Figure 6-31: Impact mitigation principles

6.2.8 Overview of the visual issues

Overall the proposed Manildra Solar Farm would result in impacts on the existing surrounding environment in terms of landscape and scenic values. The proposed solar farm contrasts with the existing landscape character of the region which is typically rural, pastoral land. The site is situated upon currently uninhabited, undulating, open, pastoral land.

For many, solar panels are a symbol of sustainability through technology and subsequently are considered to be a positive and interesting addition to the landscape regardless of the fact they contrast with the agricultural setting.

In the context of the area, the proposed solar farm development would have a moderate visual impact. The proposed Manildra Solar Farm would have a low visual impact within the context of the landscape character and scenic quality of the region. The greatest visual impact would be apparent within the immediate vicinity of the solar farm however once landscape mitigation methods have been implemented and the growth of screen planting surrounding the site has matured, the visual impact of the Solar Farm would be minimal.

6.2.9 Environmental safeguards

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
31	Deterioration of visual amenity during construction	Mitigate impacts	Measures to reduce visual impacts during construction, including but not limited to the following: • Dust reduction throughout the construction process • Restoration of any earthworks required for the construction • Clearing of existing vegetation would be kept to a minimum	Construction	CEMP
32	Deterioration of visual amenity by solar panels and associated infrastructure	Mitigate impacts	Measures include but are not limited to the following: • Colour of above ground infrastructure to be sympathetic to the landscape character • Underground cabling to be utilised if practical • The design and location of ancillary works are to incorporate measures which would reduce this visual impact	Construction Operation	CEMP OEMP
33	Deterioration of visual amenity at surrounding residences and roads	Mitigate impacts	• Visual screen planting is to be undertaken in the form of boundary planting around the solar farm, foreground planting at affected viewpoints and residential tree planting. • Screening vegetation would be planted along the northern, southern and western perimeters of the site. • Roadside planting along the eastern edge of Manildra Molong Road may be undertaken to ensure views from the road are fragmented • Tree planting would be undertaken in	Post construction	OEMP

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
			consultation with relevant landowners to achieve screening for homesteads with visual impacts to strategically block parts of the development. • Species typical of the area would be selected to enhance the existing landscape character.		
34	Creation of a visual attraction	Maximise visual opportunities	A designated viewing area may be provided where visitors would be able to safely view the solar farm and surrounding landscape.	Construction Operation	CEMP OEMP

6.3 INDIGENOUS HERITAGE

6.3.1 Methodology

New South Wales Archaeology Pty Ltd has undertaken the Indigenous archaeological and heritage assessment of the proposed Manildra Photovoltaic Solar Farm. This assessment has been conducted in accordance with consultation process as outlined in the NSW Department of Environment, Climate Change and Water's (DECCW) newly introduced Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010.

Prior to conducting the field assessment NSW Archaeology Pty Ltd has undertaken consultation with relevant NSW DECCW personnel in regard to the archaeological context and potential of the proposal site. The field survey and assessment has been undertaken with representatives from the Orange Local Aboriginal Land Council.

The study has sought to identify and record Aboriginal objects, to assess the archaeological potential of the landforms encompassed by the proposal site, and to formulate management recommendations based on the results of background research, a field survey and significance assessment.

The investigation has included a NSW DECCW AHIMS Site Search, literature review, field survey and analysis of results. Field work was undertaken in August 2010. A landscape based approach has been implemented during this study. The proposal site is comprised of a number of landforms including crests, simple slopes, a lower slope and a drainage line. These landforms have been defined as Survey Units and are utilised as a framework of recording, analysis and the formulation of management and mitigation strategies.

The New South Wales National Parks and Wildlife Service has prepared a draft document which provides a series of guidelines regarding the assessment and management of Aboriginal cultural heritage in New South Wales. This report has been prepared in accordance with these draft guidelines (NSW NPWS 1997).

Additionally the study has been conducted in accordance with the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (NSW DEC 2005) which have been prepared specifically for development applications assessed under Part 3A of the Environmental Planning and Assessment Act 1979.

The archaeological and heritage report (see Appendix G) documents the following:

- The Aboriginal consultation process undertaken for the project and the involvement in the project of the Aboriginal community.
- A description of the proposal and whether or not it has the potential to result in impacts to Aboriginal cultural heritage.
- A description of the impact history of the proposal site.
- The methodology implemented during the study.
- The landscape and natural resources of the proposal site in order to establish background parameters.
- A review of archaeological and relevant literature and heritage listings on the NSW DECCW Aboriginal Heritage Information Management System.
- A synthesis of local and regional archaeology.
- A predictive model of Aboriginal object type and location relevant to the proposal site.
- The cultural and archaeological sensitivity of the landform subject to proposed impacts.
- The field survey results.
- The significance of recorded and predicted subsurface Aboriginal objects.
- An assessment of the impact of the proposal on Aboriginal objects and places.
- A description and justification of the proposed outcomes and alternatives.
- A series of recommendations relating to management and mitigation based on the results of the investigation.

6.3.2 Existing environment

A review of previous investigations in the region has been undertaken in order to define the existing information relating to Indigenous archaeology and heritage and to provide an analytical context to the assessment. This information is reviewed in Section 7 of the archaeological report (Appendix G).

A search of the NSW DECCW Aboriginal Heritage Information Management System (AHIMS) has indicated that there are no previously recorded Aboriginal objects located within the proposed impact area (AHIMS #30668). The search area measured 36 km² and encompassed eastings 657000 –663000, and northings 6325000 –6331000. While no previously recorded Aboriginal objects are listed on AHIMS to be present in the proposal site, three sites are listed in the site search, all of which are located to the south.

The Aboriginal objects on AHIMS for the site search area are listed in Table 1, and the location of those sites nearest to the proposal site is shown in Figure 3, in the archaeological report (Appendix G). While there are no previously recorded Aboriginal objects in the proposal site, the AHIMS register however only includes sites which have been reported to NSW DECCW. Accordingly, this search cannot be considered to be an actual or exhaustive inventory of Aboriginal objects situated within the local area. Generally, sites are only recorded during targeted surveys undertaken in either development or research contexts. It can be expected that Aboriginal objects may present within the proposal site but that to date they have not been recorded and/or reported to NSW DECCW.

There are no previous archaeological studies known to have been conducted within the proposal site itself and few have been undertaken within the immediate local area. The construction of a relevant predictive model of Aboriginal site type and location is therefore based on a review of research conducted across the broader region. This review suggests that the most common Aboriginal object recordings in the region are distributions of stone artefacts and scarred trees. In the region a general correlation between different types of watercourses and the nature of the evidence of past Aboriginal occupation is evident. Higher artefact density sites are located near to permanent water sources and low density artefact distributions are found elsewhere. Rare site types include rock shelters, quarry and procurement sites, burials, stone arrangements, carved trees, contact sites and traditional story or other ceremonial places.

Based on a consideration of the high levels of prior impacts and disturbance which includes land clearance, landscape modification and cultivation, and the predictive model constructed from the review of previous archaeological research in the region, the proposal site is predicted to be of very low archaeological potential and sensitivity. A detailed predictive model of Aboriginal object type and location is set out in Section 7 of the archaeological report (Appendix G).

Results

The proposal site has been divided into twelve Survey Units, comprised of crests, simple slopes, a lower slope and a drainage line. At its closest point the western boundary of the proposal site is located c 0.4 kilometres east of Mandagery Creek, where it flows as an ephemeral 2nd order stream. The proposal site surveyed during the assessment measures approximately 200 hectares in area. The majority of this area had been recently ploughed and sown to crops at the time of the field survey. It is estimated that approximately 109 hectares of that area was subject to survey inspection. Ground exposures inspected are estimated to have measured approximately 21 hectares in area. Of that ground exposure area archaeological visibility (the potential artefact bearing soil profile) is estimated to have been 6.5 hectares. Effective Survey Coverage is, therefore, moderate and is calculated to have been 3.3% of the proposal site.

Two Aboriginal object locales were recorded during the field survey, one comprised of a single stone artefact and the other a low density artefact scatter within a large area of ground exposure consisting of five stone artefacts. The Effective Survey Coverage for the surveyed area is assessed to have been moderate at the time of survey, with moderate levels of archaeological visibility distributed throughout the proposal site. These conditions have enabled a reasonable characterisation of artefact distribution within the proposal site.

6.3.3 Impact assessment

Construction and decommissioning

As noted above, the Aboriginal object locales recorded in the proposal site include an isolated stone artefact and a very low density artefact scatter; these are assessed to be of low archaeological significance. Undetected or subsurface stone artefacts are assessed to be present in very low density. The Effective Survey Coverage achieved during the survey is considered to have been sufficient to characterise the nature of artefact distribution in the proposal site. The survey results are therefore assessed to be a relatively accurate reflection of the artefact density in the proposal site. Accordingly, based on the relevant predictive model of site distribution for the area, and the results of the field

survey, artefact density in the proposal site is assessed to be very low. The proposal site is assessed to be of low archaeological potential and significance.

The construction of the Solar Farm could result in physical impact on any Aboriginal objects that may be located within direct impact areas - *irrespective of their archaeological significance*. That is, any Aboriginal object situated within an area of direct impact would be comprehensively disturbed, and/or destroyed during construction. As with any development the chances of impacting Aboriginal objects, particularly stone artefacts, is high, given that they are present in a continuum across the landscape and located on or within ground surfaces. The Manildra Solar Farm is no exception in this regard and it would be impossible to have a development of this nature without causing direct physical impact. However given that the installation of the solar panels would be either via a pole driven mechanism or laying of concrete footings shallowly dug, at most, the proposed impacts relating to construction is minimal and is not comprehensive and extensive.

Given that both the recorded Aboriginal objects and the predicted undetected and subsurface artefacts are assessed to be of low significance, the impacts can be viewed as being of correspondingly low significance. This assessment forms the basis for the formulation of recommendation relating to the proposal.

The Aboriginal object locales recorded in the proposal site do not surpass scientific significance thresholds which would act to preclude the construction of the proposed solar farm. Based on a consideration of the predictive model applicable to the environmental context in which impacts are proposed, and the results of the study, it is concluded that the proposed impact area does not warrant further investigation such as subsurface test excavation. The environmental context in which the impacts are proposed is predicted to contain sparse and very low artefact density. It is considered that subsurface testing is unlikely to produce results different to predictions made in respect of the archaeological potential of the landform in question.

Given the nature of the two artefact locales recorded in the proposal site and the low scientific significance rating they have been accorded, unmitigated impacts is considered appropriate; a strategy of impact avoidance is not warranted in regard to these locales.

Detailed management and mitigation strategies are outlined and justified in the archaeological report (Appendix G); they are outlined below in summary form:

- The proposal site does not warrant further archaeological investigation such as subsurface test excavation; the Effective Survey Coverage achieved during the field survey is be considered to have been generally adequate for the purposes of determining the archaeological status of the proposal site.
- The two recorded Aboriginal object locales and the predicted very low density subsurface artefact distribution in the proposal site does not surpass archaeological significance thresholds which would act to preclude proposed impacts.
- The two recorded Aboriginal object locales are assessed to be representative of a very low density distribution of stone artefacts. The archaeological significance of these locales is assessed to be low. Accordingly unmitigated impact is considered to be appropriate.
- There are no identified Indigenous heritage constraints relating to the proposal.

Operation

It is considered unlikely that there would be any impact to Indigenous sites during the operation of the solar farm.

6.3.4 Environmental safeguards

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
35	Disturbance to artefacts	Minimise impact	Where possible, the artefact scatter comprising five stone artefacts would be avoided.	Detailed design Construction	CEMP
36	Impact on local Aboriginal community	Minimise impact	Ongoing consultation would be undertaken with Registered Aboriginal Parties	All	CEMP OEMP

6.4 NOISE

6.4.1 Construction noise guidelines

Construction noise is one of the major environmental noise issues in NSW. In July 2009 the NSW Department of Environment, Climate Change and Water released the Interim Construction Noise Guideline, which is specifically aimed at managing noise from construction works regulated by DECCW (DECCW 2009). The construction noise guidelines are intended to provide respite for residents exposed to excessive construction noise outside the recommended standard hours whilst allowing construction during the recommended standard hours without undue constraints.

The guidelines identify sensitive receivers, which include residences, classrooms, hospitals, places of worship and recreational areas such as parks and sports grounds. The guidelines also contain recommended standard work hours for construction activities to minimise potential noise impacts:

- Monday to Friday 7 am to 6 pm
- Saturday 8 am to 1 pm
- No work Sundays or public holidays.

Recommended maximum levels for construction noise at noise sensitive locations are based on the Rating Background Level or RBL, as defined in Section 3.1 of the NSW *Industrial Noise Policy*, 2009. For construction activities with an anticipated duration of more than three weeks, the Guideline provides the following recommended Management Levels:

Table 6-4: Recommended Management Levels for Construction Noise

Time of Day		Management Level, dBA $L_{eq, 15\ min}$	Comment / Classification
Recommended standard hours	**Monday to Friday 7 am to 6 pm**	**RBL + 10**	**Noise affected**
	Saturday 8 am to 1 pm	**75**	**Highly noise affected**
Outside recommended hours	**All other times and public holidays**	**RBL + 5**	**Noise affected**

6.4.2 Existing environment

The proposal site is located in a rural environment north-east of Manildra, NSW. Background noise is generally low. Intermittent noise would currently be emitted from a variety of sources, including farm vehicles and machinery, animals, rail noise, and traffic noise from Orange Road and Molong Manildra Road, particularly trucks.

Background noise monitoring was carried out by Heggies Pty Ltd at nearby properties 'Hillview' and at 4205 Henry Parkes Way (refer Appendix I). A Rating Background Level (RBL) was calculated, the results of which are outlined in Table 6-5.

Table 6-5: Rating Background Levels Relative to Manildra solar farm site

Location	Rating Background Level (RBL) dBA		
	Day	**Evening**	**Night**
'Hillview', 1998 Molong/Manildra Road	34	**30**	**30**
4205 Henry Parkes Way	31	32	26
Average or 30dBA (whichever is greater)	32	31	30

Sensitive receivers

Sensitive receivers are considered to include residences, schools and other educational institutions, hospitals, places of worship, recreation areas and community centres. All sensitive receivers within 1 km of the site are residences. The closest residential property to the proposal site is 130 m to the east on Molong to Manildra Road. Several other residences are close to the site including three properties on Old Orange Road approximately 850 m south of the site. A map showing the locations of sensitive receivers within 1 km of the site is provided in Figure 6-32.

Figure 6-32: Sensitive receivers within 1 km of the proposed Manildra solar farm site

The general location of the solar farm is indicated above.

6.4.3 Impact assessment

Construction and decommissioning

Sources of noise during construction and decommissioning include use of on-site machinery, vehicle movements and other construction-related activities. Typical noise levels of equipment to be used at are provided in Table 6-6 below.

Table 6-6: Typical noise levels of construction equipment used for the works

Plant Description	Sound Power Level at source (dBA)	Noise level at closest residence to the site – 130m (dBA)	Exceed 42 dBA target?
Bulldozer	112	62	Yes
Excavator	110	60	Yes
Vibratory Roller	109	59	Yes
Concrete Truck	109	59	Yes

Dump Trucks	108	58	Yes
Water Cart	107	57	Yes
Concrete Pump	105	55	Yes
Generators	100	50	Yes
Mobile Crane	105	55	Yes
Powered Hand Tools	109	59	Yes
Air Compressor (power tools)	98	48	Yes
Compactor	113	63	Yes
50-tonne crane	102	52	Yes
Vibrated Piling	116	66	Yes
Traffic Control	101	51	Yes
Grader	109	59	Yes
Front End Loader	111	61	Yes
Backhoe	108	58	Yes

The proposed works would be undertaken during standard working hours during construction and decommissioning as follows:

- Monday – Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sunday and Public Holidays: no work

Night work could be required as a one-off for the delivery of a 50 tonne transformer.

It is anticipated that construction would take eight months to complete. In accordance with the *DECCW Interim Construction Noise Guidelines,* a quantitative noise assessment is required where construction noise affects sensitive receivers for more than three weeks (DECCW 2009).

Based on the noise monitoring carried out by Heggies for the Manildra Solar farm, the recommended maximum levels for construction noise at sensitive locations during standard hours is **42 dBA**. A lower noise management level of **35 dBA** applies to construction noise undertaken outside standard hours.

Given the typical noise levels of construction equipment and activities such as pile driving and traffic control would exceed the target noise level of 42dBA at 130m (Table 6-6), the works are likely to impact on sensitive receivers. Impacts are likely to be intermittent as works would be undertaken at different parts of the site for varied periods. The most western paddock is the closest to residences and it is likely that works would avoid this paddock due to visual impacts and biodiversity constraints.

