proactively consulting stakeholders and neighbours (section 6) and systematically identifying risks and potential impacts. An impact risk assessment for the proposal is provided in section 7. The identification and assessment of impacts which may affect neighbours and other stakeholders is provided in sections 8 and 9. The assessments conclude that impact risks to neighbours are not likely to be significant, and manageable using continuing consultation and notification, best practice works methods and identified mitigation measures.

Future land uses

Given the context of the site, surrounded by large agricultural land holdings, no land use conflicts are likely during operation in terms of rural residential development, land managed for forestry or conservation purposes.

During the operation of the proposal, future mineral exploration would be limited within the site boundary. Exploration in areas with above ground infrastructure would be precluded. Traffic and additional underground infrastructure such as cabling would make exploration in other areas very difficult and this would not be preferred.

Decommissioning

Following decommissioning of the PV Plant, a Site Rehabilitation Plan would be implemented to fully restore agricultural potential and land use opportunities at the Proposal Site. All infrastructure to a depth of 500mm and internal track surfacing would be removed, soils would be decompacted as required, any required reinstatement of paddock levels, small dams and irrigation and drainage channels would be undertaken and a suitable cover crop sown to stabilise the site.

Property subdivision

The Proposal would require the subdivision of the property to accommodate the substation, the PV Plant lot and residue lot; refer section 4.3. At the end of the life of the PV Plant the excised lot would be reconsolidated back into the residual lot. The subdivision would not affect future land use potential, resource extraction or land use planning options at the Proposal Site.

9.10.4 Mitigation measures

Mitigation measures to ensure that adverse impacts to land use and resource values at the Proposal Site are avoided and minimised are provided in Table 9-27. Mitigation measures in the EIS relating to the protection of soils (section 9.1) and water quality (section 9.2) and control of pest plants and animals (section 8.1) are also relevant to the protection of land use and resource values at the Proposal Site.

Table 9-27 Mitigation measures for impacts to land use and resource values

Mitigation measures	Phase
Essential Energy would be consulted prior to commencement of works to ensure that the works do not adversely affect electricity transmission or impede access for inspection and maintenance.	Pre-construction
Construction and operations personnel would drive carefully and below the designated speed limit according to the Traffic Management Plan, to minimise dust generation and disturbance to livestock.	Construction Operation Decommissioning
Consultation with Jemalong Station Farm Manager regarding any temporary impacts to access or risks to livestock. Additional specific mitigation may be required such as: • Additional fencing to protect livestock from collision risks. Vehicle speed restrictions on access roads.	Construction Decommissioning
Landholders and residents adjacent to the property and along the access route from the Lachlan Valley Way would be consulted and notified regarding the timing of works to minimise the noise, dust, traffic and other disturbance impacts.	Construction Decommissioning
Underground cabling and other works to remain in situ following decommissioning of the	Construction

Mitigation measures	Phase
PV Plant would be installed deeper than 500mm to allow cultivated cropping to resume following decommissioning.	
If possible and practical, sheep grazing would be used as a preferred option to control weeds and grass growth, and to maintain agricultural production at the site.	Operation
A DEMP would be prepared and submitted to DP&E for approval prior to decommissioning. The DEMP would include a Site Rehabilitation Plan covering: • criteria and indicators for the restoration of land capability and agricultural potential based on pre-works soil survey results • details of rehabilitation actions such as removal of infrastructure, remediation of soils, reinstatement of dams and irrigation/drainage channels as required and establishment of suitable groundcover vegetation on bare areas • a monitoring and assessment process to demonstrate that the target state has been achieved • an expected timeline for the rehabilitation program.	Decommissioning

9.11 WASTE

9.11.1 Background

The National Waste Policy: Less waste, more resources (EPHC 2009) sets out the objectives, principles, outcomes and strategies for waste management. The policy aims to:

- *avoid the generation of waste, reduce the amount of waste (including hazardous waste) for disposal, manage waste as a resource and ensure that waste treatment, disposal, recovery and re-use is undertaken in a safe, scientific and environmentally sound manner, and*
- *contribute to the reduction in greenhouse gas emissions, energy conservation and production, water efficiency and the productivity of the land.*

In NSW, waste management and pollution are regulated under the POEO Act and the *Protection of the Environment Operations (Waste) Regulation 2005.* Unlawful transportation and deposition of waste is an offence under Section 134 of the Act. Littering is an offence under Section 145 of the Act.

The NSW *Waste Avoidance and Resource Recovery Act 2001* contains waste minimisation and management objectives, including:

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

The NSW Waste Avoidance and Resource Recovery Strategy (EPA 2014), the 'WARR Strategy', provides a framework for achieving these statutory objectives, focusing on the following key result areas:

- avoid and reduce waste generation
- increase recycling
- divert more waste from landfill
- manage problem wastes better
- reduce litter
- reduce illegal dumping.

The Central West (CENTROC) and Orana Regional Organisation of Councils (OROC) NetWaste Strategic Waste Plan has been developed in line with EPA guidelines and aims to achieve a coordinated approach to waste management based on the WARR Strategy key result areas.

9.11.2 Potential impacts

Construction

The management of waste during the construction phase would observe the objectives of the *Waste Avoidance and Resource Recovery Act 2001* and the relevant key result areas of the WARR Strategy and the NetWasteStrategic Waste Plan.

Solid waste is one of the major pollutants caused by construction. A number of different construction activities associated with the proposal would produce solid wastes, including:

- packaging materials
- excess building materials
- scrap metal and cabling materials
- plastic and masonry products, including concrete wash
- excavation of topsoils and vegetation clearing
- bio wastes, from on-site septic and greywater systems.

In accordance with the definitions in the POEO Act and associated waste classification guidelines, most waste generated during the construction and decommissioning phases would be classified as building and demolition waste within the class *general solid waste* (non putrescibles). Ancillary facilities in the site compound would also produce sanitary wastes classified as *general solid waste* (putrescibles) in accordance with the POEO Act. Waste produced during construction would be disposed of at an appropriately licensed waste facility. Green waste from tree clearing would be mulched for use in rehabilitation at the site, or removed from the site.

Operation

During the operation phase, the solid waste streams would be associated with maintenance activities and presence of employees. Some materials, such fuels, lubricants and metal and electrical components, are likely to require replacement over the operational life of the PV Plant. These materials would be reused or recycled wherever possible.

Decommissioning

As during the construction phase, waste during decommissioning would be handled in line with the objectives of the relevant legislation, policies and strategies. Decommissioning of the PV Plant would involve the recycling or reuse of materials including:

- solar panels and mounting system
- metals from posts, cabling, fencing
- buildings and equipment such as the inverters, transformers and similar components.

Buildings and major electrical equipment would be removed for resale or reuse, or for recycling as scrap.

Items that cannot be recycled or reused, would be disposed of at appropriate facilities in accordance with applicable regulations. All above ground infrastructure would be removed from the site during decommissioning.

Lifecycle analysis

Life cycle analysis (LCA) assesses and quantifies the energy and material flows associated with a given process to identify the resource impacts of that process and potential for resource recovery. LCA estimates of energy and emissions based on the total life cycle of materials used for a project, i.e. the total amount of energy consumed in procuring, processing, working up, transporting and disposing of the respective materials (Schleisner 2000).

A life cycle inventory of polycrystalline PV panels has been undertaken by European and US photovoltaic module manufacturing companies over the 2005/2006 period. The ‘energy payback time’ for polycrystalline PV modules has been estimated at two years for a solar installation in Southern Europe

(Fthenakis *et al*. 2011). Recycling multi-crystalline cells can further reduce manufacturing energy by over 50% (Muller *et al.* 2006).

The purification of the silicon, which is extracted from quartz, accounts for 30% of the primary energy to produce the module. This stage also produces the largest amount of pollutants with the use of electricity and natural gas for heating (Fthenakis *et al.* 2011). The waste produced during production of the modules which can be recycled include graphite crucibles, steel wire and waste slurry (silicon and polyethylene glycol). However, silicon crystals cannot be recycled during this stage (Fthenakis *et al.* 2011). The production of the frames and other system components including cabling would also produce some emissions and waste.

The carbon footprint of PV systems - assuming a location in southern Europe - ranges from 16 to 32 gCO2 eq. per kWh compared to between 300 and 1000 g CO2 eq. per kWh when produced from fossil fuels (Solar Power Europe 2017b). In terms of the water footprint, PV consumes 0.1 l/kWh(VI), mainly during manufacturing and recycling, compared to 0.75 to 75 l/kWh for typical fossil fuel electricity production in a southern Europe location (Solar Power Europe 2017c).

9.11.3 Mitigation measures

Mitigation measures to avoid and minimise waste impacts are identified in Table 9-28.

Table 9-28 Mitigation measures for waste impacts

Mitigation measures	Phase
A Waste Management Plan (WMP) would be developed to minimise waste, including: • identification of opportunities to avoid, reuse and recycle, in accordance with the waste hierarchy • quantification and classification of all waste streams • provision for recycling management on-site • provision of toilet facilities for on-site workers and identify that sullage would be disposed of (i.e., pump out to local sewage treatment plant) • tracking of all waste leaving the site • disposal of waste at facilities permitted to accept the waste • requirements for hauling waste (such as covered loads).	Construction Operation Decommissioning
A septic system would be installed and operated according to the Forbes Shire Council regulations.	Construction Operation

9.12 CUMULATIVE IMPACTS

9.12.1 Existing environment

Cumulative impacts relate to the combined effect of similar or different impacts on a particular value or receiver, and may occur concurrently or sequentially. For these purposes, cumulative impacts are associated with other known or foreseeable developments occurring in proximity to the proposal. The preceding assessment sections take into account the potential for the proposal to interact with existing conditions in the study area.