The DECCW interim guidelines allows for the application of feasible and reasonable safeguards to mitigate impacts where noise levels are exceeded. Safeguards are outlined below incorporating recommendations from the guidelines.

Operation

Operational noise issues would be minor. Solar farm infrastructure is generally silent outside of the boundary of the solar farm. During operation, the only sources of noise would be from maintenance activities such as washing panels and undertaking repairs. Both activities would be short term and

infrequent. Vehicle movements would occur daily, but are not anticipated to disturb residents. If any complaints are made, reasonable and feasible measures would be considered to reduce the impacts of vehicles movements such as quieter reversing alarms.

Noise is emitted by transformers. Augmentation of the substation is unlikely to increase noise levels significantly.

6.4.4 Environmental safeguards

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
37	Noise impacts to sensitive receivers	Compliance	Construction would be undertaken during standard working hours of: • Monday – Friday: 7am to 6pm • Saturday: 8am to 1pm • Sunday and public holidays: No work	All	CEMP OEMP
38	Noise impacts to sensitive receivers	Compliance	Construction staff would be made aware of noise sensitive receivers and would be made aware of noise reduction options.	All	CEMP OEMP
39	Noise impacts to sensitive receivers	Compliance	Periods of respite would be provided in the case of unavoidable maximum noise level events.	All	CEMP OEMP
40	Noise impacts to sensitive receivers	Compliance	Reasonable and feasible measures to reduce noise would be implemented and could include reducing the throttle setting and turning off equipment when not being used.	All	CEMP OEMP
41	Noise impacts to sensitive receivers	Compliance	Equipment and plant would be maintained to reduce noise emissions.	All	CEMP OEMP
42	Noise impacts to sensitive receivers	Compliance	Mobile plant clustering near residences would be avoided.	All	CEMP OEMP
43	Noise impacts to sensitive receivers	Compliance	A 24 hour toll-free contact phone number for enquiries during the works would be provided.	All	CEMP OEMP
44	Noise impacts to sensitive receivers	Compliance	A documented complaints process would be implemented and would include an escalation procedure so that if a complainant is not satisfied there is a clear path to follow.	All	CEMP OEMP
45	Noise impacts to sensitive receivers	Compliance	Where complaints occur safeguards would be reviewed to determine if further safeguards are required or possible.	All	CEMP OEMP

7 LESSER ISSUES

7.1 TRAFFIC AND ACCESS

7.1.1 Approach

The potential traffic implications that may result from the proposal were assessed using the following methodology:

- Road junctions and intersections were inspected and photographed
- Roads and Traffic Authority data was used to establish the existing traffic volumes (vehicles per day) on the main roads.
- Methods of photovoltaic array construction and programming of the works were investigated to estimate the proposed vehicle trips[3]
- Rodger Ubrihien, traffic consultant (Bega Duo Designs), consulted during impact assessment.

The potential impacts of the proposed development were assessed and recommendations provided for minimising potential traffic impacts associated with the proposal. The traffic impact assessment is primarily focused on the construction phase of the proposal as it is considered that the construction phase would generate the greatest volume of traffic.

7.1.2 Existing environment

The roads in the vicinity of the proposal site are generally classified as follows:

- State Roads –MR61, Federation Way, which is owned and maintained by the Roads and Traffic Authority
- Local Roads – All other roads which are owned and maintained by the Cabonne Council

Existing traffic volumes

Annual Average Daily Traffic (AADT) for The Escort Way, south of Orange Road is the closest recorded AADT to the proposal site. AADT for this location is 1605 which is relatively low. Traffic around the locality would mostly be a result of industry and rural activities, particularly associated with the flour mill.

Access requirements

Access requirements for the proposed solar farm can be separated into the following categories:

- Cars – represent the largest proportion of vehicles and would be used by project management staff and site workers to access the site. Between 20 and 40 cars would utilise the site daily, subject to car pooling and finalisation of workforce numbers.

[3] In accordance with the Guide to Traffic Generating Developments, a 'trip' is defined as a one-way vehicle movement from one point to another, excluding the return journey. The general method of measuring traffic volume is 'vehicles per day'. This is the total of all trips made in either direction per day.

- 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.
- 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 three trucks would be used on a daily basis at the site.
- Standard articulated trucks – would be used to transport 12 metre containers from point of origin.
- Oversize vehicle – for one-off delivery of substation transformer.

Access to the proposal site would generally be either a combination of rail and road or purely road network. Construction equipment and materials are proposed to be shipped via rail or road to Blayney and trucked from Blayney to Manildra via Orange Road, Mitchell Highway and Federation Way. From Federation Way, locally maintained roads would be used to access the proposal site. This route also provides access to the 132 kV substation. The distance from Blayney to Manildra is 80 kilometres.

The main access route for the proposal site is from Old Orange Road at the southern boundary of the site. Old Orange Road is part of the public road network and crosses a railway line between the highway a site access road. A private unsealed access road leads to the proposal site from Old Orange Road. An alternative access point would be considered from Molong Manildra Road where there are access gates that open directly onto the site. This access point may be used if Old Orange Road access is restricted during the construction period.

On site access

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

- each site inverter and kiosk transformer site
- construction site office
- construction equipment laydown area
- operations and maintenance building
- around the perimeter of the solar farm
- along the transmission line corridor

Tracks would be constructed of hard-packed gravel and would be 8 metres in width. A car park would also be constructed over an area of 750 square metres.

7.1.3 Impact assessment

Construction and decommissioning

During construction, vehicle movements would occur daily. Three trucks, five utilities and between 20 and 40 cars would utilise the site, most of which would travel to and from the site each day. Additional vehicles in the locality would not strain the local road system. A parking area for cars would be established within the lay down area over a 750 square metre area. This would minimise the need for site workers to park their cars on local roads. A Traffic Management Plan would be prepared an implemented to control traffic at the site.

Two hundred and eighty-five 12 metre containers would be required to be delivered during the construction phase. Assuming the shortest amount of time for construction is eight months, this would equate to between two and three deliveries per day. Deliveries would have noise impacts to local residents on Old Orange Road and possibly Molong Manildra Road, if access to the site via this road occurs. Impacts to residents on Federation Way would occur, though this road already experiences heavy vehicle traffic and therefore impacts would be minor.

It is unlikely that the anticipated number of deliveries would cause queuing on the highway in the event of delays waiting for rail to pass. The number of deliveries would be minimal and the railway traffic infrequent. However, there is a shoulder on the highway that is wide enough for traffic to overtake in the event of traffic delay.

Residents would be consulted as part of the Community Consultation Plan regarding potential for noise generated by additional traffic on local roads. Deliveries would occur during normal working hours to minimise noise impacts.

Additional vehicles using local roads could impact on the road quality causing further dilapidation, particularly from heavy vehicles deliveries of 12 metre containers. Cabonne Shire Council and the RTA would be consulted and a road dilapidation investigation, including consideration of the rail crossing, would be undertaken prior to construction.

Internal access roads within the site boundaries could be impacted from additional heavy vehicle traffic during construction and decommissioning. Where required, these roads would be upgraded with hard packed gravel and widened to 8 metres to withstand the anticipated traffic.

Operation

The additional traffic generated during the operation phase (up to 10 car trips/day) would have a negligible impact on local road and traffic conditions. Additional vehicle visits required for maintenance activities would be low and would have a similarly low impact on the local and regional road system. Additional vehicles may be required to carry out repairs. Most repairs can be carried out in a similar manner to routine maintenance, although transport of large or heavy infrastructure such as replacement inverters or kiosk transformers would require heavy vehicles. It is not anticipated that this would occur frequently. PV array and electricity connections have an operating life of 20 to 30 years.

7.1.4 Environmental safeguards

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
46	Safety and asset protection	Minimise risk	The proponent would develop and implement a Traffic Management Plan (TMP) in consultation with roads authorities to facilitate appropriate management of potential traffic impacts. The TMP would include provisions for: • Scheduling of deliveries and managing timing of transport to minimise impacts on road and rail traffic • Limiting the number of trips per day • Undertaking community consultation before and during all haulage activities • Designing and implementing temporary modifications to intersections, roadside furniture, stock grids and gates • Managing the haulage process, including the erection of warning and/or advisory speed signage prior to isolated curves, crests, narrow bridges and change of road conditions • Designation of a speed limit would be placed on all of the roads that would be used primarily by construction traffic • Preparation of a Transport Code of Conduct to be made available to all contractors and staff • Identification of a procedure to monitor the traffic impacts during construction and work methods modified (where required) to reduce the impacts • Provide a contact phone number to enable any issues or concerns to be rapidly identified and addressed through appropriate procedures • Reinstatement of pre-existing conditions after temporary modifications to the roads and pavement along the route.	Construction and decommissioning	CEMP
47	Safety and asset protection	Minimise risk	The proponent would use a licensed haulage contractor with experience in transporting similar loads, responsible for obtaining all required approvals and permits from the RTA and Councils and for complying with conditions specified in those approvals.	Construction and decommissioning	CEMP
48	Safety and asset protection	Minimise risk	The proponent would prepare road dilapidation reports covering pavement and drainage structures in consultation with roads authorities for the route prior to the commencement of construction and after construction is complete. This report would include consideration of the Old Orange Road rail crossing.	Construction and decommissioning	CEMP
49	Safety and asset protection	Minimise risk	The proponent would repair any damage resulting from the construction traffic (except that resulting from normal wear and tear) as required during and after completion of construction at the proponent's cost or, alternately, negotiate an alternative for road damage with the relevant roads authority.	Construction and decommissioning	CEMP

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
50	Safety and asset protection	Minimise risk	Route specific mitigation measures, which would be investigated and detailed further in the Traffic Management Plan, include accessing the site via Old Orange Road and using the existing access track within site boundaries.	Construction and decommissioning	CEMP

7.2 HISTORIC HERITAGE

7.2.1 Existing environment

Approach

A site inspection and desktop study were undertaken to determine the heritage values of any objects or places within the proposal site, with a particular focus on the area of the proposed works. The site inspection of the proposed route assessed the proposal site to determine the potential presence of any additional unlisted items that may be of potential heritage significance, and therefore protected under the Heritage Act 1977. This included assessing potential direct and indirect impacts to heritage items within or adjacent to the proposal site.

Heritage database searches of the proposal site included:

- The NSW State Heritage Register (items of state heritage significance) State Heritage Inventory (includes items listed by state agencies) to identify any items currently listed within or adjacent to the proposal site. The area searched was the Cabonne Shire LGA.
- The National and Commonwealth Heritage Lists to identify any items that is currently listed within or adjacent to, the proposal site.
- The Register of the National Estate.
- The heritage schedule of the Cabonne Local Environment Plan (LEP) 2002 for locally listed heritage items that are within or adjacent to the proposal site. This is the current LEP for the proposal site.

Results

Historic items in the region are mainly concentrated in the towns throughout the shire area; however, several occur at a greater distance and lower density in and around the outlying areas, and cultural places and infrastructure such as bridges, stores, railway stations, hospitals, hotels, cemeteries, churches and family burial grounds. These scattered features add to the historic rural character of the area. The site inspection also identified an unlisted and abandoned stone cottage near the southern boundary of the proposal site.

In Australia, there are heritage registers protecting places of heritage significance at the National, State and local levels. Results of searches of these registers are summarised in Table 7-1 below.

Table 7-1: Summary of heritage listings in the council area

Name of register	Number of places
World Heritage	0
National Heritage List	0
Commonwealth Heritage List	0
Register of the National Estate	1
NSW State Heritage Register	4
NSW State Agency Heritage Registers (Section 170)	1
Cabonne Local Environment Plan (LEP) 1991	43

State Heritage Register

A search of the NSW State Heritage Register (SHR) within the Cabonne Shire LGA indicated 4 listings. These included:

- Amusu Theatre, Manildra
- Cadia Engine House and Surrounds
- Grave of Yuranigh, near Molong
- Molong Railway Station and Yard Group, Molong

State Agency Heritage Registers

A search of places listed by State Agencies under s.170 of the NSW Heritage Act 1977 listed 1 heritage place. This was:

- Molong Fire Station (NSW Fire Brigades)

Register of the National Estate

A total of one item is registered in the Manildra area on the Register of the National Estate (RNE). This is:

- Boree Cabonne, Boree via Cudal

Following amendments to the Australian Heritage Council Act 2003, the RNE was frozen on 19 February 2007, which means that no new places can be added, or removed. In 2004, a new national heritage system was established under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). This led to the introduction of the National and Commonwealth Heritage Lists, which are designed to recognise and protect places of outstanding heritage to the nation. As a result, there was a significant level of overlap between the old RNE, and heritage lists at the national, state and territory, and local government levels.

Although the RNE does not affect decisions of state or local government, the RNE would continue as a register until February 2012. During this period the Minister for the Environment, Heritage and the Arts (the Minister) is required to continue considering the Register when making some decisions under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). No referral in this case is required for items listed on the RNE.

Local Heritage Schedule Listings

The site proposed for the solar farm is now covered by the Cabonne LGA. Schedule 1 of the LEP list heritage items in the area governed by the LEP. Similar to the National and State listings, heritage significance may be attributed to an item on social, architectural, natural, scientific, archaeological, aesthetic, historic or cultural grounds.

A total of 43 items are listed on the LEP. However, none of these items are within the Manildra town or surrounding area. Therefore, no further assessment is required.

Unlisted Heritage Items

It is important to note that while many heritage items have been identified and listed on heritage registers at National, State and local levels, some have not, and penalties can still apply for items destroyed without investigation.

During the site inspection an abandoned stone cottage was identified that is likely to be within the boundary of the proposal site (Figure 7-1 and Figure 7-2). The cottage is likely to be from early European settlement of the Manildra area. It consists of a corrugated iron roof and outdoor kitchen, but is currently in very poor condition. No previous assessment of significance appears to have been prepared for this item. The cottage is located near the access road into the property and is of potential heritage significance for at least its historical association with the area (see below).

Figure 7-1: Abandoned stone cottage within the site boundaries

Table 7-2: Manildra solar farm site showing the location of the stone cottage ruin, marked with a yellow circle.

7.2.2 Impact assessment

Construction and decommissioning

The desktop study identified a number of listed heritage items within the Cabonne Shire LGA. All of these items, however, are located outside of the proposed area for the solar farm.

The construction of the solar farm site which includes the solar module array and associated works, arranged in angled rows, supported by steel posts, in rows 1-3 metres above ground, is not considered to have any direct impact on significant heritage items within the immediate and surrounding area.

The majority of heritage listed items within the Cabonne Shire LGA are not located in or around Manildra. The only exception is the Amusu Theatre (SHR and LEP listed) that would not be impacted by the proposal.

The proposal would be located near the remains of an abandoned stone cottage ruin that has been identified as being within the proposal site. The cottage, which is not heritage listed, is likely to be a former farm house that has been in existence since the early settlement days of the Manildra area. The proposed works would not impact directly on the item, as access to the proposal site passes approximately 35 metres away. However, there is potential for some indirect impact on the remaining fabric from vibration and dust. The solar farm infrastructure would be approximately 200 metres from the cottage ruin when installed.

The transport of heavy vehicles on roads passing near heritage items may subject the sites to increased levels of dust and vibration and affect the character of the area during this time. Transportation of materials to the site would be via Blayney. Therefore, no access is required within Manildra township or passing close to any known listed heritage items.

In summary, the proposal is not considered likely to have a significant impact in accordance with the NSW Heritage Act 1977, Environmental Planning and Assessment Act 1979, or the Commonwealth Environment Protection and Biodiversity Conservation Act 1999, in terms of heritage.

Operation

No impacts are considered likely during the operational phase.

7.2.3 Environmental safeguards – construction and decommissioning

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
51	Impact to a potential heritage item (abandoned stone cottage)	Manage direct impacts	An assessment of heritage significance would be prepared to determine the heritage significance of the abandoned stone cottage. This would be prepared by a heritage consultant, pre-determination.	Pre-determination	CEMP
52	Impact to a potential heritage item (abandoned	Manage direct impacts	Should direct impacts on the cottage ruin or part of its built fabric be required (including road upgrades or heavy vehicle vibration), impacts would be managed in accordance with the assessment of heritage significance recommendations, above, and in consultation with an	Construction	CEMP

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
	stone cottage)		noise and vibration specialist. This may include: • Traffic management measures, such as 'go slow' areas or vibration loggers • Fencing or demarcating the site • Clear identification of the feature on CEMP site maps and staff induction		
53	Disturbance to a potential historic relic	Minimise disturbance	In the event of an item of heritage significance being uncovered at the proposal site after works commence, the NSW Heritage Branch (Department of Planning) should be contacted prior to further work being undertaken at the site.	Construction Decommissioning	CEMP

7.3 SOILS AND LANDFORMS

7.3.1 Existing environment

Soil and landscape features

The *Soil Landscapes of the Bathurst 1:250 000 Sheet* (Kovac and Lawrie, 1990) classifies the proposal site as the *Manildra soil landscape*. The Manildra soil landscape is characterised by hard setting loamy sand to loam and fine sandy soils. The various soil types associated with this soil landscape are provided in Table 7-3. The Manildra landscape is described as a large area of undulating low hills with a few low hills in the west. The proposal site has mostly mid slopes with crests and minor low-lying areas between slopes where a drainage line runs through the site.

Table 7-3: Soil types within the Manildra soil landscape relevant to the proposal site

Slope/Aspect	Soil type	Fertility	Erosion hazard	Drainage
Mid to upper slopes	• Red earths • Red-brown earths • Non-calcic brown soils	Low to moderate	Low to moderate	Well-drained
Mid to lower slope	• Yellow podzolic	Low	Low to moderate	Moderately well drained
Lower slope and drainage lines	• Yellow solodic • Red solodic • Euchrozems	Low to moderate	Moderate	Well to imperfectly drained

The proposal site is cropped and grazed in a cyclical fashion which involves regular disturbance to soil (Figure 7-2). Patches of boulders occur throughout the site and are particularly common in the western paddocks (Figure 7-3). Soil at the site was observed to be generally rocky throughout (Figure 7-4).

Figure 7-2: Overturned earth on cropped paddock

Figure 7-3: Boulders in the western paddocks

Figure 7-4: Rocky paddocks

Dryland salinity

The Manildra soil landscape is generally of low soil salinity (Kovac and Lawrie 1990). This correlates with findings of the SEE undertaken by Terra Consulting (2003) for construction of the Country Energy substation. The site is classified as moderate dryland salinity hazard on the SPADE Atlas (Department of Natural Resources 2010).

Acid sulphate soils

The proposal site has a very low to extremely low probability of acid sulphate soils occurring according to the ASRIS database (CSIRO 2006).

Contaminated land

A search of the contaminated land records (DECCW 2010b) was undertaken on 5 August 2010 for contaminated site located in the Cabonne LGA. No records exist. There is no knowledge of past land practices that would suggest that the site is contaminated.

7.3.2 Impact assessment

Construction and decommissioning

Earthworks would be required for construction of the operations and maintenance building and temporary site office. Approximately 500 square metres would be impacted. There may be excess material to be stockpiled on site and reused or disposed of as a result of earthworks. Stockpile material would also include topsoil and subsoil from trenching works and installation of inverters. Trenching would occur for cabling from the collection box at the end of each row of panels to the inverters and from the inverters to the substation. Trenching would require disturbance of approximately 1,250 square metres. Approximately 72 inverters would be installed which occupy 9.46 square metres each. An area of approximately 662 square metres would be disturbed for installation of the inverters. Approximately 36 pad mount transformers would result in disturbance to approximately 216 square metres.

Pile driving posts would compact and disturb soils. The number of posts required is approximately 50,000. Posts would be spread out over the 120 hectare PV array site. Soil disturbance would be confined to the immediate site of the posts as pile driving creates minimal disturbance otherwise. A total area of approximately 500 square metres would be directly impacted by pile driven posts. Alternatively, if concrete footings are used to hold the solar panel frames then approximately 17,385 square metres of soil could be disturbed. The concrete footings would be either placed on the ground or dug to a shallow depth below ground level resulting in minor disturbance to the soil.

Upgrading existing site access, construction of access tracks on site and use of access tracks during construction and decommissioning would impact soils. Soil compaction would occur as hardstands and tracks are created which would reduce soil permeability thereby increasing run off. Internal access tracks around the panels and inverters would be up to 5-8 metres wide. The access track from Old Orange Road to the site would be upgraded to 8 metres wide.

Approximately 55 mature trees would be cleared. Disturbance to groundcover species and low-lying shrubs may occur over an area up to 152 hectares. Clearing and other activities creating disturbance to soils would increase the risk of erosion. Rilling and gullying are erosion hazards associated with soil

disturbance and clearing on the Manildra soil landscape (Kovac and Lawrie 1990). Impacts to soil are likely be low given that the erosion hazard of soil types at the site is generally low. The highest risk areas are in lower slopes and drainage lines. Erosion and sediment controls would be implemented to reduce the risk.

In the event of a spill, soil contamination could occur. A range of chemicals would be required during the construction phase including paints, cleaning products, concrete products and fuels among others. When used or stored improperly, these chemicals can become mixed with stormwater and carried by sediment and runoff from construction sites. They can also cause soil contamination, affecting plant growth. The proponent would prepare a spill response plan that would identify procedures to respond to chemical spills that have the potential to impact the surrounding environment. The DECCW would be notified if a spill was considered to present a significant risk of harm to humans or the environment.

Decommissioning impacts would be similar to those during construction. Removal of pile driven posts and other infrastructure would result in some disturbance to soil. Rehabilitation of the site would need to occur as soon as practicable after removal of the posts to prevent further impact on soils.

Operation

Soil disturbance during operation would be minor. Maintenance and use of access roads would cause some compaction which could lead to reduced permeability and increase in runoff. Runoff from the panels could increase erosion below the panels, concentrating flow during rain events. Soil stabilisation would be enhanced by planting groundcover species beneath solar panels.

The use of fuels and other chemicals on site pose a minor risk of soil contamination in the event of a spill. Nevertheless, a spill response plan would be developed for the operational phase.

Thick and continuous pasture cover should be established prior to the installation of the array, and maintained at all times, including during winter and drought periods if possible. This would require careful monitoring and responsive grazing control. The slower recovery rates of shaded pasture should be considered in the management of stock and vegetation at the site (refer Thomas and Davies 1978).

The runoff from the panel rows would cause a concentration of rainsplash and potential soil erosion in a strip below the lower edge of the rows during heavy rainfall events. If concentrated rainsplash and runoff below the panel rows result in localised erosion, treatment of the splash zone may include hardening with gravel or organic mulch, reseeding and covering with an open weave jute matting, gypsum application to improve structure and infiltration, protection with geotextile fabric or localised flow dispersal and diversion structures.

While the potential for erosion exists at the site, these risks are considered to be manageable using adequate site preparation, and responsive pasture and stock management. The erosion risk of soils at the site is low to moderate. Any erosion which does occur can be readily treated using established techniques. The proponent would routinely monitor soil condition and vegetation cover below the array and liaise with the landowner regarding stock and vegetation management issues as required.

7.3.3 Environmental safeguards

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
54	Soil loss and soil quality	Minimise impact	Progressive Erosion and Sediment Control Plans would be prepared for the site, including controls at drainage lines and slopes.	Construction	CEMP
55	Soil loss or stability of landform loss	Minimise risks	Access track construction and management would comply with guidelines set down in DLWC (1994), Landcom (2004) and DECC (2008b).	Construction	CEMP
56	Soil quality	Minimise impact	Avoid compaction of soil resulting from vehicle access and laying of materials particularly during saturated soil conditions, and remediate as necessary.	Construction	CEMP
57	Soil quality	Minimise impact	Where cement is included in cable trench backfill, at least 20 centimetres of cement-free topsoil would be replaced as the top layer in the backfill.	Construction	CEMP
58	Soil loss or stability of landform loss	Minimise risks	Concrete wash would be deposited in an excavated area, below the level of the topsoil, or in an approved landfill site. Where possible, waste water and solids would be reused onsite.	Construction	CEMP
59	Soil loss or stability of landform loss	Minimise risks	Access routes and tracks would be confined to already disturbed areas, where possible. All contractors would be advised to keep to established tracks.	Construction	CEMP
60	Soil quality	Minimise risks	A spill response plan would be developed for all phases of the project. This would include trigger points of when to notify the DECCW.	Construction Decommissioning Operation	CEMP OEMP
61	Soil loss or stability of landform loss	Minimise impact	If concentrated rainsplash and runoff below the panel rows result in localised erosion, the affected soils at the site should be treated and protected without delay.	Operation	OEMP
62	Soil loss or stability of landform loss	Minimise impact	The proponent would routinely monitor soil condition and vegetation cover below the array and liaise with the landowner regarding stock and vegetation management issues as required.	Operation	OEMP
63	Soil loss or stability of landform loss	Minimise impact	Thick and continuous pasture cover should be established prior to the installation of the array, and maintained at all times, including during winter and drought periods if possible.	Pre-construction Operation	CEMP OEMP

7.4 HYDROLOGY AND WATER QUALITY

7.4.1 Existing environment

Regional hydrology

Mandagery Creek lies 400 metres west of the site and is part of the Lachlan River Catchment. It is a tributary of the Lachlan River. The Lachlan River Catchment covers an area of 84,700 square metres and makes up 8% of the Murray-Darling Basin system (Lachlan CMA 2006). Lachlan River and its tributaries pass through the towns of Canowindra, Crookwell, Cowra, Condoblin, Forbes, Parkes and West Wyalong among others. The Lachlan River Catchment is shown in Figure 7-5.

Water supply to the Manildra Township is from Central Tablelands Water based at Blayney. The Cabonne LGA uses approximately 300 megalitres per year (Central West CMA 2009).

The nearest weather station to the proposal site is located in George Street, Manildra; 1.3km southeast of the site. The annual rainfall for this location is on average 591.2mm (Bureau of Meteorology 2010). Rainfall levels are comparable to other locations within the catchments such as Parkes with an average annual rainfall of 580.6mm and Cowra with an average of 588.8mm (Bureau of Meteorology 2010). Annual rainfall levels over the previous four years have remained close to the annual average except for rainfall in 2006 which was extremely low (247.9mm).

Water quality in the Central West region has decreased between 2007 and 2009 (Central West SoE). 67% of samples taken in 2008-2009 contained Phosphorus levels exceeding the ANZECC guidelines. Phosphorous levels are an indicator of algal growth.

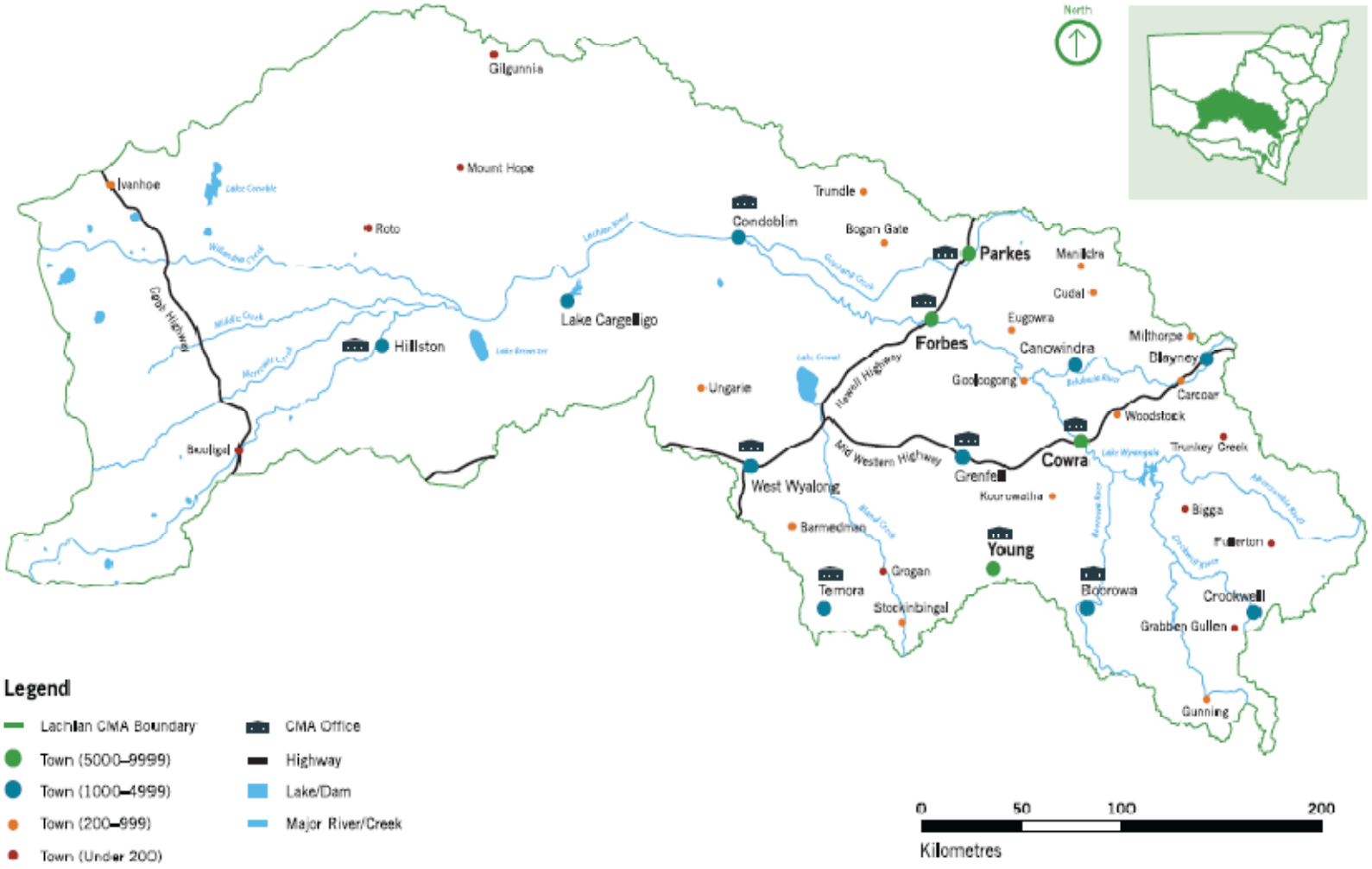

Figure 7-5: Lachlan River Catchment (*Source: Lachlan CMA 2006*)

Proposal site

Land at the proposal site is gently undulating with elevation ranges from 450 m to 490 m. The site is at a high elevation relative to the town and has no issues with flooding, the majority of runoff directed towards low lying areas in the south and west. The soil landscape associated with the proposal site has a nil to low flood hazard (Kovac and Lawrie 1990). A dry drainage line runs through some of the proposal site. There are several dams on the property which are likely to be used for livestock and potentially crop watering. There are also dams in neighbouring paddocks just outside of the proposal site boundary. An example of a farm dam on the site is shown in Figure 7-6. Drainage features of the site and surrounds are shown in Figure 7-7.

Figure 7-6: Dam at the site

Groundwater

Several registered groundwater bores are located in the region and are privately owned. A map showing the locations of groundwater bores within 10km of the proposal site is shown in Figure 7-8. It is likely that several residents and property owners extract water from the bores. No groundwater bores are located within the site boundary.

No groundwater extraction or works are planned at the proposal site as part of the proposal.