The Jemalong Hybrid Solar Park will comprise of 50MW PV Solar Plant located on the north side of the Hallidays paddock and a 30MW CSP Plant located in the south eastern section of Lot 13 DP753118. These stations will share connection and transmission infrastructure.

The DP&E Major Project Register and the Forbes Shire Council, and Parkes Council websites were searched for nearby developments which may be relevant to the assessment of cumulative impacts. Other proposed solar park developments which may contribute to the cumulative impacts of the proposal include:

- the proposed 70MW Goonumbla Solar, 47km north east of the site
- the proposed 65MW Parkes Solar, adjacent to Goonumbla Solar.

Other infrastructure projects in the region which may be concurrent with the proposal include the Syerston Nickel Cobalt Mine, Northparkes Copper and Gold Mine, North West Parkes 120MW Gas fired Power station.

9.12.2 Potential impacts

Goonumbla and Parkes Solar Plants

Considering the distance of this proposal from the Goonumbla and Parkes Proposal Site, there is unlikely to be any cumulative impacts during construction or operation. The only potential cumulative impacts that could result are socio-economic impacts resulting from additional pressure on availability of accommodation for the labour force to be employed. However, the number of towns in close proximity to the Proposal Sites will remove any pressures.

Jemalong Hybrid Solar Park

Construction and decommissioning

Biodiversity

The clearing of native vegetation, which is a key threatening process at both State and Commonwealth level, is considered a major factor in the loss of biological diversity. At least 61 per cent of the native vegetation in NSW has been cleared or highly modified since European settlement (NSW Scientific Committee 2001e), and the removal of the minimal amount of vegetation for the Hybrid solar station is contributing to this process. However, the large majority of native woodland in the Proposal Site has been preserved due to a design aimed at minimizing clearing of native vegetation in the study area. This is most apparent with the preservation of all Western Grey Box Woodland within the Proposal Site.

Furthermore the development of the CSP solar field will be over a cleared and levelled irrigated agricultural field.

The loss of large habitat trees or hollow-bearing trees is a long-term cost of projects such as these, because these features of the environment can take well over 100 years to form (Mackowski, 1984; Wormington & Lamb 1999). Loss of hollow bearing trees would offset by development and implementation of an Offset Management Plan.

The additional clearing impacts proposed would be minor and not likely to add substantially to cumulative impacts of native vegetation removal.

Cumulative impacts are considered best addressed by avoiding and minimising. This has been achieved via site selection, and construction of the CSP in an over a cleared and levelled irrigated agricultural field. Where avoidance is not possible, the impacts of each contributing project has been assessed on a case by case basis.

Traffic impacts

Construction traffic impacts include:

- Minimal increases in collision risks (other vehicles, stock and wildlife).
- Some incremental damage to road infrastructure.
- Associated noise and dust (where traffic is on unsealed roads) may adversely affect nearby receivers.
- Potential minor disruption to existing school bus services and farm vehicle movements.

A TMP would be prepared to take into account other road users including buses and tourist or trade events that may generate additional traffic impacts.

Construction Traffic along Lachlan Valley Way would increase if the CSP and PV Plants were built concurrently. This may lead to congestion or delays to traffic due to the movement of heavy good vehicles. The frequency of road maintenance may increase. However, it is envisaged that the CSP Plant will be built after commissioning of the PV Plant is completed, as such an increase in traffic density directly related to the construction activities is not expected.

During operation, both Wilbertroy Lane and Naroo Lane would also be used to access the CSP Plant. Grain trucks may experience some congestion during the harvest season, however such impacts would be temporary and short term. Furthermore, the labour force required for the operation and management of the PV and CSP Plant would not exceed eight persons, which is an insignificant increase in daily vehicle trips on these Lanes, particularly during the harvest seasons.

Economic and resource impacts

There is potential for positive cumulative economic effects of the PV and CSP Plant during the construction phase. They would potentially generate more jobs for local residences and income for local business suppliers. However, there may be some negative impacts if construction works are undertaken concurrently. This includes additional pressure on availability of accommodation for the labour force to be employed.

Amenity impacts would be managed through a consultation processes, including complaints mechanisms, whereby the sources of complaints are promptly identified and addressed. Although the construction process would be relatively long (12 months) these amenity impacts would be temporary and unlikely to be present equally at any one location. The construction activities and their location onsite would be changing throughout the construction process. Considering the distance to sensitive receivers and their

low numbers, the cumulative effect of these impacts is considered highly manageable. Cumulative construction impacts are considered to be best managed by managing well each component (dust, noise etc.) individually. Cumulative decommissioning impacts would be minor. Cumulative impacts would be managed at the time of decommissioning. Infrastructure developed during construction (e.g., access tracks) would be utilised during decommissioning.

Noise impact

Noise impacts through the use of plant machinery and vehicles would be heightened if the works on both the PV and CSP solar plants are undertaken concurrently. However, residential and other noise sensitive receivers are a considerable (closest receiver is 1.7kilomoters) distance from both solar plants. Cumulative impacts are therefore unlikely to increase construction noise impacts above noise management guideline levels. Overall, cumulative noise impacts are expected to be minor and would be managed by the implementation of mitigation measures and construction planning that considers both solar plant, where relevant. Should the two solar plants be built successively this may increase the duration of construction noise which may be heard by receivers.

Operation

During operation, cumulative impacts would be minimal. Impacts are identified as follows:

Visual

The VIA determined the PV Plant to have an overall low level of visual impact. The addition of the CSP Plant would extend the overall area to be occupied by solar infrastructure. However, the visual impacts of the combined proposal are expected to be similar and would be managed according to each project's management measures.

Noise

Cumulative noise impacts during operation of the Jemalong Hybrid solar park would be minimal and noise levels are likely to comply with the criteria conservatively established in accordance with the NSW Industrial Noise Policy 2000 without any specific acoustic treatment.

Biodiversity

The Jemalong hybrid solar park would pose minimal operational risks to biodiversity; specifically, no minor impacts to bird and bats during the CSP solar plant operation, and negligible impacts from the PV operation.

Economic impacts

The Jemalong hybrid solar park would result in additional staff being employed within the locality resulting in positive employment impacts.

Agricultural production from the Proposal Site would be affected during the operation of the solar plant. Following decommissioning, the existing forms of agricultural production (grazing and cropping) could resume. Existing land used for grazing and cropping could continue under the proposed transmission line during operation. Sheep grazing could potentially continue within the solar plant area, but would occur at reduced levels of production. A temporary reduction in agricultural production at the Proposal Site is not expected to have a major impact on the overall agricultural production from Jemalong Station or the Forbes areas.

Greenhouse gas emissions and air quality impacts

The cumulative impact of additional renewable energy generator in the region would have positive impacts for NSW in terms of provision of electricity to meet increasing demand as well as the reduction of coal fired electricity generation with the associated environmental benefits.

9.12.3 Mitigation measures

Cumulative impacts are best addressed through careful management of individual components, as set out in the sections above. Mitigation measures to avoid and minimise cumulative impacts are identified in Table 9-28.

Table 9-29 Mitigation measures for waste impacts

Mitigation measures	Phase
Construction management plans prepared for the proposal would take into account the cumulative impacts of any council or RMS road works should these activities occur concurrently.	Preconstruction Construction
Construction noise management plans prepared for the proposal would take into account the cumulative impacts where works on the PV and CSP plants concurrently.	Preconstruction Construction

10 ENVIRONMENTAL MANAGEMENT

10.1 ENVIRONMENTAL MANAGEMENT FRAMEWORK

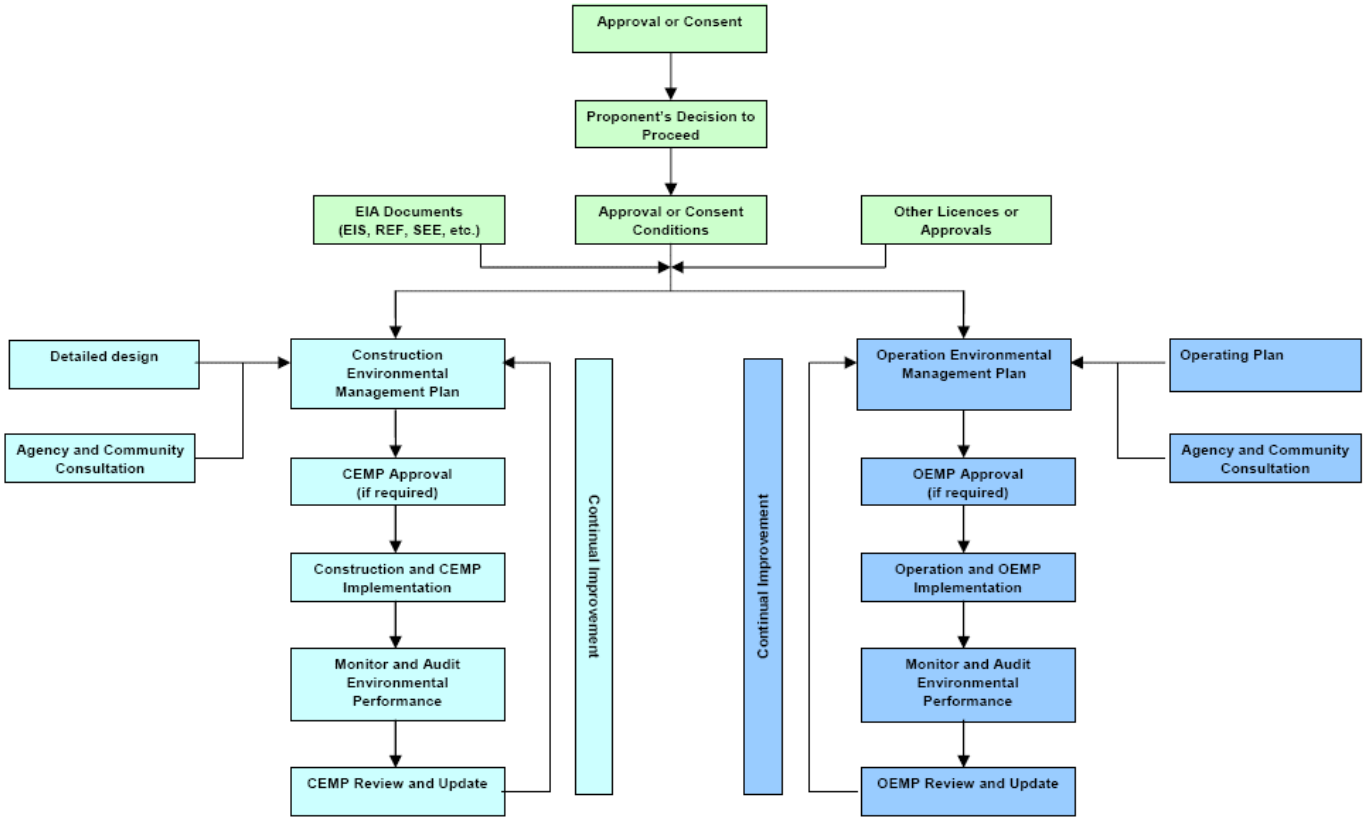
10.1.1 Environmental Management Plans (EMPs)

Environmental protection and management measures would be implemented via a CEMP, OEMP and a DEMP. These plans would be prepared sequentially, prior to each stage of works.

The EMPs would include performance indicators, timeframes, implementation and reporting responsibilities, communications protocols, a monitoring program, auditing and review arrangements, emergency responses, induction and training and complaint/dispute resolution procedures. The monitoring and auditing program would clearly identify any residual impacts after mitigation. Adaptive management would be used to ensure that improvements are consolidated in updated EMPs.

The EMP framework including CEMP and OEMP, is illustrated in Figure 10-1. The EMPs would incorporate all of the specific mitigation measures contained in this EIS.

Figure 10-1 Post-approval Environmental Management Plan (EMP) process (DIPNR 2004).



10.1.2 Sub-plan structure

The CEMP would incorporate the following sub-plans:

- Soil and Water Management Plan, incorporating an Erosion and Sediment Control Plan and Site Drainage Plan (section 9.1)
- Traffic Management Plan (section 9.5).
- Biodiversity Management Plan (section 8.1).

The following plans would be finalised prior to construction and implemented at all stages of the proposal via the CEMP and the OEMP:

- Emergency Response Plan, incorporating an Evacuation Plan, Fire Response Plan, Flood Response Plan (section 8.4 and 9.6) and Spill and Contamination Response Plan (sections 9.1, 9.2)
- Fire Management Plan (section 9.7)
- Noise Management Plan (section 9.3)
- Waste Management Plan (section 9.11).

The DEMP would also incorporate a Site Rehabilitation Plan (section 9.1).

10.2 CONSOLIDATED MITIGATION MEASURES

The mitigation measures contained in this report comprise proposal-specific safeguards, recommendations from specialist assessment reports and reference to a range of best practice guidelines and regulatory requirements. The measures are to be incorporated in project plans and designs, contract specifications and the CEMP, OEMP and DEMP as appropriate. The mitigation measures are consolidated below. Where measures are relevant to more than one environmental aspect, they are cited only once under the most relevant aspect, to avoid duplication.

Table 10-1 Consolidated list of mitigation measures

No.	Mitigation measure	Phase
Biodiversity		
B1	Clearing impacts would be minimised by: • A CEMP would be prepared including an erosion sediment control plan, vegetation management measures, a revegetation and weed management program, fauna management measures, and Work Methods Statements for all works within 10 m of the waterways occurring adjacent to the Proposal Site. All site workers should be inducted and made aware of the conservation issues and associated CEMP for the site. • Prior to the commencement of work, the clearing limit needs to be clearly demarcated and implemented. The delineation of such a boundary may include the use of temporary fencing, flagging tape, parawebbing or similar. • Pre-clearing surveys would be carried out by an ecologist and would include targeted surveys for nesting Superb Parrots, Grey-crowned Babblers, Brown Treecreepers and general tree hollow inspections where possible. They would include targeted searches for arboreal fauna and inspections of vegetation for other fauna occupancy. Habitat trees would be clearly marked with flagging tape. If active nests are found during clearing works, or hollows are being used by nesting birds or arboreal mammals, an ecologist or local wildlife carer should be contacted to remove the eggs, chicks or juvenile mammals to be hand-raised. • Trees would be removed in such a way as not to cause damage to surrounding vegetation. Root systems of trees and shrubs to be removed should be retained in-ground to ensure surrounding ground layer vegetation is undisturbed and to prevent soil erosion. • Where possible, trees to be removed would be mulched on-site and re-used to stabilise disturbed areas. • Where trees are to be retained, an adequate tree protection zone (TPZ) should be provided around each tree for the duration of construction. Details for calculating TPZs are provided within *Australian Standard 4970-2009 – Protection of trees on development sites*. • If work cannot avoid encroaching into the TPZ, it would not impinge on the structural root zones (SRZ) of trees to be retained. Details for calculating the SRZs are provided within *Australian Standard 4970-2009 – Protection of trees on development sites*. • An unexpected threatened species finds procedure would be developed before clearing is begun.	Construction

No.	Mitigation measure	Phase
B2	Hollow bearing tree impacts would be minimised by: • Staged habitat removal for the removal of hollow-bearing trees would be undertaken where non-habitat vegetation would be cleared initially following a pre-clearing inspection by a qualified ecologist. Habitat trees would be disturbed by 'knocking' at this time and cleared at least 24 hours after. • Clearing of hollow-bearing trees would not take place between September and February, where possible. If clearing during this period cannot be avoided, an ecologist would be present on site to check all hollows for animals. If a hollow is being used by a threatened species (e.g. Superb Parrot), an exclusion barrier of appropriate distance (e.g. 30 m from the base of the tree) would be installed to prevent disturbance. If a hollow is being used by a species not listed under the TSC Act or EPBC Act, any animals present will be caught and either released into appropriate alternative habitat or taken to a wildlife carer.	Construction
B3	Residual impacts would be offset: • An Offset Management Plan would be developed and implemented to offset the loss of native vegetation, including hollow-bearing trees. This may include direct offsets or other strategies to improve biodiversity outcomes commensurate with the impacts of the project on native vegetation.	Operation
B4	To minimise impacts native vegetation outside the impact zone, stockpile and compound sites would be located using the following criteria: • Within the Proposal Site. • At least 40 m away from the nearest waterway. • In areas of low ecological conservation significance (i.e. previously disturbed land). • On relatively level ground. • Outside the 1 in 10 year Average Recurrence Interval (ARI) floodplain.	Construction
B5	A Weed Management Plan would be developed for the sites to prevent/minimise the spread of weeds in and between sites. This would include: • Declared noxious weeds would be managed according to the requirements stipulated by the *Noxious Weeds Act 1993* during and post construction • Develop protocol for weed hygiene in relation to plant, machinery and importation and management of fill • All pesticides would be used in accordance with the requirements on the label. Any person undertaking pesticide (including herbicide) application would be trained to do so and have the proper certificate of completion/competency or statement of attainment issued by a registered training organisation. • Any occurrences of pathogens such as Myrtle Rust and Phytophthora would be monitored, treated and reported.	Construction Operation Decommissioning
B6	Disturbance to habitat features would be minimised by:	Construction

No.	Mitigation measure	Phase
	• Any fallen timber, dead wood and bush rock (if present) encountered on site would be left in situ or relocated to a suitable place nearby. Rock would be removed with suitable machinery so as not to damage the underlying rock or result in excessive soil disturbance.	
B7	To minimise injuries to microbats and birds: • Use of barbed wire would be avoided.	Construction Operation
B8	Implement feral animal management program, including species such as rabbits, rodents and starlings to reduce risk of attracting raptors.	Operation
Aboriginal heritage		
A1	A Cultural Heritage Management Plan would be prepared to guide the process for management and mitigation of impacts to Aboriginal cultural heritage. This would be undertaken in consultation with a consulting archaeologist, the registered Aboriginal parties and the NSW Office of Environment and Heritage. The 66kv HV line has been relocated eastward away from the lagoon so that the predicted sensitive area within 200m of the lagoon is avoided. Parts of the new alignment were not surveyed in 2014. Additional survey will need to be carried out during the detailed design phase.	Pre-construction
A2	Personnel involved in the construction and management phases of the project would be trained in awareness and procedures to implement recommendations relating to cultural heritage, as necessary.	Construction
A3	Cultural heritage would be included within any environmental audit of impacts proposed to be undertaken during the construction phase of the development.	Construction
A4	In the unlikely event that human remains are discovered during the construction, all work must cease in the immediate vicinity. OEH, the local police and the registered Aboriginal parties should be notified. Further assessment must be undertaken to determine if the remains were Aboriginal or non-Aboriginal.	Construction
A5	Additional archaeological assessment would be required in any areas which are proposed for impacts that have not been surveyed during the current assessment	Construction
Visual amenity and landscape character		
V1	The following measures are recommended to reduce the general visual impact of the development: • PV Plant infrastructure should be reduced in height as far as practicable. • the materials and colour of onsite infrastructure will, where practical, be non-reflective and in keeping with the materials and colouring of existing infrastructure or of a colour that will blend with the landscape. Where practical:	Design