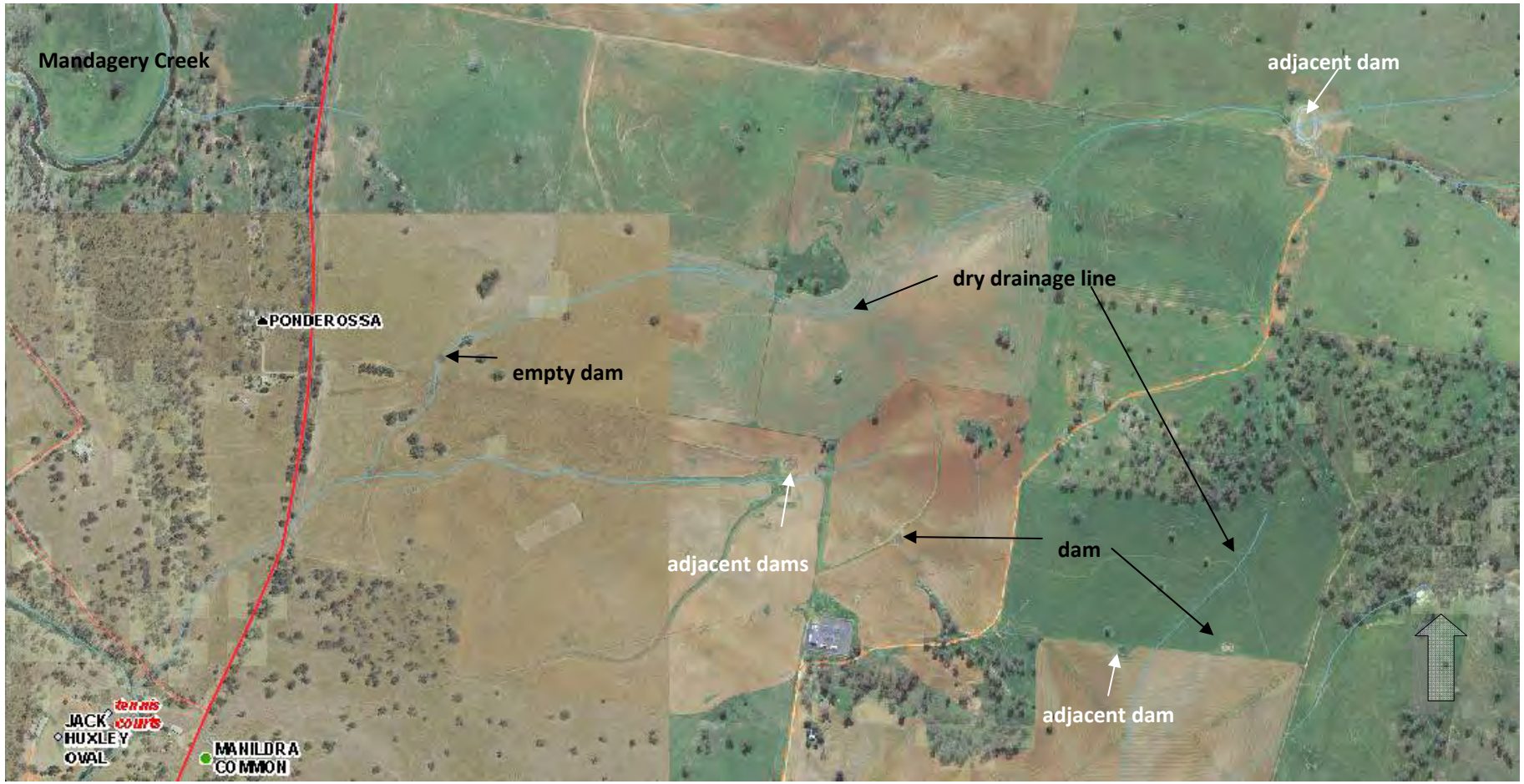

Figure 7-7: Drainage features of the site and surrounds (*Source: Department of Lands: Six Viewer*)

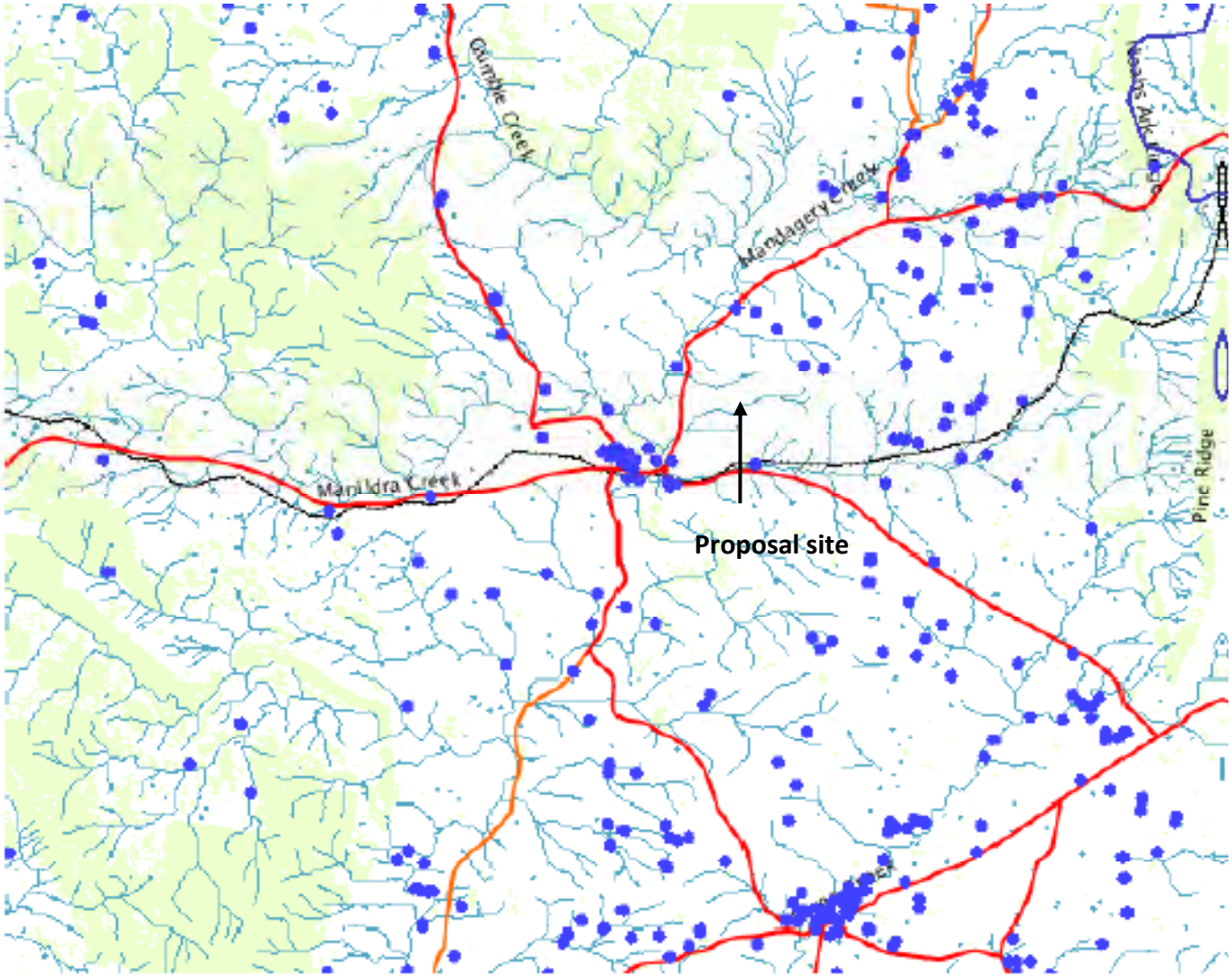

Figure 7-8: Groundwater bores in the Manildra locality (*Source: SPADE Atlas DNR 2010*)

7.4.2 Impact assessment

Construction and decommissioning

Excavation, soil stockpiling and haulage represent potential risks to water quality from sedimentation during the construction and decommissioning periods. The transport of chemicals and the use of hydrocarbons represent chemical spill risks.

Mandagery Creek lies 1.5 kilometres west of the site. Impacts to local and regional hydrology would be minimal as a result of the proposal. There are no natural permanent waterbodies on the site. The drainage line that passes through the site (Figure 7-7) was dry at the time of the site visit and is not likely to carry high volumes of sediment-laden water except in periods of heavy rain.

Sediment or pollutant laden runoff could impact farms dams and nearby drainage lines, however it is unlikely that this would reach any larger watercourses. Impacts to the farm dams would affect the property owner as they use dams as a resource for livestock and watering crops.

The proposal would involve the construction of hard packed gravel access tracks and hardstand areas including the site office, operations and maintenance building, car park and temporary laydown areas. Construction of these facilities would increase runoff. With best practice construction, drainage and management techniques, these risks are manageable and acceptable within the context of the project and water values of the site.

A range of chemicals would be required during the construction phase; in paints, acids for cleaning surfaces, cleaning solvents, concrete products, soil additives used for stabilisation and other purposes, concrete-curing compounds, fuels as well as other sources. When used or stored improperly, these chemicals can become mixed with stormwater and carried by sediment and runoff from construction sites. They can also cause soil contamination, affecting plant growth. The proponent would prepare a spill response plan that would identify procedures to respond to chemical spills that have the potential to impact the surrounding environment. DECCW would be notified if a spill was considered to present a significant risk of harm to humans or the environment.

Water usage during construction and decommissioning would be sourced from the local water supply. Water would be required to suppress dust on unsealed roads and for minor construction activities and would therefore have minimal impacts to the Council's water supply volume.

Operation

The drainage line running through the site is likely to be disturbed by site activities. Any runoff from a rain event would naturally divert towards the drainage line which is in the low lying areas of the site. This could result in erosion and in the case of higher rainfall, water may remain for longer periods in the drainage line.

Water would be used for washing the panels as required. It is likely they would need to be washed infrequently in the event of extreme weather conditions where build-up of sediment is affecting efficiency of the panels e.g. dust storm. Detergent is not required for washing, thereby avoiding any chemical impacts. A high pressure hose and water truck would be used for washing panels with water sourced from the town supply. Up to 100,000 litres of water may be required per month during operation for panel washing.

7.4.3 Environmental safeguards

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
64	Deterioration of water quality (Surface Water)	Minimise risk	Infrastructure placement, including tracks, substations, control buildings, stockpiles, and site compounds and turnaround areas, would not be sited within 40 metres of a major drainage line or water course	Detailed design	CEMP
65	Deterioration of water quality (Surface Water)	Achieve neutral or beneficial water quality impact	The proponent would prepare a Erosion and Sediment Control Plan (ESCP) as a sub-plan of the Construction Environmental Management Plan. This plan would include the following provisions: • Sediment traps would be installed wherever there is potential for sediment to collect and enter waterways • Stockpiles generated as a result of construction activities would be bunded with silt fencing, (mulch bunds or similar) to reduce the potential for runoff from these areas • On the steeper slopes check banks or berms would be installed across the trenchline, as appropriate, following closure of the trench. These would discharge runoff to areas of stable vegetation • Stabilisation and site remediation would be undertaken as soon as practicable throughout and post construction • Soil and water management practices would be developed as set out in Soils and Construction Vol. 1 (Landcom 2004) • Monitoring of surface water quality would be undertaken following heavy rainfall events	Construction	CEMP
66	Flooding impacts	Minimise risks of flooding impacts	Advice from a Hydrologist would be sought prior to determination regarding the potential flooding risks (eg to access and location of infrastructure) and the need for a Flood Management Plan to be prepared and implemented at the site. Should a Flood Management Plan be required, it would be incorporated into the CEMP and OEMP.	Pre-determination	CEMP
67	Deterioration of water quality (Surface Water)	Achieve neutral or beneficial water quality impact	The site CEMP and OEMP could be provided to the New South Wales Office of Water for review of soil and water management measures for construction and operation, if required.	Construction Operation	CEMP OEMP
68	Water supply	Minimise risk	Undertake liaison with representatives of Cabonne Council regarding the potential supply of construction water	Construction Operation	CEMP
69	Deterioration of water quality (Surface Water)	Minimise risk	All vehicles onsite would follow established trails and minimise onsite movements	Construction Operation	CEMP OEMP

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
70	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Machinery would be operated and maintained in a manner that minimises risk of hydrocarbon spills	Construction Operation	CEMP OEMP
71	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Maintenance or re-fuelling of machinery would be carried out on hard-stand in accordance with industry standards for fuel transfer	Construction	CEMP
72	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Design of concrete batch plants would ensure concrete wash would not be subjected to uncontrolled release. Areas of the batching would be bunded to contain peak rainfall events and remediated after the completion of the construction phase. Waste sludge would be recovered from the settling pond and used in the production of road base manufactured onsite. The waste material would be taken from the batching plant to be blended in the road base elsewhere onsite.	Construction	CEMP
73	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Carry out dust suppression as required through either watering or chemical means (environmentally friendly polymer based additives to water).	Construction Decommissioning	CEMP
74	Deterioration of water quality (Surface Water)	Achieve neutral or beneficial water quality impact	A Site Restoration Plan (SRP) would be prepared as part of the Construction Environmental Management Plan. This would set out protocols for restoration works including: • site preparation • stabilisation • revegetation • monitoring	Construction Decommissioning	CEMP
75	Deterioration of water quality (Surface and Ground Water)	Minimise risk	A Spill Response Plan would be prepared as part of the CEMP and OEMP including: • Identify persons responsible for implementing the plan if a spill of a dangerous or hazardous chemical/waste would occur • Identify all chemicals required for the proposal, including physio-chemical properties, risks posed to water quality objectives and appropriate methods of storage of these chemicals. • Locate Material Safety Data Sheets (MSDS) for all chemical inventories at on site and readily available • Comply with manufacturers recommendations in relation to application and disposal where chemicals are used • Report any spill that occurs to the Construction Manager regardless of the size of the spill	Construction Operation Decommissioning	CEMP OEMP

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
			• Establish clearly defined works and refuelling areas • Spill protocols in this plan would dictate when the EPA would be notified • Chemical / fuel storage areas would be identified, and be bunded to prevent loss of any pollutants • Hydrocarbon spill kits would be stored at the site. A number of site staff are to be trained in the use of the spill kits		
76	Deterioration of water quality (Surface and Ground Water)	Minimise Risk	The proponent would notify the NSW DECC EPA in the event of any spill that had the potential to pollute waters	Construction Operation	CEMP OEMP
77	Protection of ground water	Minimise risk	Undertake investigations, as part of the geotechnical investigation, to ensure that the project would have no material adverse effect on groundwater/aquifers as a result of blasting activities	Pre-construction	CEMP
78	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Monitor bunded infrastructure to ensure that volume of oil could be fully contained in the event of leak	Operation	OEMP
79	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Maintain septic systems, if installed, to meet appropriate Australian standards	Construction Operation Decommissioning	CEMP OEMP

7.5 AIR QUALITY AND CLIMATE

7.5.1 Existing environment

Air quality

A search for sources of air emissions and pollution levels in the locality was undertaken on 4 August 2010 from the National Pollution Inventory (NPI 2010). Within the Manildra postcode there are five identified sources of air pollution in the form of Nitrogen and Phosphorous. These are:

- Cropping in Murray-Darling Basin
- Unimproved pasture in Murray-Darling Basin
- Improved pasture in Murray-Darling Basin
- Woodland/forest/forestry in Murray-Darling Basin
- Sub-threshold point sources in Murray Darling Basin

Other sources of pollution would include local industry, such as the Manildra Flour Mill. The Manildra Flour Mill has a calculated estimate for greenhouse gas emissions of 1.068 kg CO_2e/kWh. This is calculated using the sum of the annual electricity consumption figures associated with the plant (including equipment and lighting) multiplied by the Australian Greenhouse Gas Office (AGO) emissions factor (GHD 2007)

There were three odour-related complaints in Cabonne LGA in 2009 (Central West Catchment Management Authority 2009).

Climate

Manildra lies within the South Western Slopes bioregion. This bioregion is characterised by a sub-humid climate with hot summers and no dry season (DECCW 2010a).

Table 7-4 depicts a range of climate statistics for the region, taken from the closest data available at Molong, 25 kilometres from the site.

Table 7-4: Climate statistics for Molong, 25 kilometres from the proposal site (*Source: BOM 2010*)

Mean Annual Temperature	Minimum Average Monthly Temp	Maximum Average Monthly Temperature	Mean Annual Rainfall	Mean Annual Wind Speed
20.6^{0}C	-0.1^{0}C	31.0^{0}C	700.4mm	7.1km/h at 9am 9.3km/h at 3pm

Wind conditions are generally calm (29% of the time) and, when windy, wind direction is most frequently south west (18% of the time) (BOM 2010).

7.5.2 Impact assessment

Construction

No climatic impacts are anticipated to be generated during the construction phase.

The construction phase of the project would generate dust from clearing works, vehicle movements, earthworks, stockpiling, transporting materials, road works and concrete works. Exhaust emissions would also be generated from vehicles, plant and machinery. Impacts would be temporary (eight months). It is unlikely that impacts would be high as there are few sensitive receivers close enough to the site to be noticeably affected by emissions or dust. Mitigation measures including water carts and visual inspections would keep air emissions down.

Operation

The proposal would have positive climate change related impacts by reducing greenhouse gas emissions as detailed in Section 2.6. The proposal has an emission level of 0%.

There could be dust issues during operation due to vehicle movements and, potentially, wind erosion. Dust suppressive mechanisms would be used if dust becomes a problem and measures to maintain

vegetation cover and minimise potential for erosion would reduce the likelihood of dust. Exhaust emissions associated with vehicles and machinery would be low.

7.5.3 Environmental safeguards

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
80	Air quality	Minimise risks	Dust levels at stockpile sites would be visually monitored. Dust suppression would be implemented if required. Stockpiles would be protected from prevailing weather conditions	Construction	CEMP
81	Air quality	Minimise risks	Undertake ongoing visual dust monitoring and suppression (if required) during the construction phase. Monitoring would regularly assess the effectiveness of dust suppression activities. Monitoring would regularly assess the effectiveness of dust suppression activities.	Construction	CEMP
82	Air quality	Minimise risks	Should a complaint relating to dust by a resident be received, dust monitoring would be undertaken. The proponent would assess the dust gauges and identify additional mitigation measures, where required.	Construction	CEMP
83	Air quality	Minimise risk	Vegetation cover would be maintained throughout operation.	Operation	OEMP

7.6 WASTE MANAGEMENT AND RESOURCE USE

7.6.1 Existing environment

Life cycle analysis (LCA) is based on careful accounting of energy and material flows associated with a system or process. It is a way to quantify and analyse the resource impacts of a process or project. This approach covers the whole project life cycle, from the extraction of raw materials to the disposal of materials at the completion of projects. LCA is particularly relevant for renewable technologies, where it is often argued that the energy used to produce the technology is not 'paid back' during the lifetime of the technology (Schleisner 2000). 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).