No.	Mitigation measure	Phase
	○ buildings and other infrastructure will be non-reflective and in eucalypt green, beige or muted brown. ○ mounting systems for the solar arrays will be non-reflective. • security fencing posts and wire would be non-reflective; green or black rather than grey would reduce the industrial character of the fence.	
V2	Parking areas, material stockpiles and other construction activities would be located as far as practical from nearby residences and roads or screened (by existing vegetation) for the period of construction.	Construction
V3	Areas of soil disturbed by the project would be rehabilitated progressively or immediately post-construction, reducing views of bare soil.	Construction
V4	Night lighting would be minimised to the maximum extent possible (i.e. manually operated safety lighting at main component locations) Light fittings shall be directional as deemed appropriate for their use and intended areas of illumination. Lighting column and lighting head design should be chosen to limit back spill and any unwanted light spill to other site areas or, those areas off the site. Strictly monitor the light intensity, direction and duration of lighting. Design and install lighting such that light bulbs and reflectors are not visible from public viewing areas. Lighting should not cause reflected glare.	Construction
V5	A verification process would be implemented close to the completion of the construction phase. A Visual Verification Report and Landscape Plan would: • confirm the assumptions of this assessment by ground based assessment and ensure medium impacts are mitigated. • finalise the location and species for proposed screening, in consultation with nearest affected landholders. detail planting methods and maintenance requirements of the screen planting.	Construction
V6	Select colours for above ground structures, including the construction site offices, sympathetic to the landscape character of the site.	Construction
V7	The following screening requirements would be met: • planting would be more than one row deep and preferably be located on the outside of the security fence, so that it breaks up views of the fencing as well as onsite infrastructure. The final location of planting and density would be undertaken following verification of actual impacts. • the plant species to be used in the screen are to be native and consistent with existing vegetation types on the Proposal Site. They should be fast growing, with spreading habit. Species selection should be undertaken in consultation with a botanist. • vegetation should include a high shrub layer which would provide a more effective visual screen compared to trees as the panels would be maximum 3m high. Where feasible, plants selected should be of adequate size when initially planted to allow	Construction

No.	Mitigation measure	Phase
	immediate effect as a visual screen. • the timing is recommended to be close to completion of construction so that actual and not predicted impacts of infrastructure are mitigated. The screen would be maintained for the operational life of the PV Plant. Dead plants would be replaced. Pruning and weeding would be undertaken as required to maintain the screens visual amenity and effectiveness in breaking up views.	
Hydrology and water quality		
H1	The design of buildings and equipment foundations would consider the potential for flooding at the site	Design/ Pre-Construction
H2	PV modules in flood prone areas of the Proposal Site would be installed on modules of 3 to 3.5m high	Design/ Pre-Construction
H3	Earthen pads to be constructed for PCU's	Design/Construction
H4	Critical infrastructure to be located in site locations that are not subject to flooding, 1/25 year event	Design/Construction
H5	Grazing under tree canopies adjacent to the Lagoon would be prevented, so as to prevent erosion and sedimentation entering the lagoon.	Design Operation
H6	The design and construction of the internal access tracks will include soil erosion and sediment control measures.	Design Construction
H7	The Flood Response Plan covering all phases of the project would: • detail who would be responsible for monitoring the flood threat and how this is to be done • detail specific response measures to ensure site safety and environmental protection • outline a process for removing any necessary equipment and materials offsite and out of flood risk areas • consideration of site access in the event that some tracks become flooded • establish an evacuation point • define communications protocols with emergency services agencies.	Preconstruction Construction Operation Decommissioning
Soils and landforms		

No.	Mitigation measure	Phase
S1	The solar array would be designed and installed to allow sufficient space between panels to establish and maintain perennial groundcover (subject to climatic conditions).	Preconstruction Construction
S2	A CEMP would be implemented to manage runoff, soil erosion and sedimentation and pollution risks at the site. The CEMP would be prepared in accordance with the 'Blue Book' Volume 1 Managing Urban Stormwater: Soils and Construction (Landcom 2004), Volume 2A Installation of Services (DECC 2008a) and Volume 2C Unsealed Roads (DECC 2008b).	Pre-construction Construction
S3	As part of the CEMP, a Soil and Water Management Plan (incorporating a Site Drainage Plan and Erosion and Sediment Control Plan) would be prepared, implemented and monitored during the proposal to minimise soil and water impacts. These plans would include provisions to: • install, monitor and maintain erosion controls • identify and protect sensitive features such as native vegetation, dams and Irrigation channels • ensure that machinery leaves the site in a clean condition to avoid tracking of sediment onto public roads • manage topsoil: in all excavation activities, separate subsoils and topsoils to restore natural soil profiles and assist revegetation, guided by the findings of the pre-works soil survey. Topsoils stockpiled for extended periods would be managed to avoid contact with overland runoff, minimise weed risks, and maintain soil organic matter, soil structure and microbial activity • minimise the area of disturbance from excavation and compaction and rationalise vehicle movements to minimise soil impacts • ensure any discharge of water from the site is managed to ensure ANZECC (2000) water quality criteria are met • as far as practicable, ensure excavations are not scheduled when heavy rainfall events are predicted or soils are saturated.	Pre-construction Construction
S4	The CEMP, OEMP and DEMP and relevant sub-plans should incorporate the following management recommendation: • soil disturbance should be kept to a minimum where higher localised salinity or sodicity may be present. Topsoil stripping should avoid mixing salty and/or sodic subsoils with the topsoil – testing is recommended. Excavation of subsoils should be limited and subsoils should be stockpiled and contained to avoid dispersion and sediment transfer • direction of surface waters and run-on should be avoided to minimise mobilisation of any salts stored in the soil • appropriate infrastructure design is required to avoid damage caused by shrink-swell clays • deep rooted vegetation should be maintained where present, ground clearing should be minimised and ground cover around the structures should be maintained where possible • seed bed preparation and rolling, gypsum and/or composted organic matter will improve surface structure and germination in coarse structured soils. Low intensity, deep watering should be used. Fertilisers should be applied before and during plant growing periods. Compaction relief may be required for revegetation • plant species used for revegetation need to be adapted to cracking, alkaline, moderately to poorly drained, fertile soils with high plant	Preconstruction Construction Operation Decommissioning

No.	Mitigation measure	Phase
	available water holding capacity.	
S5	A contamination management plan would be developed to address: • Clean up of the existing farm rubbish site within the Proposal Site. Procedure for discovering buried contamination within the Proposal Site (eg pesticide containers). Disposal would be at a facility able to accept the waste.	construction
S6	A water cart (or other means) would be utilised to manage dust on all access roads and exposed dusty surfaces in response to visual cues and complaints.	Construction Operation Decommissioning
S7	Spill Response Plan would be developed as part of the overall Risk Management Plan to prevent contaminants affecting adjacent pasture and dams. It would: • Manage the storage of any potential contaminants onsite. Mitigate the effects of soil contamination by fuels or other chemicals (including emergency response and EPA notification procedures and remediation).	Construction Decomissioning
S8	The substation will be cooled with silicone or mineral oil (5000L), oil containment and fire safety measures outlined in Ausgrid (2017) NS189 Oil Containment for Major Substations would be implemented.	Preconstruction Construction Operation
S9	Following the construction phase, a Site Rehabilitation Plan would be implemented remediating soils as, removing rubbish, restoring soil and landform profiles and decompacting soils in construction areas.	Construction
S10	Any area that was temporarily used during construction (laydown and trailer complex areas) would be restored back to original condition or re-vegetated with appropriate species (native in native dominated areas).	Construction
S11	Live grass cover would be maintained at or above 70% at all times (subject to climatic conditions) to protect soils and landscape function. Any grazing stock would be removed from the site when cover falls below this level. Grass cover would be monitored on a fortnightly basis using an accepted methodology.	Operation
Water Use and Water Quality		
W1	The Spill and Contamination Response Plan prepared as part of the Emergency Response Plan would include measures to: • respond to the discovery of existing contaminants at the site (e.g. pesticide containers or asbestos), including stop work protocols and	**Pre-construction** **Construction**

No.	Mitigation measure	Phase
	remediation and disposal requirements • manage the storage of any potential contaminants on-site • mitigate the effects of soil and water contamination by fuels or other chemicals (including emergency response and EPA notification procedures) • ensure that machinery and materials arrive on site in a clean and secure condition • prevent contaminants affecting adjacent pastures, irrigation channels, dams and native vegetation • monitor and maintain spill equipment • induct and train site staff.	**Operation**
W2	If the substation used is oil-cooled, the layout, oil containment bunding and drainage would comply with the standards and guidelines in Ausgrid (2017) NS189 Oil Containment for Major Substations. The substation would be bunded with a capacity exceeding the volume of the cooling oil. The bund would be regularly inspected and cleaned, including removal of rainwater.	**Pre-construction** **Construction** **Operation**
W3	The Proponent will consult with EPA to determine whether any changes are required to Jemalong Station's EPL 5102.	**Construction**
W4	Road and carpark sealing works would not be undertaken if rain is anticipated within 24 hours of the completion of the works. Where possible, sealing works would be scheduled during fine, sunny, warm/hot conditions, avoiding wet, overcast, cool conditions.	Construction
W5	All fuels, chemicals, and liquids would be stored at least 50m from any waterways or drainage lines, in an impervious bunded area. The refuelling of plant and maintenance would be undertaken in impervious bunded areas on hardstand areas only.	Construction Operation Decommissioning
W6	All machinery on-site would contain spill kits to manage hydrocarbon spills. Machinery would be checked regularly to ensure there is no oil, fuel or other liquids leaking from the machinery.	Construction Operation Decommissioning
W7	Any soils contaminated by hydrocarbons, chemicals or concrete during any phase of the project would be removed from the site and disposed of appropriately.	Construction Operation Decommissioning
W8	Any soils, fill or track surfacing materials imported to the site would be clean and non-dispersing.	Construction
W9	No detergents or other chemicals would be added to the solar panel cleaning water.	Construction Operation

No.	Mitigation measure	Phase
W10	Concrete washout shall be carried out offsite or in concrete washout areas described in the Soil and Water Management Plan and identified on the Erosion and Sediment Control Plan (ESCP)	Construction Decommissioning
W11	Procedures for testing, treatment and discharge of construction waste water must be as described in the Soil and Water Management Plan.	Construction Decommissioning
W12	Machinery would be checked daily to ensure there is no oil, fuel or other liquids leaking from the machinery. All staff would be appropriately trained through toolbox talks for the minimisation and management of accidental spills	Construction Operation Decommissioning
W13	All staff would be appropriately trained through toolbox talks for the minimisation and management of accidental spills.	Construction Operation Decommissioning
W14	A Groundwater Management Plan would be developed to manage impacts on groundwater. This would be informed by onsite geotechnical survey and include: • Pollution controls • Management of dewatering.	Pre-Construction
Noise and vibration		
N1	Noise control measures, such as those suggested in Australian Standard 2436-2010 “Guide to Noise Control on Construction, Demolition and Maintenance Sites” should be implemented to reduce predicted construction noise levels. Reference to Australian Standard 2436-2010, Appendix C, Table C1 suggests possible remedies and alternatives to reduce noise emission levels from typical construction equipment. Table C2 in Appendix C presents typical examples of noise reductions achievable after treatment of various noise sources. Table C3 in Appendix C presents the relative effectiveness of various forms of noise control treatment.	Construction
N2	In addition to physical noise controls, the following general noise management measures should be followed: • Plant and equipment should be properly maintained. • Provide special attention to the use and maintenance of ‘noise control’ or ‘silencing’ kits fitted to machines to ensure they perform as intended. • Strategically position plant on site to reduce the emission of noise to the surrounding neighbourhood and to site personnel. • Avoid any unnecessary noise when carrying out manual operations and when operating plant. • Any equipment not in use for extended periods during construction work should be switched off.	Construction

No.	Mitigation measure	Phase
	• In addition to the noise mitigation measures outlined above, a management procedure would need to be put in place to deal with noise complaints that may arise from construction activities. Each complaint would need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences, where the noise in question is in excess of allowable limits. • Good relations with people living and working in the vicinity of a construction site should be established at the beginning of a project and be maintained throughout the project, as this is of paramount importance. Keeping people informed of progress and taking complaints seriously and dealing with them expeditiously is critical. The person selected to liaise with the community should be adequately trained and experienced in such matters.	
N3	Where noise level exceedances cannot be avoided, then time restrictions and/or providing periods of repose for residents, must be considered where feasible and reasonable. That is, daily periods of respite from noisy activities may also be scheduled for building occupants during construction hours.	Construction
N4	Some items of plant may exceed noise limits even after noise treatment is applied. To reduce the overall noise impact, the use of noisy plant may be restricted to within certain time periods, where feasible and reasonable and to be negotiated with Council and the residents. Allowing the construction activities to proceed, despite the noise exceedance may be the preferred method in order to complete the works expeditiously.	Construction
N5	A letter box drop would be prepared and provided to residences within 2km of the site. The letter would contain details of the proposal including timing and duration of construction and a contact details for a person for any enquiries or complaints. Plant would be operated in an effective manner to minimise noise such as by turning off plant which is not being used.	Construction Operation
Social and economic		
SE1	The Community Consultation Plan would continue to be implemented throughout the planning, assessment and construction phases of the project, and would include: • regular community updates about the progress of the proposal and findings of the assessments • consultation and notification of local residents and other relevant stakeholders regarding the timing of major deliveries and other activities which may produce particular social and economic impacts • an accessible complaints process with a timely response protocol.	Preconstruction Construction
SE2	Neighbours of the Jemalong PV Park property would be consulted and notified regarding the timing of major deliveries which may require traffic control and disrupt access.	Construction Decommissioning

No.	Mitigation measure	Phase
SE3	Local businesses would be used to supply good and services during all phases of the project wherever possible, as a first priority. The proponent would actively liaise with local industry representatives to maximise and coordinate the use of local contractors, manufacturing facilities and goods and materials suppliers, and to minimise adverse impacts to local supplies, services and tourism.	Construction Operation Decommissioning
SE4	Local representatives would be consulted regarding accommodation options for staff, to minimise adverse impacts on local services	Construction Operation Decommissioning
SE5	Large deliveries involving oversize or overmass loads or vehicles requiring traffic control which may inconvenience road users on Lachlan Valley Way would not be scheduled during festivals or other major tourism activities. Local tourism industry representatives would be consulted to manage potential timing conflicts with local events.	Construction Decommissioning
Traffic, transport and road safety		
T1	A Traffic Management Plan would be developed as part of the CEMP and DEMP, in consultation with Forbes Council and Roads and Maritime Services. The plan would include: • confirmation of designated routes for construction and haulage traffic • evaluation of any road or intersection upgrade requirements and associated traffic controls, in consultation with Edward River Council and Roads and Maritime Services (and consistent with Austroads Guides and Roads and Maritime Services supplements) • scheduling of deliveries • carpooling/shuttle bus arrangements to minimise staff vehicle movements • consultation and notification arrangements regarding traffic impacts for nearby residents and local road users, particularly when traffic delays are expected • arrangements and locations for traffic controls (speed limits, signage, stop/go) • procedure to monitor traffic impacts and adapt controls (where required) to reduce the impacts • provision of a contact phone number for stakeholders and the public to obtain information and to enable rapid response to any issues or concerns • assessment of road condition prior to construction on all local roads that would be utilised, and a road condition monitoring program • Avoiding use of Naroo Lane and Wilbertroy Lane during floods or after heavy periods of rain.	Preconstruction Construction Decommissioning
T2	The proponent would ensure the approval of Forbes Council prior to the selection of the final construction access route on local roads.	Construction

No.	Mitigation measure	Phase
T3	Vast Solar to develop a Driver Behaviour Code in line with their corporate statement policy for employee safety. All construction and operation staff would be inducted to the Driver Behaviour Code.	Construction Operation Decommissioning
T4	The proponent would consult with Roads and Maritime Services/Forbes Council in regard to use of the Wilbertroy Lane / Lachlan Valley Way intersection and requirement for upgrades, if any.	Construction Decommissioning
T5	Consultation with stakeholders including Roads and Maritime Services, Forbes Council, local landholders and emergency services would continue during construction and decommissioning to advise of any changes to road use and conditions.	Construction Decommissioning
T6	Where possible, large deliveries requiring stop/go traffic controls would not be scheduled during peak tourism periods (such as during local festivals), and morning and evening commuting or school bus operating periods. The proponent would aim to restrict traffic delays to a maximum of 10 minutes.	Preconstruction Construction Decommissioning
T7	Prior to construction, a pre-condition survey of the relevant sections of the existing road network would be undertaken, in consultation with Forbes Council. During construction the road network would be monitored and maintained to ensure continued safe use by all road users, any faults attributed to construction of the PV Plant would be rectified. At the end of construction a post-condition survey would be undertaken to ensure the road network is left in the same state as at the start of construction. This approach would also be applied during the decommissioning phase.	Preconstruction Construction Decommissioning
Hazards		
HA1	An Emergency Response Plan, incorporating an Evacuation Plan, Fire Response Plan, Flood Response Plan and Spill and Contamination Response Plan, would be developed prior to commissioning the PV Plant. A copy of the plan would be kept on site in a prominent position adjacent to the site entry point at all times.	Preconstruction Construction Operation Decommissioning
HA2	Dangerous or hazardous materials would be transported, stored and handled in accordance with AS1940-2004: *The storage and handling of flammable and combustible liquids* and the ADG Code where relevant. All potential pollutants kept on-site would be stored in accordance with relevant HAZMAT requirements and bunded.	Construction Operation Decommissioning
	EMF	
HA3	All electrical equipment would be designed in accordance with relevant codes and industry best practice standards in Australia.	Preconstruction Construction