The US Department of Energy (2004) notes the 'energy payback time' for multi-crystalline PV modules was 4 years for systems using recent technology (as at 2004) and 2 years for anticipated technology (by 2014). That is, in approximately 2-4 years, the energy produced by a multi-crystalline PV system would 'pay back' the energy consumed in producing, installing and decommissioning that system and begin to produce a net positive energy balance. A subsequent analysis by Alsema et al. (2006) advised that crystalline silicon PV systems had energy pay-back times of 1.5-2 years for South-European locations where irradiation was considered to be 1700 kWh/m^2/yr. These payback times are considered

comparable to those that could be expected at Manildra, which, based on information obtained from the Bureau of Meteorology website, has irradiation levels of between 1825 to 2129 kWh/m^2/yr[4].

Mackay (2009) estimates the energy yield ratio (the ratio of energy delivered by a [PV] system over its lifetime, to the energy required to make it) of a roof-mounted, grid-connected solar system in Australia to be more than seven. That is, the PV system would produce more than seven times the amount of energy required to make it). GA & ABARE (2010) further note that this positive energy yield ratio also means that greenhouse gas emissions generated from the production of solar energy systems are more than required to offset emissions over the systems' life cycle, as there are no greenhouse gas emissions generated during operation.

Materials used in the construction of multicrystalline PV panels can be recycled, including the silicon wafers, glass and aluminium frame. Frisson et al. (2000) identified a cost effective industrial PV module recycling process and conducted a life cycle analysis based on a module with 125 x 135 mm multicrystalline silicon cells, which found a 40% reduction in energy consumption per generated kWh using a module with recycled wafers. This analysis found that reclaimed silicon wafers preserved their initial high quality resulting in high-efficiency recycled solar cells that would dramatically reduce the energy payback time of a PV module using recycled wafers. This reduction was due to the higher initial energy requirements for silicon production in a new PV module (7.55kWh/wafer) being replaced by a much smaller energy requirement for module recycling (0.4kWh/wafer).

A life-cycle assessment was also conducted by Frankl et al. (2006) for current and future PV technology plants. The life-cycle was divided into four phases: fuel supply (in this case solar irradiation), and production (construction), operation and disposal of the PV plant. The PV plant production phase was further split into sub phases including PV module production, balance of system (BOS) construction (i.e inverters, other electrical components, and mechanical supporting structure), and installation of the plant.

The study identified that the greatest consumption of energy and resources occurred during the production phase, with the major part of the environmental burden due to the energy requirements of the upstream processes related to the production of silicon and PV wafers. The environmental impacts in this phase are secondarily due to the materials needed for the installation and the operation of the PV systems, i.e. aluminium frame, steel in mechanical BOS and inverters. In contrast, impacts during the disposal phase were relatively minor, while no impacts (resource use or emissions to air, land or water) were associated with the fuel supply and operation phases.

During the operational phase, the costs of construction and decommissioning begin to be offset by the operational capacity of the PV array. Disposal encompasses the resources required to dismantle the PV array as well as the disposal of materials.

The main energy source produce in Australia in 2007-2008 on an energy content basis was coal (54%) (GA and ABARE 2010). Wright and Hearps (2010) provide comparisons between the CO_2 equivalent emissions of a PV plant, and coal fired power stations with and with carbon capture and storage technology. Alsema et al. (2006) additionally provide CO_2 equivalent emissions per kilowatt hour for Combined Cycle Gas Turbine. These comparisons are summarised in Table 7-5.

[4] Calculated using an average daily solar exposure annual range of 18-21 megajoules per square metre converted to kWh/m^2 using a conversion factor of 1kWh to 3.6 megajoules and multiplied by 365 to obtain a yearly figure.

Table 7-5: Comparison of CO_2 equivalent emissions produced per kilowatt hour. *Using energy output (kWh) to compare emissions, the PV array produces a small fraction of the CO_2 equivalent emissions of coal- and gas-fired power stations*

Generation method	Emissions produced
Solar PV plant	19-59 grams CO_2 equivalent per kWh
Coal-fired power station – with carbon capture and storage	255-442 grams CO_2 equivalent per kWh
Coal-fired power station – without carbon capture and storage	800-1000 grams CO_2 equivalent per kWh
Combined Cycle Gas Turbine	400 grams CO_2 equivalent per kWh

Hence, by comparison to major electricity generating methods employed in Australia, solar farms rate favourably based on:

- CO_2 emissions generated per kilowatt hour of energy produced
- Potential to reuse and recycle component parts
- Energy payback time in comparison to the life span of the project

7.6.2 Impact assessment

Construction

It is considered that the majority of resource use and waste generation would occur during the construction phase.

Use of resources

The construction of the proposed solar farm, including associated infrastructure, would require the use of various resources, such as construction materials (metals, glass, plastics), concrete and other masonry products (slabs, hardstand areas, building elements), and materials associated with the operation of machinery and motor vehicles (fuels and lubricants). These materials are not currently depleted or restricted in supply, however, increasing scarcity and environmental impacts are becoming apparent from the use of fossil fuels, mineral resources and other non-renewable resources. As such, the proposal is unlikely to place significant pressure on the availability of local or regional resources.

Additionally, research cited above indicates that embedded energy within the PV system would be 'paid back' within a relatively short time frame. Research reviewed indicated that payback times could be likely to extend up to two years after commissioning of the solar farm.

Recycling of materials at the end of the life of the solar farm would create another opportunity for a positive impact resulting from the proposal. Recycling of the PV modules.

Generation of waste

Solid waste is one of the major pollutants caused by construction. Waste would be generated by a number of different activities occurring during the construction phase including:

- material from packaging
- building materials
- scrap metals
- excess soil material
- plastic and masonry products
- vegetation clearing

It is considered that waste generated as a result of the construction phase, detailed above would be classified as building and demolition waste within the class *general solid waste (non putrescibles)* in accordance with the POEO Act.

Sanitary wastes would also be generated within the ancillary facilities (site compound) during the construction period. This waste would be classified as *general solid waste (putrescibles)* in accordance with the POEO Act.

Table 7-6 identifies the potential waste streams and proposed management options for each stream.

Table 7-6: Likely waste streams and associated management options

Waste stream	Generation process	Example of waste type	POEO Act classification	Management strategy	Waste storage
Office Waste	General office activities	Paper, plastics, packaging, cartridges, polystyrene	General Solid (non-putrescible)	Provide separated recycling bins onsite for recyclable material. Provide general waste bins for non recyclable materials.	A mixed recycling bin would be provided and located within the site office compound.
Office Waste	General office activities	Food	General solid (putrescible)	Provide separate waste bins on site for food waste. Regular collection of this waste would be undertaken with the collected waste disposed of at an appropriately licensed facility.	A food scraps bin would be provided and located in the site compound.
Packaging	General construction activities	Timber pallets, plastic, steel strapping, cardboard	General Solid (non-putrescible)	Provide separated recycling bins onsite for recyclable material. Provide general waste bins for non recyclable materials.	A recycling bin would be provided and located within the designated lay down area.
Construction Activities	Excavation and earthworks	Excess spoil	General Solid (non-putrescible)	Reuse onsite, if unable to re use on site dispose of at appropriately licensed land fill.	Any excess material would be stockpiled on site.
Construction Activities	Vegetation clearing	Excess cleared vegetation	General Solid (non-putrescible)	Non-weedy material would be mulched and used during rehabilitation.	Any excess material would be disposed of at an appropriately licensed facility.
Construction Activities	Vegetation clearing	Excess cleared vegetation	General Solid (non-putrescible)	Weedy vegetation would be sprayed and bagged to avoid potential proliferation.	This material would be disposed of at an appropriately licensed facility.

Construction Activities	Construction materials	Formwork, reinforcing steel, PVC conduits, cables, glass	General Solid (non-putrescible)	Ensure this waste is not mixed with any other waste. Provide separated recycling bins onsite for recyclable material. Provide general waste bins for non recyclable materials.	This material would be stockpiled on site and removed by an appropriately licensed waste contractor.
Construction Activities	Construction materials	Cable reels	General Solid (non-putrescible)	All cable reels would be stored on site and returned to the manufacturer	Cable reels would stored on site within the lay down area.
Construction Activities	Concrete Truck Wash out	Concrete laden water	Liquid waste	Washout waster would be contained within a concrete wash out bay. This water has a high pH and high turbidity. The water component of the waste water is left within settling ponds to evaporate. The resulting waste is concrete sludge.	A dedicated concrete wash facility would be located in the construction site compound or laydown area. Concrete sludge would be re-used for road base aggregate or disposed as inert waste to an appropriately licensed land fill.
Construction Activities	Sewage	Sewage	Liquid waste	Sewage waste generated onsite would be stored within toilet tanks.	The sewage would be collected and transported by a transport company licensed to transport class C waste.
Construction Activities	Use of chemicals	Empty drums and storage containers	Classification dependant on chemical stored	Drums and containers would be stored in an appropriately bunded hardstand area.	This material would be disposed of at an appropriately licensed facility.

POEO Act: *Protection of Environment Operations Act* 1997

A key strategy of construction and decommissioning works would be to avoid and minimise waste from the construction site, reuse and recycle waste where possible and dispose appropriately of waste which cannot be managed in any other way. This is the application of the *waste hierarchy*, which states that:

1. strategies which try to avoid products becoming waste are generally preferable to:
2. strategies which seek to find a use for waste; which are in turn generally preferable to:
3. strategies for disposal, which should be used as a last resort

The proponent would prepare a Waste Management Plan (WMP) as part of the CEMP. The WMP would identify all potential waste streams associated with the proposal. The WMP would also outline methods of disposal of waste at appropriately licensed facilities.

Operation

Resource use

Producing electricity with photovoltaics (PV) emits no pollution, produces no greenhouse gases, and uses no finite fossil-fuel resources (US DoE 2004). The only fuels likely to be required during the operational phase of the solar farm would be fuel for maintenance vehicles. Replacement of balance of system components (e.g. inverters, transformers, electrical cabling) that may be required would consist of metal and plastic based products. For example, Borenstein (2008) (cited in GA & ABARE 2010) identified the inverter that converts the direct current to alternating current needs to be replaced at least once every 10 years.

Water would be required for panel washing following event-based incidents, such as dust storms, if the efficiency of the panels is considered to have been significantly impaired. It is not envisaged that panels would need to be regularly washed. Water would be sourced from the local Carbonne shire water supply and, most likely, applied using a portable pressure washer or water truck. Detergent would not be used when washing panels.

Waste

The discussion and safeguards above apply equally to this phase, although resource requirements and wastes are anticipated to be much lower. All wastes would be removed by contractors and operational and maintenance staff. A local garbage service is unlikely to be required.

7.6.3 Environmental safeguards

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
84	Waste generation	Minimise waste and maximise recycling of materials	The proponent would prepare a **Waste Management Plan** to be included within the **Construction Environmental Management Plan**. It would include but not be limited to the following: • The scope for reuse and recycling would be evaluated • Provision for recycling would be made onsite • Wastes would be disposed of at appropriate facilities • Toilet facilities would be provided for onsite workers and sullage from contractor's pump out toilet facilities would be disposed at the local sewage treatment plants or other suitable facility agreed to by Council • Excavated material would be used in road base construction where possible. Surplus material would be disposed of in appropriate locations on site (on agreement with the landowner), finished with topsoil, and revegetated.	Construction Operation	CEMP OEMP
85	Waste generation	Maximise recycling of materials	PV modules would be recycled, where possible.	Decommissioning	

7.7 SOCIO-ECONOMIC AND COMMUNITY

7.7.1 Existing environment

Community and Tourism

Manildra and the Cabonne Country are known for a food, wine and country lifestyle, which attract tourists to the area. Manildra holds an agricultural show every September, and is home to the National Bread Show. The village of Manildra contains food services and recreational park and picnic areas along Mandagery Creek.

Other sources of tourism within the village include the Manildra Flour Mill and associated Mill and Rail Museum and The Amusu, Australia's oldest operating picture theatre (Cabonne Country 2010). The Amusu began as a travelling picture show in 1923 and settled in Manildra in 1936. The Manildra Flour Mill, just 1.6 kilometres from the site, is the largest in the southern hemisphere. The mill was moved to Manildra from Cargo in 1906 and has been owned by the Manildra Group since 1952.

Socio Economic

The proposed Manildra Solar Farm is situated within the Cabonne LGA which has a total population of 12,396 (ABS 2006). This LGA falls under the Lachlan River Catchment (Figure 7-5) and, along with Manildra, includes the villages of Borenore, Canowindra, Cargo, Cudal, Cumnock, Eugowra, Molong, Mullion Creek and Yeoval. The Cabonne LGA is known for its food, wine and country lifestyle. Agriculture and mining are the main industries in the region. Nearby regional centres such as Orange, Bathurst, Cowra, Parkes and Forbes provide employment opportunities for locals outside the LGA. In company with other rural communities, the region suffers from skills shortages for health professionals and trades people.

According to the latest Australian Census for Manildra (2006), village employment includes the industries of Grain Mill and Cereal Product Manufacturing (32.7%), Supermarket and Grocery Stores (4.7%), Hospitals (4.3%), Sheep, Beef Cattle and Grain Farming (3.8%) and Road Passenger Transport (3.3%) with an unemployment level of 4.5%. A summary of key statistics for Manildra and Cabonne Council are listed in Table 7-7.

Table 7-7: Key statistics for Manildra and Cabonne Council (*Source: Australian Bureau of statistics 2006)*

Subject	Manildra 2006 Statistics	Cabonne Council 2006 statistics
Population	503	12, 396
Male Population	48.3%	50.3%
Female Population	51.7%	49.7%
Aboriginal and Torres Strait Islander	2.3%	2.3%
Medium age 2006 (yrs)	36	41
Population aged over 55 years	27.2%	29.9%
Population aged between 0-14 years	23.3%	22%
Median Weekly Income ($AUSD)	$384	$411
Median Weekly Family Income ($AUSD)	$1,023	$1,054

7.7.2 Impact assessment

Construction

Community impacts during the construction phase of the solar farm include an increase in traffic, as well as increased noise and minor visual impacts. These impacts would be temporary and are not anticipated to be reflected in the land value of the site or land values in the area. More information about mitigation for traffic, noise and visual impacts can be found in Sections 6.2, 0 and 7.1.

The provision of temporary employment for 50 staff during construction would have a positive impact on the Manildra economy and the broader region. Construction would provide employment opportunities for locals, people in neighbouring areas and people willing to temporarily relocate. Increased demand for services in the local area during construction would occur as contractors seek accommodation and food and utilise other services in the local area, providing an increased stream of business.

Indirect impacts to nearby land could occur due to turbid runoff, erosion, weed ingress and pollution from chemical spills during the construction stages of the project. Unmitigated, these impacts could reduce productivity of the affected areas. These impacts are highly manageable, however, and discussed further in Sections 6.1, 0 and 7.4.

Construction impacts are, therefore, considered to be largely temporary and manageable with mitigation measures outlined below and in other relevant sections of this document.

Operation

If constructed, the Manildra Solar Farm would be one of the first large-scale solar farms in Australia. In this event, the constructed solar farm could potentially attract greater tourism to Manildra, thereby stimulating the local economy further. The site would be visible from several locations that are publically accessible including Molong Manildra Road and Federation Way.

There would be no ongoing financial expenses to the community or any government agency. Economic inputs would involve employment opportunities for the local, regional and national work force. Five long-term jobs over an operating life up to 50 years would be created for maintenance works during the operation period. The works would have a positive long term impact on the socio economics of the region.

The operational solar farm is not anticipated to affect the way that involved landowners or neighbouring landowners currently manage their agricultural activities. Nor is it anticipated to affect the production capacity of the land. A negative impact could result in the temporary loss of land for use in agriculture (up to 50 years); however, the land owner would be duly compensated in the lease agreement.