No.	Mitigation measure	Phase
HA4	All design and engineering would be undertaken by qualified and competent person/s with the support of specialists as required and would aim to minimise EMFs.	Preconstruction Construction
	Aviation	
HA5	The materials and colour of on-site infrastructure will, where practical, be non-reflective and in keeping with the materials and colouring of the local landscape.	Preconstruction Construction
Fire and Bush Fire		
F1	The Fire Management Plan would be developed in consultation with the local RFS District Fire Control Centre, and include: • specific management of activities with a risk of fire ignition (hot works, vehicle use, smoking, use of flammable materials, blasting) • incorporation of fire safety and response in staff and contractor induction, training, OHS procedures and Work Method Statements • dedicated staff training on the use and maintenance of fire-fighting equipment and resources • designation of a staff safety officer tasked with ensuring implementation of the plan and regular liaison with firefighting agencies • document all firefighting resources maintained at the site with an inspection and maintenance schedule • monitoring and management of vegetation fuel loads • identification of Asset Protection Zones (APZs) and key access routes • a communications strategy incorporating use of mobile phones, radio use (type, channels and call-signs), Fire Danger Warning signs located at the entrance to the site compounds, emergency services agency contacts • activation triggers for the Emergency Response Plan and Fire Response Plan.	Preconstruction Construction Operation Decommissioning
F2	In developing the Fire Management Plan, NSW RFS would be consulted on the volume and location of water supplies, fire-fighting equipment maintained on-site, fire truck connectivity requirements, proposed APZ and access arrangements, communications, vegetation fuel levels and hazard reduction measures.	Preconstruction
F3	An APZ of minimum 10 metres would be maintained between remnant or planted woody vegetation and PV Plant infrastructure. The APZ around the perimeter of the site would incorporate a 4 metre wide gravel access track.	Preconstruction Construction
F4	Average grass height within the APZ would be maintained at or below 5 centimetres throughout the October-April fire season. Average grass height outside the APZ, including beneath the solar array, would be maintained at or below 15 centimetres throughout the fire season.	Construction Operation Decommissioning

No.	Mitigation measure	Phase
F5	The overhead powerlines at the site would be managed by maintaining appropriate vegetation clearance limits to minimise potential ignition risks, in accordance with the ISSC 3 Guideline for Managing Vegetation Near Power Lines.	Operation
F6	Landscaping around buildings at the site would comply with Appendix 5 Bush Fire Provisions - Landscaping and Property Maintenance in the PBP guidelines.	Construction Operation
F7	Appropriate fire-fighting equipment would be held on site to respond to any fires that may occur at the site during construction. This equipment will include fire extinguishers, a 1000 litre water cart retained on site on a precautionary basis, particularly during any welding operations. Equipment lists would be detailed in Work Method Statements.	Construction
F8	A steel or concrete water storage tank would be installed adjoining the main internal access road for fire-fighting and other non-potable water uses, with a 65 mm Storz outlet, a metal valve and a minimum of 20,000 litres reserved for fire-fighting purposes.	Preconstruction Construction Operation Decommissioning
F9	The NSW RFS and Fire and Rescue would be provided with a contact point for the PV Plant, during construction and operation.	Construction Operation
F10	Following commissioning of the PV Plant, the local RFS and Fire and Rescue brigades would be invited to an information and orientation day covering access, infrastructure, firefighting resources on-site, fire control strategies and risks/hazards at the site.	Operation
F11	The substation will be cooled with PCB oil (5000L), oil containment and fire safety measures outlined in Ausgrid (2017) NS189 Oil Containment for Major Substations would be implemented.	Preconstruction Construction
F12	The perimeter access track would comply with the requirements for Fire Trails in the PBP guidelines. All access and egress tracks on the site would be maintained and kept free of parked vehicles to enable rapid response for firefighting crews and to avoid entrapment of staff in the case of bush fire emergencies. Access tracks would be constructed as through roads as far as possible. Dead end tracks would be signposted and include provision for turning fire trucks.	Construction Operation Decommissioning
F13	Machinery capable of causing an ignition would not be used during bushfire danger weather, including Total Fire Ban days.	Construction Operation Decommissioning
F14	A Hot Works Permit system would be applied to ensure that adequate safety measures are in place. Fire extinguishers would be present during all hot works. Where possible hot works would be carried out in specific safe areas (such as the Construction Compound temporary workshop areas).	Construction Operation Decommissioning

No.	Mitigation measure	Phase
Historic Heritage		
HH1	Should an item of historic heritage be identified, the Heritage Division (OEH) would be contacted prior to further work being carried out in the vicinity.	Construction
Air Quality and Climate		
A1	The Community Consultation Plan would continue to be implemented throughout the planning, assessment and construction phases of the project, and would include: • consultation and notification of local residents and other relevant stakeholders regarding the timing of major deliveries and other activities which may affect local air quality • an accessible complaints process with a timely response protocol.	Preconstruction Construction Decommissioning
A2	Dust generation by vehicles accessing the site and earthworks at the site would be suppressed using water applications or other means as required.	Construction Decommissioning
A3	Vehicle loads of material which may create dust or litter would be covered while using the public road system.	Construction Decommissioning
A4	All vehicles and machinery used at the site would be in good condition, fitted with appropriate emission controls and comply with the requirements of the POEO Act, relevant Australian standards and manufacturer's operating recommendations. Plant would be operated efficiently and turned off when not in use.	Construction Decommissioning
Land Use and Resource		
L1	Essential Energy would be consulted prior to commencement of works to ensure that the works do not adversely affect electricity transmission or impede access for inspection and maintenance.	Pre-construction
L2	Construction and operations personnel would drive carefully and below the designated speed limit according to the Traffic Management Plan, to minimise dust generation and disturbance to livestock.	Construction Operation Decommissioning
L3	Consultation with Jemalong Station Farm Manager regarding any temporary impacts to access or risks to livestock. Additional specific mitigation may be required such as: • Additional fencing to protect livestock from collision risks. Vehicle speed restrictions on access roads.	Construction Decommissioning

No.	Mitigation measure	Phase
L4	Landholders and residents adjacent to the property and along the access route from the Lachlan Valley Way would be consulted and notified regarding the timing of works to minimise the noise, dust, traffic and other disturbance impacts.	Construction Decommissioning
L5	Underground cabling and other works to remain in situ following decommissioning of the PV Plant would be installed deeper than 500mm to allow cultivated cropping to resume following decommissioning.	Construction
L6	If possible and practical, sheep grazing would be used as a preferred option to control weeds and grass growth, and to maintain agricultural production at the site.	Operation
L7	A DEMP would be prepared and submitted to DPE for approval prior to decommissioning. The DEMP would include a Site Rehabilitation Plan covering: • criteria and indicators for the restoration of land capability and agricultural potential based on pre-works soil survey results • details of rehabilitation actions such as removal of infrastructure, remediation of soils, reinstatement of dams and irrigation/drainage channels as required and establishment of suitable groundcover vegetation on bare areas • a monitoring and assessment process to demonstrate that the target state has been achieved • an expected timeline for the rehabilitation program.	Decommissioning
Waste		
Wa1	A Waste Management Plan (WMP) would be developed to minimise waste, including: • identification of opportunities to avoid, reuse and recycle, in accordance with the waste hierarchy • quantification and classification of all waste streams • provision for recycling management on-site • provision of toilet facilities for on-site workers and identify that sullage would be disposed of (i.e., pump out to local sewage treatment plant) • tracking of all waste leaving the site • disposal of waste at facilities permitted to accept the waste • requirements for hauling waste (such as covered loads).	Construction Operation Decommissioning
Wa2	A septic system would be installed and operated according to the Forbes Council regulations.	Construction Operation
Cumulative impacts		

No.	Mitigation measure	Phase
C1	Construction management plans prepared for the proposal would take into account the cumulative impacts of any council or RMS road works should these activities occur concurrently.	Preconstruction Construction

11 JUSTIFICATION

The SEARs for the proposal state that the EIS must provide:

- a strategic justification of the development focusing on site selection and suitability, and
- the reasons why the development should be approved having regard to relevant matters for consideration under the EP&A Act, ESD principles, site suitability with respect to potential land use conflict and feasible alternatives to the development.

In this section, the proposal is justified in terms of reasons for approval, site suitability, matters for consideration under the EP&A Act and ESD principles. The impacts on existing and potential land uses are assessed in detail in section 9.10 and summarised below. A discussion of alternative locations, technologies and designs, including the 'do-nothing' option, is provided in section 2.3.