7.7.3 Environmental safeguards

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
86	Impact on current land use	Minimise impact	Develop, implement and monitor the effects of a Site Restoration Plan. The plan would aim to stabilise disturbed areas. The Plan would consider: • Appropriate stabilisation techniques across the precincts • Suitable species for re-seeding (native, locally occurring species would be given preference) in areas dominated by native cover • Monitoring for weed and erosion issues	Construction Decommissioning	CEMP
87	Impact on current land use	Minimise disruption	Liaison would be undertaken with neighbouring landowners to provide information about the timing and routes to be used during construction and decommissioning. This could be in the form of advertising and provision of a contact point for further inquiries. The aim would be to reduce the risk of interference with agricultural activities on affected roads and road verges.	Construction	CEMP
88	Impact on local community	Maximise positive impact of proposal	Liaise with local industry representatives to maximise the use of local contractors and manufacturing facilities in the construction and decommissioning phases of the project.	Construction	CEMP
89	Impact on local community	Maximise positive impact of proposal	Liaise with the local visitor information centres to ensure that construction and decommissioning timing and haulage routes are known well in advance of works and to the extent practical coordinated with local events, such as the Agricultural show.	Construction	CEMP
90	Impact on local community	Maximise positive impact of proposal	Make available employment opportunities and training for the ongoing operation of the solar farm to local residents where reasonable.	Operation	OEMP
91	Impact on local community	Provide accurate information	Dissemination of accessible and independent information on solar farm impacts.	Pre-construction	CEMP

7.8 LAND USE AND MINERAL RESOURCE IMPACTS

7.8.1 Existing environment

Historically, the Cabonne Council has a significant amount of gold, copper and sulphur deposits in the area. There is a current proposal for a large scale mine on Copper Hill, 17 kilometres north east of the proposed Manildra solar farm site. Feasibility studies are currently underway and a decision on whether to go ahead with the mine is expected by the end of 2010. The mining potential of the site is

420,000 tonnes of copper, 1.2 million ounces of gold and 3 million tonnes of sulphur (Cabonne Council 2010b).

According to the Bathurst Sheet (Si55-8) of the Australian 1:250 000 Geological Series maps, the proposal site is underlain by rocks of the Late Silurian Wansey Formation, which consists mainly of sandstone, siltstone and shale. The local occurrence of the Wansey Formation at Manildra covers an area approximately 20 kilometres long and up to approximately 3 kilometres wide at the widest point.

The Manildra Common Pit, a sandstone quarry, operated by Cabonne Council lies to the south east of the site, approximately 450m from the proposed access track.

A gold deposit lies 5 km northwest of the site with minor copper deposit. Other nearby deposits (within 10km of the site) include metallic mineral deposits (three), iron (three), copper (eight) and zinc (one). There are another two gold deposits within 10km. A map of the mineral tiles in the region is shown in Figure 7-9 below. Exploration License (Cumnock) EL 6417 is held by Ausmon Resources and lies northwest of the site, west of Molong Manildra Road (MinView, 2010).

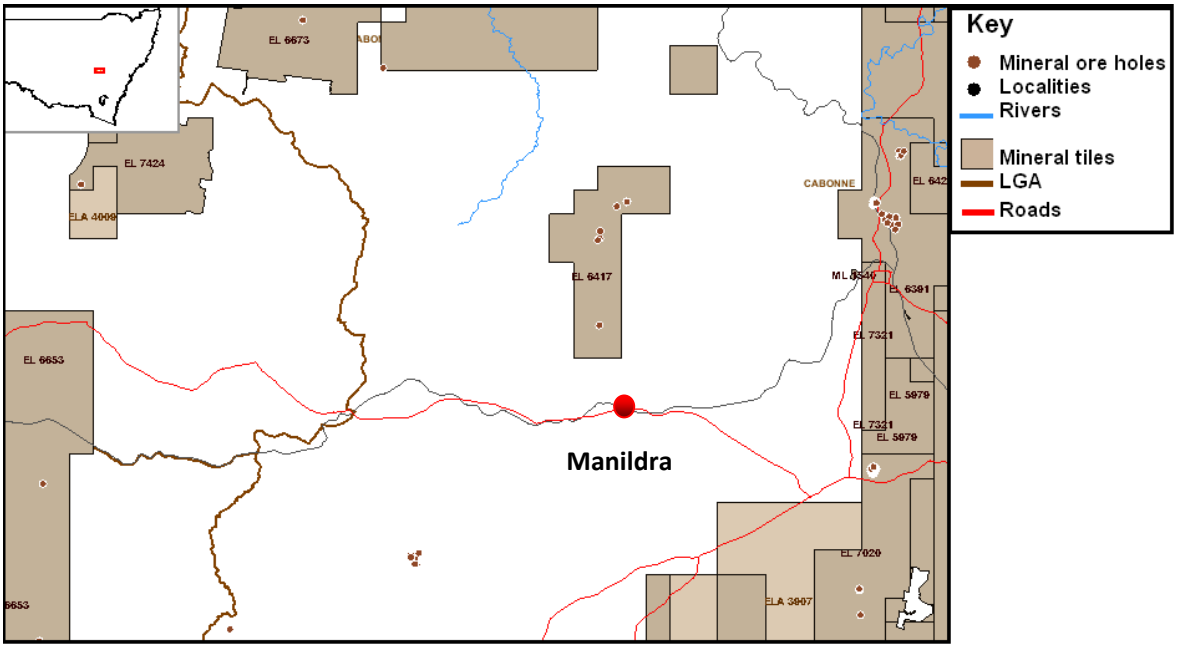

Figure 7-9: Mineral titles in the region (*Source: Minview 2010*)

Land Use

Manildra lies within the Lachlan River Catchment. At a regional scale, the Lachlan River Catchment is known for its rich agricultural base, the dominant land uses being modified pasture grazing, native vegetation grazing and dryland cropping. A detailed breakdown of the land use for the Catchment can be viewed in Table 7-8. The proposal site is used for cropping and mostly modified pasture grazing. The site has a cropping cycle of wheat, canola and pasture grasses followed by grazing by sheep or cattle.

Table 7-8: Lachlan River Catchment land use (*Source: Australian Collaborative Land Use and Management Program 2009)*

Land use	Area (sqkm)	Area (%)
Nature conservation	3,182	3.7%
Other protected areas	59	0.1%
Minimal use	6,550	7.6%
Grazing native vegetation	20,780	24.1%
Production forestry	971	1.1%
Plantation forestry	593	0.7%
Grazing modified pastures	34,252	39.7%
Dryland cropping	16,652	19.3%
Dryland horticulture	15	0.0%
Irrigated pastures	156	0.2%
Irrigated cropping	730	0.8%
Irrigated horticulture	142	0.2%
Land in transition	122	0.1%
Intensive animal and plant production	10	0.0%
Intensive uses (mainly urban)	902	1.0%
Rural residential	68	0.1%
Mining and waste	36	0.0%
Water	1,028	1.2%
Total	86,249	100.0%

7.8.2 Impact assessment

Construction

No exploration licences or mining leases occur within the proposal site at this time, however if a mineral deposit is discovered then an application can be made. There is no certainty that a discovery would be made or a mining lease or exploration licence would be granted and accordingly the amount of potential lost mining revenue cannot be known in advance. Any potential economic impact from the loss of a mining resource would be due to delay in availability of the land. When the site is decommissioned, the land would be able to be used as it was before or otherwise to the discretion of the land owner.

Construction traffic has potential to cause short traffic delays for the neighbouring Manildra Common Pit, which also uses access off Old Orange Road. The proponent would undertake consultation with the appropriate representative from the Cabonne Council regarding any potential traffic delays or conflicts in relation to the construction phase of the proposal , for incorporation into the Traffic Management Plan. Traffic impacts are discussed further in Section 7.1.

Indirect impacts to nearby land could occur due to turbid runoff, erosion, weed ingress and pollution from chemical spills during the construction stage of the project. Unmitigated, these impacts could reduce productivity of the affected areas. These impacts are highly manageable, however, and discussed further in Sections 6.1, 7.3 and 7.4.

Furthermore, indirect impacts to adjacent land owners could occur as stock may need to be excluded from the works area and restricted from access roads, to minimise the risk of collisions. There are likely to be temporary speed limits enforced to mitigate the risk.

Operation

In principle, there is no reason why the exploration of minerals could not occur around the operational solar farm. The proposal would not prevent access to the ground based exploration of minerals except

in the vicinity of infrastructure where there may be safety, structural, operational or engineering limitations. In this context however, it is possible that the operational solar farm may impede the ability to obtain an Exploration Licence.

Mineral exploration can be achieved using remote sensing technology including radar among others. The operation of the solar farm would not limit the opportunity for this exploration method to be achieved.

The geology of the site (Late Silurian Wansey Formation) has potential for resource extraction. The local extent of the Wansey Formation is estimated to be in the order of 3000 hectares local (based on the Bathurst 1:250 000 geology map and assuming an approximate 20 kilometres length and an average 1.5 kilometres width). The proposal would temporarily prevent extraction over approximately 120 hectares (or 4%) of the local occurrence of the Wansey Formation for the life of the solar farm. Given the temporary, reversible and confined nature of the proposal, impacts to resource extraction are not considered to significant.

The proposal is not considered likely to have an impact on the operation of the neighbouring Manildra Common Pit.

There are no anticipated long term impacts to land use as a result of the installed infrastructure. Disturbed soil, excluding access tracks which the landowners may wish to retain, would be stabilised and rehabilitated. These impacts would be temporary in nature and a Site Restoration Plan has been recommended below in Section 7.7.3.

The operational solar farm is not anticipated to affect the way that neighbouring landowners currently manage their agricultural activities. Nor is it anticipated to affect the production capacity of the land. A negative impact could result in the loss of land for use in agriculture for the land owner, however, the land owner would be duly compensated in the lease agreement. Consideration would be given to allowing the grazing of sheep underneath panels. It would not be suitable for cattle to be grazed at the site as they may damage the solar infrastructure.

7.8.3 Environmental safeguards

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
92	Impact on current land use	Minimise impacts	A Site Restoration Plan would be developed to ensure stabilisation of disturbed areas as quickly as possible. The Plan would consider: • Appropriate stabilisation techniques across the precincts. • Suitable species for re-seeding (native, locally occurring species would be given preference) in areas dominated by native cover. • Monitoring for weed and erosion issues.	Construction Decommissioning	CEMP
93	Impact on Manildra Common Pit	Minimise impacts	The proponent would consult the Cabonne Council regarding any potential traffic issues during construction of the Solar Farm, for incorporation into the Traffic Management Plan.	Pre-construction	CEMP

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
94	Impact on current land use	Minimise disruption	Liaison would be undertaken with neighbouring landowners and landowners adjoining access roads, to provide information about the timing and routes to be used during construction and decommissioning. This could be in the form of advertising and provision of a contact point for further inquiries. The aim would be to reduce the risk of interference with agricultural activities on affected roads and road verges.	Construction	CEMP
95	Impact on current land use	Minimise impact	Grazing of sheep within the panel areas is likely to occur. The carrying capacity is likely to be reduced, however condition of the site would be considered in relation to stocking rates.	Operation	OEMP

7.9 HEALTH AND SAFETY

7.9.1 Existing environment

Electromagnetic fields

Transmission lines and other electrical devices such as substations generate electromagnetic fields (EMF) which have both an electric and a magnetic component. Transmission lines and other electrical devices, including substations, generate 50 Hz electric and magnetic fields within their vicinity.

In response to growing public health concerns over possible health effects from exposure to electromagnetic field sources, the World Health Organization (WHO) launched a large, multidisciplinary research effort in 1996. The International EMF Project brings together current knowledge and available resources of key international and national agencies and scientific institutions. Based on a recent in-depth review of the scientific literature, the WHO concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields, however, some gaps in knowledge about biological effects exist and need further research.

The results of all EMF studies to date have indicated either no association or a weak association with adverse health effects. Despite some study outcomes regarding the link between cancer and electromagnetic fields, the evidence for any effect remains highly controversial. It is clear, however, that if electromagnetic fields do have an effect on cancer, then any increase in risk would be extremely small. The results to date contain many inconsistencies, but no large increases in risk have been found for any cancer in children or adults, though scientists are actively continuing to research this area throughout the world (World Health Organization 2010).

At low frequencies, external electric and magnetic fields induce small circulating currents within the body. In virtually all ordinary environments, the levels of induced currents inside the body are too small to produce obvious effects. The main effect of high-level electromagnetic fields is heating of body tissues. There is no doubt that short-term exposure to very high levels of electromagnetic fields can be harmful to health (WHO 2010), however the majority of scientists, and Australian radiation

health authorities in particular, do not regard chronic exposure to 50 Hz electric fields at the levels commonly found in the environment to be a proven health risk. Whether chronic exposure to weak magnetic fields is equally harmless remains an open question. While there is no evidence that these fields cause immediate, permanent harm, laboratory studies on animals and cell cultures have shown that weak magnetic fields can have effects on several biological processes (hormone and enzyme levels, the rate of movement of some chemicals through living tissue). The fact sheets state that while most studies have produced inconclusive results or no increased cancer incidence in laboratory animals following exposure to EMFs, a few studies have indicated an increased incidence (ARPANSA 2007). They note that research suggests that health effects are associated with prolonged exposure; measurements at one point in time do not accurately reflect prolonged exposure levels.

Each country sets their own national standards for exposure to electromagnetic fields. Currently, Australia does not have standards regulating exposure to the electric or magnetic fields, however ARPANSA have issued recommended levels. ARPANSA refer to the National Health and Medical Research Council's (NHMRC) *Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields* (1989). ARPANSA has taken over responsibility of the NHMRC publications related to radiation health and therefore utilise these guidelines for their own recommendations. Table 7-9 contains a summary of these guidelines and compares them to the anticipated levels from installation of power lines and upgrades to the substation.

Table 7-9: Summary of the *Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields* including anticipated levels at the proposal site

	Power frequency	
Frequency	50/60 Hz	50/60 Hz
	Electric field (V/m)	**Magnetic field (microtesla - µT)**
Public exposure limits	5 000	100
Occupational exposure limits	10 000 (continuous exposure)	500 (continuous exposure)
Maximum level anticipated at the proposal site – transmission lines	0	1
Maximum level anticipated at the proposal site – substation	negligible	1.9

The majority of other countries' national standards draw on the guidelines set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). ICNIRP's European Power Frequency exposure guidelines are the same as the NHMRC recommended levels.

Existing 132 kV powerlines

The proposal site is bordered by an existing overhead 132 kV transmission line within the TSR that links to the substation. The magnetic fields associated with a transmission line at any moment in time depend on a range of factors, including the amount of power flowing in the line and the distance of the measurement point from the conductors. Typical levels of magnetic field under a 132 kV transmission line range from 0.5 – 5 µT at a distance of 25 metres from the centre of the easement.

The maximum magnetic field, approximately 5m from the easement is 30 µT (EMFs.info 2010). The strength of the field falls away rapidly with increased distance.

Electric fields from power lines diminish rapidly with distance from the source. Maximum electric fields for a 132kV transmission line are 3600V/m under the line and 80V/m at a 50m distance (EMFs.info 2010).

Substation

The United Kingdom National Grid Company has conducted a survey of suburban substations to determine the level of EMFs produced. Measurements were taken at 0.5 m above ground level within 1m of enclosures. The results revealed mean magnetic flux densities of approximately 1.9 µT, halving at an average distance of 1.3 m and becoming indistinguishable from the background due to other domestic sources within 5 m (Health Protection Agency United Kingdom 2004).

Health and safety – other issues

Other health and safety issues associated with the proposal include bushfire risk and risk of chemical spills. Potential impacts and associated safeguards are discussed in the relevant sections of the EA (0, 7.4 and 7.10).

7.9.2 Impact assessment

Construction and decommissioning

Potential for EMF impacts during the construction phase are low. Exposure to EMFs would occur for site staff over intermittent periods during works at and around the substation and near the 132 kV transmission line. The maximum magnetic field of the existing transmission line is far less than the 100 µT limit recommended for public exposure and 500 µT limit recommended for occupational exposure. Similarly, the maximum electric field of a 132kV transmission line is less than the 5000V/m ICNIRP guidelines for public exposure. At the voltage workers would be exposed to, the effects are negligible. Potential impacts of substations are discussed below.

Operation

Transmission lines

EMF sources at the proposed solar farm site include the substation, inverters/kiosk transformer locations and transmission lines. Underground transmission lines from the kiosk transformers to the substation would be 11, 22 or 33 kV. At the substation, the voltage would be stepped up to 132 kV and fed into the existing Country Energy transmission network. The voltage of the existing overhead transmission line would not be changed and therefore potential impacts would not be increased as a result of this proposal. However, potential impacts of 11, 22 or 33kV transmission lines to be installed at the proposal site need to be considered.

Transmission lines of 11, 22 or 33kV from the inverters to the substation would be underground, maximising the shielding effect to minimise EMF exposure. Typically, underground cables of this voltage have a magnetic field ranging from 1 µT at the centre to 0.07 µT at 20m (EMFs.info 2010), considerably less than the recommended exposure limits of 100 µT.

Furthermore, electric fields can be reduced both by shielding and with distance from operating electrical equipment. Magnetic fields are reduced more effectively with distance. The transmission lines would be trenched underground and would be located at a distance greater than 130m from any sensitive receiver. Electric and magnetic fields for 11, 22 or 33kV lines are close to zero at this distance.

Therefore, the proposal would not have electromagnetic impacts to the public as a result of the installation of power lines. The EMF levels of the proposed power lines would be well below the recommended levels.