11.1 REASONS FOR APPROVAL SUMMARY

The assessments presented in the EIS indicate that the proposed Jemalong 50MW PV Solar Plant should be approved, subject to the identified mitigation measures, principally because:

- the proposal is generally permissible and meets planning requirements, including those pertaining to the EP&A Act and Regulation, State and Regional Development SEPP, ISEPP, Rural Lands SEPP and the Forbes LEP
- the identified environmental impacts are generally minor, highly localised, capable of mitigation or offsetting and often confined to the construction phase
- the environmental risks associated with the proposal are manageable and uncertainty is low
- the site is highly suited to utility scale solar electricity generation
- the proposal reflects the technology best suited to the site and network requirements
- the proposal provides an important contribution to the urgent need to abate carbon emissions in the electricity sector to meet government commitments and policy objectives and avoid dangerous climate change
- the proposal offers a range of community benefits relating to electricity supply, economic activity, and local employment opportunities
- the proposal is reversible and would not result in any permanent loss of land use potential or reduce future land and resource use options

11.2 SITE SUITABILITY

Selecting the best site for the Proposal reduces construction and operating costs, reduces environmental impacts and risks and maximises benefits in terms of generation performance and carbon emission reduction. The criteria used to select the proposed PV Plant site include:

- low environmental constraints (predominantly cleared cropping land) ensuring minimal loss of native vegetation
- level terrain for cost effective construction, minimal shading between panels and a straight forward ongoing maintenance process
- high quality solar resource (estimated to be approximately 18MJ/m^2 annually)
- negligible impact on heritage

- low density population and limited close neighbouring properties
- suitable planning context
- road access
- on-site access to the transmission network
- high levels of available capacity on the grid transmission system.

The PV Plant site is flat and predominantly clear of vegetation, and highly suited to efficient, high-output utility scale solar generation. The Proposal is located in a sparsely populated rural area where the dominant land use is broad scale agriculture. The land uses surrounding the PV Plant site and along the construction access route are described in sections 9.4 and 9.10. The PV Plant is not likely to restrict or negatively impact any surrounding land uses.

The PV Plant property comprises several large paddocks which have been used for cropping over a long period. In areal terms, the proposal would affect a very small proportion of the land used for cropping in the LGA. The reduction in crop production would be offset by increased productivity on other properties held by the landowner (refer section 9.10). The proposal would not impose requirements for additional Council or State Government services or facilities.

The Essential Energy network is located 3.2km north of the property, as such an overhead 66kV transmission line would be constructed to connect the proposal to the existing West Jemalong Substation at the junction of Whispering Pines Lane and Lachlan Valley Way. Preliminary electrical system studies show there is sufficient capacity on the 132kV Essential Energy system to accept electrical generation into the network from the PV Plant proposal. The studies also show the level of generation is commensurate with demand in the Central Tableland region, leading to low electrical losses.

The PV Plant would be permissible under the ISEPP (refer section 5.1.3), although the subdivision of the substation lot is prohibited. As such, the development is partly prohibited, but in a minor aspect only. The proposal would not affect long term agricultural capability or future use or land use planning options for the property.

11.3 MATTERS FOR CONSIDERATION

The consent authority for SSD development applications is required to take into consideration matters listed in section 79C of the EP&A Act. An evaluation of the proposal against the relevant objects of the Act and section 79C matters is provided in Table 11-1.

Table 11-1 Evaluation of the proposal against sections 79C matters for consideration

Relevant objects of the Act
To encourage: • the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment • the promotion and co-ordination of the orderly and economic use and development of land • the protection, provision and co-ordination of communication and utility services • the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats • ecologically sustainable development.

The proposal would involve a site-appropriate harvesting of solar resources for the purposes of electricity generation. The development would not affect land use capability or reduce future land and resource use options. The proposal demonstrates clear economic and social benefits for the community, and negative impacts are shown to be localised, capable of mitigation and often confined to the construction phase. The proposal would not adversely affect local communications or utilities infrastructure or services. The proposal has been sited and designed to minimise impacts to threatened species, populations and ecological communities. Any residual impacts would be limited and offset according to State Government requirements. The proposal is considered sustainable within the context of ESD principles; refer section 11.4.

Environmental planning instruments

Environmental planning instruments relevant to the proposal are identified in section 5. The proposal and this report are consistent with the objectives and assessment requirements of these instruments.

The regulations (to the extent that they prescribe matters for consideration)

Clause 228 of the EP&A Regulation 2000 lists factors that must be taken into account concerning the impact of an activity on the environment. Relevant factors and corresponding sections within this EIS include:

(a) any environmental impact on a community (sections 8 and 9)

(b) any transformation of a locality (sections 8.3)

(c) any environmental impact on the ecosystems of the locality (section 8.1)

(d) any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality (sections 8.3, 0)

(e) any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations (sections 8.2, 8.3, 0, 9.8)

(f) any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974) (section 8)

(g) any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air (section 8.1)

(h) any long-term effects on the environment (sections 8 and 9)

(i) any degradation of the quality of the environment (sections 8 and 9)

(j) any risk to the safety of the environment (sections 8 and 9)

(k) any reduction in the range of beneficial uses of the environment (sections 9.4 and 9.10)

(l) any pollution of the environment (sections 9.2 and 9.1)

(m) any environmental problems associated with the disposal of waste (section 9.11)

(n) any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply (section 9.10)

(o) any cumulative environmental effect with other existing or likely future activities (section 9.12).

The Proposal has been assessed against each of these factors in this EIS. The report concludes that the Proposal would not result in significant impacts to any aspect of the environment, including the above factors, subject to the mitigation measures and offsetting provisions identified in the report.

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

The likely impacts of the Proposal, including environmental impacts on both the natural and built environments, and the social and economic impacts in the locality, have been identified and quantified where possible in sections 8 and 9 of this report. The assessments conclude that the Proposal would not result in significant impacts to the natural or built environment, or social and economic values in the locality, subject to

the relevant mitigation measures and offsetting provisions identified in the report.

The suitability of the site for the development

The Proposal Site has been selected according to criteria relating to solar resources, network connection, hazard potential, planning requirements and likely environmental impacts. The suitability of the site for the proposed PV Plant development is addressed in section 11.2. The site is considered highly suitable for a utility scale PV Plant development.

Any submissions made in accordance with this Act or the regulations

This EIS has been prepared in response to agency input to the SEARs, and the results of consultations involving a wide range of government and non-government stakeholders; refer section 6. Submissions received during the exhibition period of the EIS would also be taken into account in the planning and implementation of the Proposal.

The public interest

The needs and benefits associated with the Proposal are described in section 2. The Proposal is considered to be demonstrably in the public interest because it would:

- assist with the abatement of greenhouse gas emissions and the avoidance of dangerous climate change by displacing approximately 36,530 tonnes of carbon dioxide pollution per year
- benefit network reliability and security by providing embedded electricity generation close to local consumption, and by providing a more diverse mix of energy sources
- support 100 direct and 100 indirect jobs over the construction period, and 3 direct and 9 indirect jobs during operation.
- provide an economic boost to the local economy through the purchase of local goods and services.

11.4 ECOLOGICALLY SUSTAINABLE DEVELOPMENT

ESD involves the effective integration of social, economic and environmental considerations in decision-making processes. In NSW, the concept has been incorporated into legislation including the EP&A Act and Regulation and the *Protection of the Environment Administration Act 1991*.

Based on the likely costs and benefits of the proposed PV Plant, the Proposal is considered to comply with the principles of ESD. ESD principles and their relationship to the design, construction and ongoing operations of the Proposal are identified in Table 11-2.

Table 11-2 Assessment of the Proposal against the principles of Ecologically Sustainable Development

(a) The precautionary principle—namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:

(i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and

(ii) an assessment of the risk-weighted consequences of various options.

The impacts of the construction of the PV Plant at the site are likely to be reasonably predictable and carry low levels of uncertainty and risk. Based on field surveys and assessments, the works would be unlikely to result in

irreversible environmental damage. The development would have an operational life of around 30 years and would be highly reversible. The precautionary principle has been observed in the assessment of impacts; all potential impacts have been considered and avoided or mitigated wherever possible where a risk is identified.

(b) inter-generational equity—namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

The Proposal would not diminish long term ecological or agricultural productivity, biological resources or future land use options at the site. At the end of the operating life of the PV Plant, the above-ground infrastructure would be removed (to a depth of 500mm) to restore former land use potential, agricultural productivity and land use and planning options at the site. Soil values would be restored with reference to the results of a pre-works baseline soil survey.

The Proposal would provide a significant environmental benefit by producing sustainable energy, reducing the reliance on fossil fuels which threatens the well-being of current and future generations through climate change. In contrast to non-renewable energy sources, the PV Plant would not emit carbon dioxide, airborne particulates or other pollutants. At the end of its operational life, the Proposal would not require expensive and difficult land remediation or leave a legacy of toxic waste to be stabilised and stored.

(c) conservation of biological diversity and ecological integrity— namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration.

Layout planning and mitigation measures have been adopted to avoid or mitigate any impacts which would affect the long term viability of populations of all native species at and around the site, particularly threatened species and communities. These measures include avoiding and protecting natural areas and habitats on the site. It is noted that climate change is a key global threat to many species and communities, and that the Proposal would contribute to the abatement of carbon emissions from the electricity sector in Australia.

(d) improved valuation, pricing and incentive mechanisms— namely, that environmental factors should be included in the valuation of assets and services, such as:

- ***(i) polluter pays—that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement, and***
- ***(ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste, and***
- ***(iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.***

The Proposal would provide for the increased penetration of renewable energy into the energy market. To date the environmental and social costs of electricity generation have not been fully measured or incorporated into wholesale or retail electricity pricing. The long term external costs of carbon-intensive energy sources in terms of climate change in particular have not been factored into prices. Photovoltaic solar plants produce approximately 40g CO2eq/kWh, while coal produces approximately 1,000g CO2eq/kWh (NREL 2012). This external cost differential is not reflected in electricity market prices.