Substation

The United Kingdom National Grid Company has conducted a survey of suburban substations to determine the level of EMFs produced. Measurements were taken at 0.5 m above ground level within 1m of enclosures. The results revealed mean magnetic flux densities of approximately 1.9 µT, halving at an average distance of 1.3 m and becoming indistinguishable from the background due to other domestic sources within 5 m (Health Protection Agency United Kingdom 2004).

Fencing around the substation and the current location of the substation, being away from residences, would ensure that the EMF exposure to receivers including the public, property owners and workers are well below the 100 µT levels determined for public health.

The substations proposed for this project are basically similar to substations installed by power authorities throughout Australia and similar design criteria would be adopted. The existing power supply substations exist in various environments including rural and urban locations and EMF levels outside the substation compounds are typically well below the exposure level recommended by Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) in their interim guidelines. While in theory any energised conductor within a substation is a potential source of electric fields, these fields are readily shielded and, in the context of the substation, the sheaths of high voltage cables, metallic equipment enclosures, fencing and other structures act as shields. In practice the only significant sources of electric fields within a substation are the exposed high voltage conductors such as busbars. Electric fields external to a substation are therefore negligible with the exception of the electric fields due to any high voltage overhead lines entering or leaving the substation.

In regard to magnetic fields, every piece of substation equipment carrying an electric current is a potential source of magnetic fields and these are not readily shielded. Potential sources of magnetic fields include:

- incoming and outgoing overhead lines or underground cables
- busbars and other overhead or underground connections within the substation
- transformers
- switchgear
- reactive plant

The higher currents would be associated with the low voltage side of the transformer and therefore would produce the higher magnetic fields. The magnetic field strength would vary continually with time depending on the total electrical output of the substation.

In summary, notwithstanding the various sources of electric and magnetic fields in a substation, the design procedures adopted covering equipment choice, layout, cabling techniques and compound size

would ensure that, beyond the substation fence, the EMFs produced by the equipment within the station would typically be indistinguishable from background levels. EMF's within the compound would also be designed to be below the ARPANSA recommended levels for staff. There are existing substation designs used in the power reticulation network throughout Australia which have had measurements of EMF's carried out to confirm that the levels are well below the recommended ARPANSA guidelines. Similar designs would be implemented in these projects.

7.9.3 Environmental safeguards

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
96	Radiation exposure from EMFs	Minimise exposure	Adhere to standard industry approaches and policies with respect to EMF through maintenance of adequate easements around transmission lines.	Operation	OEMP
97	Radiation exposure from EMFs	Minimise exposure	The substation upgrade and transmission lines would be located as far as practical from residences, farm sheds, and yards in order to reduce the potential for both chronic and acute exposure.	Operation	OEMP

7.10 FIRE AND BUSHFIRE ISSUES AND IMPACTS

7.10.1 Existing environment

The *Rural Fires Act 1997,* the *Bush Fire Environmental Assessment Code* and the NSW policy *Planning for Bushfire Protection* provides the legal basis for bushfire management in New South. The Canobolas Zone Bush Fire Risk Management Plan (CZBFRMP) has been prepared by the Canobolas Zone Bush Fire Management Committee (2004) under the *Rural Fires Act 1997*. The Canobolas Zone includes Blayney, Cabonne, Cowra and Orange LGAs. This plan sets out a five year program for the strategic management of bushfire risk on private and public land. Though the plan is now out of date as it commenced on 1st July 2004, it is still in use and the most recent plan is not currently accessible. Three bush fire management zones are identified; Asset Protection Zone, Strategic Fire Advantage Zone and Land Management Zone.

The main ignition sources for fires within the Canobolas Zone are from lightning, with the greatest incidence between December and February, farm machinery, hand tools, illegal burn off, incendarism, motor vehicles, escaped camp fire and power lines (Canobolas Zone Bush Fire Management Committee 2004).

The CZBFRMP identifies specific human settlement, economic, environmental and cultural assets which are considered to be at risk from bushfire. Country Energy lines are identified as an extreme risk as an economic asset listed by the Canobolas Zone Bush Fire Management Committee (2004). Also identified is the Manildra koala population with a low risk as an environmental asset. Measures used to manage Country Energy lines include removal of vegetation. The proposal site is relatively free of vegetation around the existing power lines and power lines proposed for installation would be

underground. Measures for management of koalas include firebreaks and mosaic agricultural practices.

7.10.2 Impact assessment

Construction

Ignition risks during the construction period include driving vehicles over pasture, construction workers smoking and hot work. The proponent would comply with all of the requirements of the *Rural Fires Act 1997* and related guidelines and policies in relation to construction activities during the fire danger period. Additional safeguards to minimise fire risks during the construction period have been included in Section 7.10.3 below. The proposal is not likely to produce unacceptable bushfire risks during the construction period.

Operation

Although there have been isolated cases of sparks from the back of solar panels, the risk of this causing a grass fire is considered to be low. Vegetation under the array would be kept low (<100mm) by slashing or sheep grazing. If sowing of pasture grasses in the array area is required, low growing species should be selected.

Access tracks would be constructed to each inverter and around the perimeter of the farm. This network would help to contain any fire starting at the array, to protect the array during a wildfire and to provide access for fire suppression during an event. The proposal is considered unlikely to represent an ignition risk during the fire danger period.

The exposure of the solar panels to a fire could theoretically release fumes or vapours into the atmosphere which could affect human health (Tetra Tech 2003). The types of chemicals released by a fire vary depending upon the type of photovoltaic panel installed. Fires involving photovoltaic panels are typically short-term events (Tetra Tech 2003). Alerting all residents within about 1–2 kilometres of a fire to remain in their homes and to close all their windows should be sufficient to protect public health (Tetra Tech 2003). Two residences are located within 160 metres of the site; the first is on the boundary to the north and the second is on the boundary to the south of the proposed site. The proponent's Bushfire Management Plan would address any potential for dangerous gas emissions from the solar farm during a fire event to affect firefighters, workers at the substation and solar farm and neighbouring residents.

Suntech PV modules comply with UL1703, a standard developed by Underwriters Laboratories Inc. covering flat-plate photovoltaic modules and panels intended for installation on buildings or in freestanding applications. UL 1703 also covers electrical connection and mounting components, and applies spread of flame and fire brand tests for PV panels. The panels proposed for the Manildra solar farm have passed these tests, meaning that they are not combustible and pose a very low fire risk.

Transformers would be installed in the PV array, each housed in an enclosed shed on a concrete slab. The transformers would be bunded with a capacity exceeding the volume of the transformer oil (2030 litres) to contain the oil in the event of a major leak or fire. The transformers would be regularly inspected and maintained to ensure leaks do not present a fire hazard, and to ensure the bunded area is clear (including removing any rainwater).

7.10.3 Environmental safeguards

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
98	Bushfire risk	Minimise risk	The proponent would prepare a Bushfire Management Plan as part of the Construction Environmental Management Plan and Operation Environmental Management Plan. The Rural Fire Service and NSW Fire Brigade would be consulted in regard to its adequacy to manage bushfire risks during construction, operation and decommissioning. The plan would as a minimum include: • Hot-work procedures, asset protection zones, safety, communication, site access and response protocols in the event of a fire originating in the solar farm infrastructure, or in the event of an external wildfire threatening the solar farm or nearby persons or property. • Fire response planning would address any potential for dangerous gas emissions from the solar farm during a fire event to affect firefighters and neighbouring residents. • Flammable materials and ignition sources brought onto the site, such as hydrocarbons, would be handled and stored as per manufacturer's instructions. • During the construction phase, appropriate fire fighting equipment would be held onsite when the fire danger is very high to extreme, and a minimum of one person on site would be trained in its use. The equipment and level of training would be determined in consultation with the local RFS. • Asset protection zones (APZs), based on the NSW policy document Planning for Bushfire Protection, would be maintained around the site buildings and in the transmission line corridor. Workplace health and safety protocols would be developed to minimise the risk of fire for workers during construction and during maintenance in the control room and amenities. • Fire extinguishers would be stored onsite in each of the site buildings.	Construction Operation Decommissioning	CEMP OEMP
99	Bushfire risk	Minimise risk	If sowing of pasture grasses in the PV array area is required, low growing species should be selected.	Construction Operation	CEMP OEMP
100	Bushfire risk	Minimise risk	Pasture would be maintained at a low height (<100mm) below the PV array using sheep grazing or slashing.	Operation	OEMP
101	Bushfire risk	Minimise risk	Appropriate firefighting equipment would be maintained on the site during the operation of the solar farm, including protective clothing. Staff would be trained in its use.	Operation	OEMP
102	Bushfire risk	Minimise risk	A formal response procedure would be developed for operation staff at the solar farm, including procedures for notification of neighbouring and downwind landholders if required.	Operation	OEMP

7.11 CUMULATIVE IMPACTS

7.11.1 Impact assessment

Construction and decommissioning

Potential concurrent projects could have cumulative impacts during construction on resource use, pollution events and traffic.

Cumulative traffic impacts could occur if community events such as Manildra Agricultural Show are concurrent with construction of the proposal. These impacts would be temporary and construction would be timed to avoid these events where possible (refer to Section 7.1 for discussion).

Similarly, cumulative traffic impacts could occur in the event of additional construction in the Manildra region. No known large scale developments are proposed in the area that could lead to significant cumulative impacts during the construction period. However, Manildra Flour Mill is largest operating flour mill in the southern hemisphere and has associated environmental impacts such as resource use.

Flour mill operations could have cumulative impacts on resource use and reduction in water quality as a result of pollution. Water use during construction could be a cumulative impact due to other construction or mill activities. Council would be consulted regarding potential supply of water resources (refer to Section 7.4). Other resources are not likely to be strained as a result of the proposal, most of the resources required are either specific to solar farms or common and readily available (e.g. gravel).

Potential for the proposal to impact water quality through a pollution event is low. Drainage lines at the site are highly ephemeral and do not flow into larger waterbodies. Water quality impacts are discussed in Section 7.4.

The project includes Statements of Commitment to deal specifically with impact areas, which would lessen the overall cumulative impact. The construction and decommissioning periods would be temporary and therefore any associated impacts would be temporary and relatively limited in their spatial extent.

Operation

Cumulative impacts affecting biodiversity include the loss of native vegetation, the fragmentation of habitats and the creation of barriers and hazards. Vegetation (including native and exotic) over an area of approximately 152 hectares would be impacted by the works. Existing barriers for local native fauna include fences, roads and loss of tree and shrub cover (habitat connectivity). Existing hazards at and around the proposal site include fences, roads and powerlines. The cumulative effects on flora and fauna values have been addressed in the Biodiversity Assessment (Appendix E). In view of the limited conservation value of the pasture affected by the construction of the solar farm, and the local abundance of similar vegetation, the area of this vegetation which would be cleared is unlikely to significantly add to biodiversity pressures in the locality or the region. Patches of vegetation with greater ecological importance would be avoided.

The proposal would reduce the agricultural productivity of the site for the life of the project. Grazing is the dominant agricultural land use in the local area and this temporary loss would not add significantly to agricultural land pressures in the council area. Some of the impacts would be offset if commercial sheep grazing continues at the proposal site. The solar farm would not reduce the suitability of the

proposal site for future commercial agricultural uses and the site would be available for these uses following the decommissioning. The site is not zoned for rural residential development and the solar farm would not restrict this form of development in the Council area.

There is one wind farm at Blayney, approximately 65 kilometres southeast of the site with a 9.9 MW capacity, a hydroelectric power station (19 MW capacity) lies 65 kilometres northeast of the site at Burrendong plus one Wyangala Dam (90 km south, 24MW) and a landfill methane plant with a 500 kW capacity operates at Bathurst, approximately 80 kilometres from the site (DEWHA 2010). The addition of a renewable energy resource at Manildra, along with other solar projects proposed by Infigen Energy would have a positive cumulative impact on the meeting the growing electricity demand and reducing greenhouse gas emissions in NSW.

The overall significance of the cumulative impacts of the proposed Manildra solar farm is considered to be low. The positive socio-economic effects of the proposal would combine with the economic wealth of the local mining industry to create a more diverse and prosperous local economy.

7.11.2 Environmental safeguards

No specific safeguards are identified in relation to cumulative impacts. Measures to avoid and mitigate impacts for issues such as biodiversity and salinity impacts are directly relevant to the mitigation of cumulative impacts.

8 ENVIRONMENTAL MANAGEMENT

The identified environmental risks associated with the proposed solar farm would be managed by undertaking project specific Statements of Commitment (SoC) (Section 8.2). The implementation of these commitments is guided by an environmental management framework, as set out below.

8.1 ENVIRONMENTAL MANAGEMENT FRAMEWORK

All commitments and environmental safeguards would be managed through the implementation of a Construction Environmental Management Plan (CEMP) during the construction period and an Operation Environmental Management Plan (OEMP) for the life of the project. This process is illustrated in Figure 8-1. The OEMP and CEMP would include environmental management responsibilities of staff specific to their role, reporting requirements, monitoring requirements, environmental targets and objectives, auditing and EMP review timetables, emergency responses, induction and training, complaint response procedures and measures for continuous improvement.

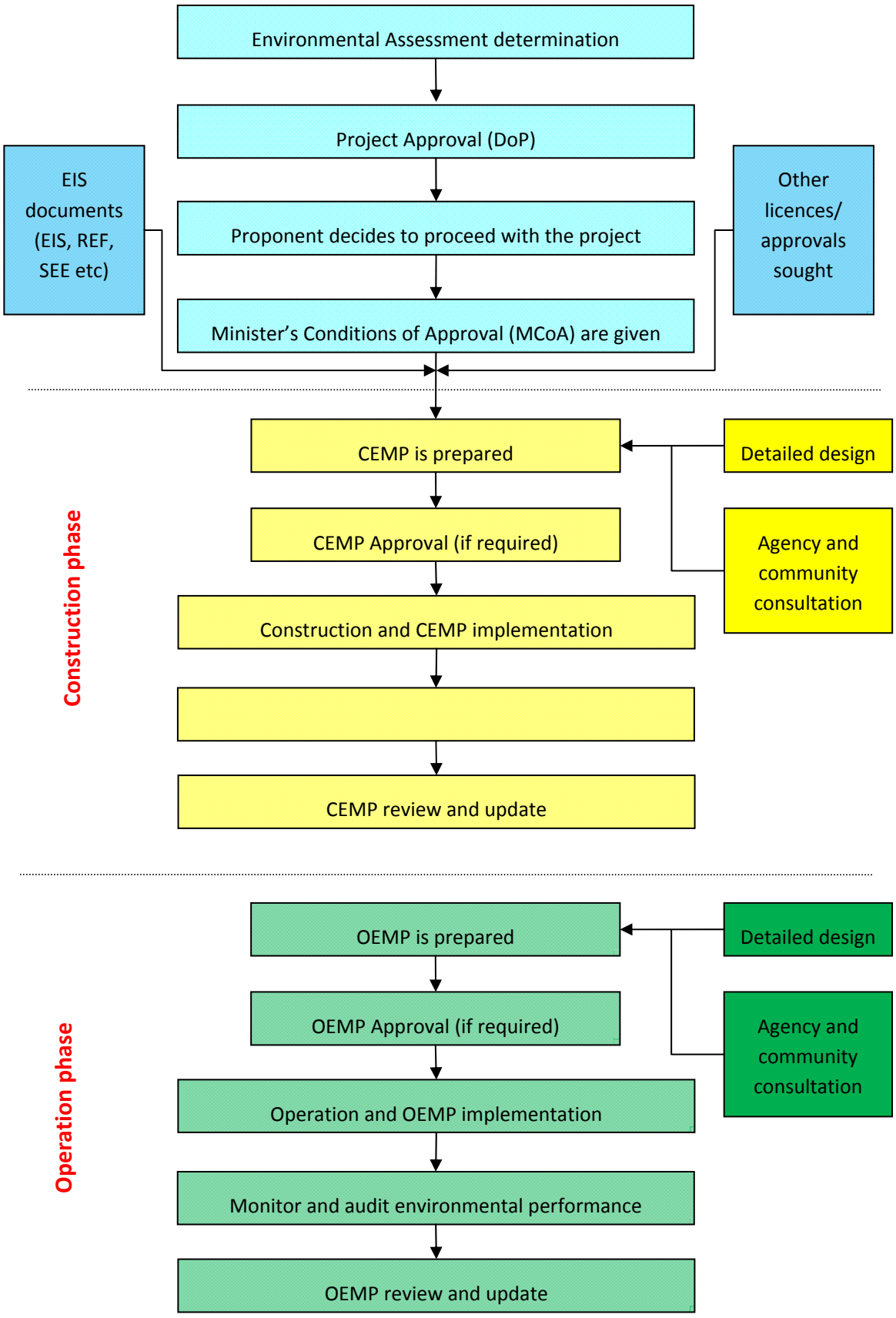

Figure 8-1: Post approval environmental management process

8.2 DRAFT STATEMENT OF COMMITMENTS

Under the Part 3A process, proponents are required to include Statements of Commitment on how they propose to manage the project to minimise, and where possible avoid, impacts. These commitments are actions that would be undertaken by the proponent to manage identified environmental impacts, should the project be approved. The commitments in this section have been developed into a comprehensive set of measures which incorporate:

- Specific recommendations contained in the specialist reports
- Additional measures identified during the preparation of this Environmental Assessment (in consultation with the community and government agencies)

To avoid duplication in this section, mitigation measures are located under the most appropriate heading only and are not repeated in subsequent tables.