External costs are similarly not included in calculations of Levelised Cost of Electricity (LCOE) - the discounted lifetime cost of ownership and use of a generation asset expressed in cost per MWh.

In terms life cycle energy consumption, the 'energy payback time' for polycrystalline PV modules has been estimated at two years for a solar installation in Southern Europe (refer section 9.11).

12 CONCLUSION

The proposed 50 MW PV Plant would be located approximately 36 km west of Forbes LGA, in the Central West region of NSW, on 165 ha of the Jemalong Station, a rural property managed for agricultural production.

The main impacts of the Proposal would be:

Construction phase (12 months)

- clearing of 10.08 hectares of moderate to good condition native vegetation
- intermittent construction noise and traffic from vehicles and machinery during standard work hours, which may affect local residents and road users.

Operation phase (30 years)

- visual and landscape character impacts, which may affect local residents and road users
- temporary suspension of irrigated cropping at the site, offset by increased production on other properties held by the landowner.

The key benefits likely to flow from the Proposal are:

- substantial contribution to climate change objectives, including the Paris Agreement commitments, Renewable Energy Target, NSW Climate Change Policy Framework and NSW Renewable Energy Action Plan
- improved electricity reliability and security by providing embedded generation closer to local consumption centres, and contributing to a more diverse mix of energy sources
- support 100 direct and 100 indirect jobs over the construction period, and three to four direct and 9 indirect jobs during operation. Local business transactions are expected to represent at least 50% of the Proposal's procurement spend.

The PV Plant Proposal has been designed iteratively to avoid and minimise impacts, such as by excluding and protecting higher density paddock tree patches and remnant woodland areas. Mitigation measures have been identified in the EIS to address risks and impacts, including:

- accessible and responsive consultation and notification process throughout the construction phase involving affected stakeholders, particularly neighbouring landholders and local road users
- indigenous tree and shrub plantings along the property boundary where required to provide visual screening
- soil protection throughout the life of the PV Plant by maintaining perennial groundcover across the site (subject to climatic conditions)
- comprehensive preparation and planning to account for potential hazards including hazardous materials and fire risks.

Residual biodiversity impacts would be offset in accordance with the Proposal's Biodiversity Offset Strategy.

The Proposal would not affect unique or significant agricultural land. Following decommissioning, PV Plant infrastructure would be removed and the site would be restored to full agricultural and land use potential.

The EIS concludes that the Proposal would not result in significant impacts to environmental, cultural, social and economic values at the locality or region scales. The selected site is highly suitable for a utility scale solar development. On the whole, the impacts of the Proposal are localised, minor and reversible, and risks are manageable.

The Proposal would form an important part of Australia's response to climate change and government commitments to reduce carbon emissions in the electricity sector. The Proposal is consistent with the principles of Ecologically Sustainable Development, particularly in relation to climate change abatement and intergenerational equity. In view of the demonstrated need for, and benefits of, the Proposal, the Jemalong PV Solar Plant is considered to be justified and clearly in the public interest.

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APPENDIX A SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

APPENDIX B PROPOSAL PLANS

APPENDIX C INFRASTRUCTURE AND CONSTRAINTS MAP

C.1 INFRASTRUCTURE AND CONSTRAINTS PART 1

C.2 INFRASTRUCTURE AND CONSTRAINTS PART 2

APPENDIX D CONSULTATION

APPENDIX E BIODIVERSITY ASSESSMENT

APPENDIX F LANDSCAPE PLAN

APPENDIX G ABORIGINAL HERITAGE ASSESSMENT

APPENDIX H HYDROLOGY AND FLOODING ASSESSMENTS

H.1 SUMMARY TECHNICAL REPORT ARUP STUDY 2017

H.2 SOUTHEAST ENGINEERING AND ENVIRONMENTAL, HYDROLOGICAL STUDY 2014

APPENDIX I SOILS STUDY

APPENDIX J VISUAL IMPACT ASSESSMENT

EXPLANATORY NOTE

The following Visual Impact Assessment (VIA) was undertaken and prepared by Fresh Landscape Designs for the original concept of the Jemalong 30MW Concentrate Solar Plant (CSP). The location of the CSP Plant was proposed for the identical area of land as that proposed for the PV Plant. The primary differences between the proposal of a PV park from a CSP park, are the components of the solar field and associated facilities. The following table provides a summary and explanation of the differences:

Table G-13-1: Comparison of PV to CSP components

CSP	Description	PV	Description	Comment
Heliostat	90 modules, each comprising of 700 tracking heliostats Each heliostat is 2 m high, 1.5 m x 2.4 m (3.6 m2).	Photovoltaic Panel	170,000 panels, each 2m by 1m. 2m high	The discussion of the VIA is relevant to the PV EIS due to the similarity of height and form of the heliostats and PV Panels. Note, reflection, glint and glare are a greater concern with Heliostats, in particular with aviation.
Heliostat mounting and tracking system	Double axis system. Metal structure.	PV mounting and tracking system	Single axis system. Metal structure	The discussion of the VIA is relevant to the PV EIS.
Receiver Tower	90 towers, each 27m tall.	-	Not needed for a PV system	The discussion and significance of the impact is not relevant to the PV EIS.
Thermal piping network	Mounted on metal frames, 600mm above ground. Approximately 23km total length	-	Not needed for a PV system	The CSP has an extensive aboveground pipe network. The VIA assessment of the CSP piping system is not relevant to the PV EIS.
Control kiosk	Total of 15, 40foot containers. Housing for electrical and communication equipment	Inverters (PCU)	22 PCUs, each 12 m long, 3 m wide and 3 m high	A certain number of large containers will be dispersed throughout the solar field. The VIA has considered the impact, and the assessment is relevant to the PV EIS

CSP	Description	PV	Description	Comment
Power Island	Two thermal storage tanks, each 12m high Air cooled condenser, 30 m wide x 30 m long x 20 m high Steam generator, supported on a frame 13m high Two Kiosks, each 15 m x 15 m	-	Not needed for a PV system	The power island comprises of several tall and imposing structures, that change the visual landscape. The impact is assessed in the VIA. However, the discussion and significance of the impact is not relevant to the PV EIS.
Evaporation ponds	Two 2,400m^2 ponds, each 1.5m deep	-	Not needed for a PV system	The discussion and significance of the impact is not relevant to the PV EIS.
Transformer Station and switchgear	66kV transformer station and switchgear, 20 m wide x 10 m long. It would contain a small number of typical switchyard components	Transformer Station and switchgear	66kV transformer station and switchgear, 20 m wide x 10 m long. It would contain a small number of typical switchyard components	No change. The discussion of the VIA is relevant to the PV EIS.
Substation	One substation on site	Substation	One substation on site	No change. The discussion of the VIA is relevant to the PV EIS.
66kV Power Line	Running from the on-site substation, along the boundary of the Proposal Site and 3.2km to the Essential Energy substation	66 kV Power Line	Running from the on-site substation, along the boundary of the Proposal Site and 3.2km to the Essential Energy substation	No change. The discussion of the VIA is relevant to the PV EIS.
Internal access tracks and parking	Internal roads passing between the rows of heliostats, and the administration buildings	Internal access tracks and parking	Internal roads passing between the rows of PV modules, and the administration buildings	No change. The discussion of the VIA is relevant to the PV EIS.

CSP	Description	PV	Description	Comment
Fencing	Perimeter of Proposal Site. 2.3m high	Fencing	Perimeter of Proposal Site. 2.3m high	No change. The discussion of the VIA is relevant to the PV EIS.

With regards to the development of the construction site, lay down areas, storage facilities and temporary administration buildings, these will be located within the Proposal Site. The dimensions and configuration of the construction facilities are largely unchanged, as the VIA discussion for the CSP is relevant to the PV EIS.

VIA Methodology

The visual assessment consists of two components, a baseline study and a visual impact assessment.

Baseline study

The baseline study is an inventory of the existing visual character and the ways views of the Proposal may be experienced.

- Definition of study area
- Desk study including collection and review of existing literature, tourism information, maps and aerial photos, review of the description of the proposed development, identification of approximate visibility of the development based on the topography and identification of potential viewing opportunities for residents, workers, visitors and travellers
- Field survey to validate the actual extent of visibility, identify key and representative viewpoints and construct a comprehensive photographic record
- Visual baseline analysis including the classification of landscape character units and values for particular areas.

AS noted previously, the plot proposed for development of the PV Plant, is the same plot which was proposed for the development of the CSP. AS such, the baseline information and description provided in the VIA is relevant to the PV EIS.

Impact assessment

The visual impact assessment describes the changes in visual character and visual amenity that are anticipated as a result of the development. Specifically, the elements of each component include:

- Identification of the views likely to be affected by the Proposal
- Identification of susceptibility of viewers to change at those locations based on general principles and the results of community consultation
- Identification of visual effects introduced by the development for key and representative viewpoints
- Assessment of options for mitigation of adverse visual effects
- Evaluation of the level of visual impact and its significance after mitigation.

Table 1, provides a comparison of the different components of a PV and CSP Plant, and summarises which discussions of the VIA have been used in the assessment of visual impacts for the PV EIS.

APPENDIX K LANDHOLDER'S LETTER OF SUPPORT

APPENDIX L LETTER RE: DA SSD 6588 AND SSD 8803

APPENDIX M NEW SOLAR PLANT CAPITAL INVESTMENT VALUE

APPENDIX N RESOURCE AND ENERGY TITLE SEARCH