Biodiversity

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
1	Flora protection	Avoid and minimise impact	A supplementary flora survey during spring (November) would be undertaken to confirm the assumptions of the Biodiversity Assessment (Appendix E), in areas including the western paddock, western access and areas identified on the Biodiversity Constraints map (Figure 6-1) that would be impacted by infrastructure.	Pre-determination	CEMP
2	Loss or modification of habitat	Minimise and offset impact	An Offset Plan would be prepared by an ecologist consistent with 'maintain or improve' principles for biodiversity outcomes, as set out in the Biodiversity Assessment. The plan would be developed in consultation with the landowner and would operate for the life of the project.	Pre-construction	CEMP
3	Infrastructure related biodiversity impacts	Minimise biodiversity impacts	The PV array, site access tracks and other infrastructure should be sited to avoid constraints identified within the Biodiversity Assessment constraints mapping. These include: • The larger stands of Box-Gum Woodland across the site • Hollow bearing trees • Isolated shade trees where possible • Native grassland and associated rock outcrops in the Western Paddock • As far as possible rock outcrops across the proposal site together with a minimum 2.5 metre buffer to avoid shading.	Design phase	CEMP
4	Infrastructure related biodiversity impacts	Minimise biodiversity impacts	Areas of high biodiversity value would be clearly identified throughout construction and protected from the direct and indirect impacts of the Proposal. Contractors and staff would be made aware of the significance and sensitivity of these areas.	Design phase	CEMP
5	Infrastructure related biodiversity impacts	Minimise biodiversity impacts	The western paddock of the proposed solar farm site should be avoided if possible to minimise impacts to grassy groundcover flora comprising the Box-Gum Woodland EEC.	Design phase	CEMP
6	Construction impacts	Minimise biodiversity impacts	Where security concerns permit perimeter fences should not contain barbed wire, particularly the top strands. If a cycisolated mesh fence is to be used efforts should be made to increase the visibility to fast flying parrots.	Design Construction	CEMP
7	Construction impacts	Minimise biodiversity impacts	If used, and where practicable, power poles and overhead powerlines will be bird-safe using flags or marker balls, large wire size and wire and conductor spacing.	Design Construction	CEMP
8	Infrastructure related biodiversity impacts	Minimise biodiversity impacts	If the removal of any hollow bearing trees was required this activity would be proceeded by a pre clearance check by a qualified ecologist including anabat survey and stag watching.	Pre-construction	CEMP

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
9	Infrastructure related biodiversity impacts	Minimise biodiversity impacts	Works will avoid impacts to mature eucalypts wherever possible. Tree protection standards should comply with Australian standard AS4970-2009 Protection of trees on development sites (Standards Australia, 2009). Wherever practicable, excavations and vehicle/machinery movements will occur outside the canopy dripline of large eucalypts.	Design phase Construction	CEMP
10	Construction impacts	Minimise biodiversity impacts	Existing farm tracks should be used wherever possible to minimise the number of new roads.	Construction	CEMP
11	Construction impacts	Minimise biodiversity impacts	Where cement is included in cable trench backfill, at least 20 centimetres of cement-free topsoil will be replaced as the top layer in the backfill.	Construction	CEMP
12	Construction impacts	Minimise biodiversity impacts	Where practicable, whole sods will be removed with an excavator where these areas are well-vegetated with dense root systems. Sods will be stored in moist, shaded conditions and replaced following the works. Sod storage time will be minimised and sods will be replaced in a manner that maximises the chances of re-establishment.	Construction	CEMP
13	Construction impacts	Minimise biodiversity impacts	Where possible, as a precaution, works should be planned to avoid sensitive times for Superb Parrots - September to January.	Construction	CEMP
14	Construction impacts	Minimise biodiversity impacts	Excavated topsoil, subsoil will be stored separately and replaced in a manner that replicates the original profile as closely as possible.	Construction	CEMP
15	Construction impacts	Minimise biodiversity impacts	Where practicable, grass surfaces and shrubs will be retained or restored on infrequently used vehicle routes.	Construction	CEMP
16	Construction impacts	Minimise biodiversity impacts	Site stabilisation, rehabilitation and revegetation of all disturbed areas would be undertaken without delay.	Construction	CEMP
17	Construction impacts	Minimise biodiversity impacts	As a general rule, disturbed areas will be used preferentially for vehicle and machinery access, materials laydown, stockpiling of cleared vegetation and the deposition and retrieval of spoil whenever practicable.	Construction	CEMP
18	Construction impacts	Minimise biodiversity impacts	Works will be avoided during, and immediately following heavy rainfall events to protect soils and vegetation at the site.	Construction	CEMP
19	Construction impacts	Minimise biodiversity impacts	Weed / pathogen controls will be implemented, including: o Machinery and vehicles used in construction works will be washed before and after site access to reduce the introduction and spread of weeds and pathogens. o Laydown sites for excavated spoil, equipment and construction materials will be weed-free or treated for weeds wherever practicable. o Weed monitoring will be carried out at all sites after the completion of construction works and ongoing weed control will occur where noxious or invasive	Construction	CEMP

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
			species are recorded. In particular, monitoring will be undertaken during the following late spring/early summer, and remedial action taken as required. o Sediment control materials should be weed free (straw bales, geotextiles). o Imported materials such as sand and gravel will be sourced from sites which do not show evidence of noxious weeds or Phytophthora infection.		
20	Construction impacts	Minimise biodiversity impacts	If dams are removed during site development works, alternative watering points should be established to compensate for their loss and maintain similar habitat resources for native fauna.	Construction	CEMP
21	Construction impacts	Minimise biodiversity impacts	Any trench sections left open for greater than a day would be inspected daily, early in the morning and any trapped fauna removed. The use of ramps or ladders to facilitate trapped fauna escape is recommended.	Construction	CEMP
22	Construction impacts	Minimise biodiversity impacts	Rock and log habitat removed during the construction phase will be reinstated following the works.	Construction	CEMP
23	Construction impacts	Minimise biodiversity impacts	Where tree hollows are required to be removed, these should be replaced by nest boxes of similar size in nearby trees.	Construction	CEMP
24	Construction impacts	Minimise biodiversity impacts	Wherever possible small rock outcrops at the site should be excluded from the array, together with a minimum 2.5 metre buffer to avoid shading.	Construction	CEMP
25	Operational impacts	Minimise biodiversity impacts	A groundcover management plan would be developed that would include regular monitoring of vegetation cover and composition and allow for adaptive management. This would include: o Establishment of a shade tolerant perennial groundcover across the cropping and exotic dominated grazing paddocks prior to the installation of the PV arrays o Advice from an agronomist in relation to preferred species/varieties, establishment methods of alternative pastures and best practice management. o Where information is lacking, trials may be required onsite	Pre-construction Construction operation	CEMP OEMP
26	Operational impacts	Minimise biodiversity impacts	If localised erosion is detected, effective treatments would be applied without delay, such as hardening with mulch, reseeding and covering with an open weave jute matting, gypsum application to improve structure and infiltration, protection with geotextile fabric or localised flow dispersal and diversion structures.	Operation	OEMP
27	Operational impacts	Minimise biodiversity	The space between the PV array rows should be maintained and kept clear to enable	Operation	OEMP

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
		impacts	access by vehicles for ongoing weed control, and pasture renovation if required.		
28	Operational impacts	Minimise biodiversity impacts	Efforts should be made to minimise disturbance to the existing groundcover during construction. Construction and maintenance vehicles should not access the site when soils are very wet to minimise soil compaction and disturbance.	Construction Operation	CEMP OEMP
29	Operational impacts	Minimise biodiversity impacts	Fencing along Molong Manildra Road should be maintained so as macropods and other large native fauna are not funnelled along the perimeter fence and onto the road creating a traffic hazard and collision risk to the animal.	Operation	OEMP
30	Operational impacts	Minimise biodiversity impacts	Monitoring of fauna site habitat usage pre and post construction is recommended but not considered essential.	Operation	OEMP

Visual amenity

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
31	Deterioration of visual amenity during construction	Mitigate impacts	Measures to reduce visual impacts during construction, including but not limited to the following: • Dust reduction throughout the construction process • Restoration of any earthworks required for the construction • Clearing of existing vegetation would be kept to a minimum	Construction	CEMP
32	Deterioration of visual amenity by solar panels and associated infrastructure	Mitigate impacts	Measures include but are not limited to the following: • Colour of above ground infrastructure to be sympathetic to the landscape character • Underground cabling to be utilised if practical • The design and location of ancillary works are to incorporate measures which would reduce this visual impact	Construction Operation	CEMP OEMP
33	Deterioration of visual amenity at surrounding residences and roads	Mitigate impacts	• Visual screen planting is to be undertaken in the form of boundary planting around the solar farm, foreground planting at affected viewpoints and residential tree planting. • Screening vegetation would be planted along the northern, southern and western perimeters of the site. • Roadside planting along the eastern edge of Manildra Molong Road may be undertaken to ensure views from the road are fragmented • Tree planting would be undertaken in consultation with relevant landowners to achieve screening for homesteads with visual impacts to strategically block parts of the development. • Species typical of the area would be selected to enhance the existing landscape character.	Post construction	OEMP
34	Creation of a visual attraction	Maximise visual opportunities	A designated viewing area may be provided where visitors would be able to safely view the solar farm and surrounding landscape.	Construction Operation	CEMP OEMP

Archaeology and Aboriginal heritage

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
35	Disturbance to artefacts	Minimise impact	Where possible, the artefact scatter comprising five stone artefacts would be avoided.	Detailed design Construction	CEMP
36	Impact on local Aboriginal community	Minimise impact	Ongoing consultation would be undertaken with Registered Aboriginal Parties	All	CEMP OEMP

Noise

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
37	Noise impacts to sensitive receivers	Compliance	Construction would be undertaken during standard working hours of: • Monday – Friday: 7am to 6pm • Saturday: 8am to 1pm Sunday and public holidays: No work	All	CEMP OEMP
38	Noise impacts to sensitive receivers	Compliance	• Construction staff would be made aware of noise sensitive receivers and would be made aware of noise reduction options.	All	CEMP OEMP
39	Noise impacts to sensitive receivers	Compliance	Periods of respite would be provided in the case of unavoidable maximum noise level events.	All	CEMP OEMP
40	Noise impacts to sensitive receivers	Compliance	Reasonable and feasible measures to reduce noise would be implemented and could include reducing the throttle setting and turning off equipment when not being used.	All	CEMP OEMP
41	Noise impacts to sensitive receivers	Compliance	Equipment and plant would be maintained to reduce noise emissions.	All	CEMP OEMP
42	Noise impacts to sensitive receivers	Compliance	Mobile plant clustering near residences would be avoided.	All	CEMP OEMP
43	Noise impacts to sensitive receivers	Compliance	A 24 hour toll-free contact phone number for enquiries during the works would be provided.	All	CEMP OEMP
44	Noise impacts to sensitive receivers	Compliance	A documented complaints process would be implemented and would include an escalation procedure so that if a complainant is not satisfied there is a clear path to follow.	All	CEMP OEMP
45	Noise impacts to sensitive receivers	Compliance	Where complaints occur safeguards would be reviewed to determine if further safeguards are required or possible.	All	CEMP OEMP

Traffic and Access

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
46	Safety and asset protection	Minimise risk	The proponent would develop and implement a Traffic Management Plan (TMP) in consultation with roads authorities to facilitate appropriate management of potential traffic impacts. The TMP would include provisions for: • Scheduling of deliveries and managing timing of transport to minimise impacts on road and rail traffic • Limiting the number of trips per day • Undertaking community consultation before and during all haulage activities • Designing and implementing temporary modifications to intersections, roadside furniture, stock grids and gates • Managing the haulage process, including the erection of warning and/or advisory speed signage prior to isolated curves, crests, narrow bridges and change of road conditions • Designation of a speed limit would be placed on all of the roads that would be used primarily by construction traffic • Preparation of a Transport Code of Conduct to be made available to all contractors and staff • Identification of a procedure to monitor the traffic impacts during construction and work methods modified (where required) to reduce the impacts • Provide a contact phone number to enable any issues or concerns to be rapidly identified and addressed through appropriate procedures • Reinstatement of pre-existing conditions after temporary modifications to the roads and pavement along the route.	Construction and decommissioning	CEMP
47	Safety and asset protection	Minimise risk	The proponent would use a licensed haulage contractor with experience in transporting similar loads, responsible for obtaining all required approvals and permits from the RTA and Councils and for complying with conditions specified in those approvals.	Construction and decommissioning	CEMP
48	Safety and asset protection	Minimise risk	The proponent would prepare road dilapidation reports covering pavement and drainage structures in consultation with roads authorities for the route prior to the commencement of construction and after construction is complete. This report would include consideration of the Old Orange Road rail crossing.	Construction and decommissioning	CEMP

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
49	Safety and asset protection	Minimise risk	The proponent would repair any damage resulting from the construction traffic (except that resulting from normal wear and tear) as required during and after completion of construction at the proponent's cost or, alternately, negotiate an alternative for road damage with the relevant roads authority.	Construction and decommissioning	CEMP
50	Safety and asset protection	Minimise risk	Route specific mitigation measures, which would be investigated and detailed further in the Traffic Management Plan, include accessing the site via Old Orange Road and using the existing access track within site boundaries.	Construction and decommissioning	CEMP

Historic Heritage

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
51	Impact to a potential heritage item (abandoned stone cottage)	Manage direct impacts	An assessment of heritage significance would be prepared to determine the heritage significance of the abandoned stone cottage. This would be prepared by a heritage consultant, pre-determination.	Pre-determination	CEMP
52	Impact to a potential heritage item (abandoned stone cottage)	Manage direct impacts	Should direct impacts on the cottage ruin or part of its built fabric be required (including road upgrades or heavy vehicle vibration), impacts would be managed in accordance with the assessment of heritage significance recommendations, above, and in consultation with an noise and vibration specialist. This may include: • Traffic management measures, such as 'go slow' areas or vibration loggers • Fencing or demarcating the site • Clear identification of the feature on CEMP site maps and staff induction	Construction	CEMP
53	Disturbance to a potential historic relic	Minimise disturbance	In the event of an item of heritage significance being uncovered at the proposal site after works commence, the NSW Heritage Branch (Department of Planning) should be contacted prior to further work being undertaken at the site.	Construction Decommissioning	CEMP

Soils and Landforms

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
54	Soil loss and soil quality	Minimise impact	Progressive Erosion and Sediment Control Plans would be prepared for the site, including controls at drainage lines and slopes.	Construction	CEMP
55	Soil loss or stability of landform loss	Minimise risks	Access track construction and management would comply with guidelines set down in DLWC (1994), Landcom (2004) and DECC (2008b).	Construction	CEMP
56	Soil quality	Minimise impact	Avoid compaction of soil resulting from vehicle access and laying of materials particularly during saturated soil conditions, and remediate as necessary.	Construction	CEMP
57	Soil quality	Minimise impact	Where cement is included in cable trench backfill, at least 20 centimetres of cement-free topsoil would be replaced as the top layer in the backfill.	Construction	CEMP
58	Soil loss or stability of landform loss	Minimise risks	Concrete wash would be deposited in an excavated area, below the level of the topsoil, or in an approved landfill site. Where possible, waste water and solids would be reused onsite.	Construction	CEMP
59	Soil loss or stability of landform loss	Minimise risks	Access routes and tracks would be confined to already disturbed areas, where possible. All contractors would be advised to keep to established tracks.	Construction	CEMP
60	Soil quality	Minimise risks	A spill response plan would be developed for all phases of the project. This would include trigger points of when to notify the DECCW.	Construction Decommissioning Operation	CEMP OEMP
61	Soil loss or stability of landform loss	Minimise impact	If concentrated rainsplash and runoff below the panel rows result in localised erosion, the affected soils at the site should be treated and protected without delay.	Operation	OEMP
62	Soil loss or stability of landform loss	Minimise impact	The proponent would routinely monitor soil condition and vegetation cover below the array and liaise with the landowner regarding stock and vegetation management issues as required.	Operation	OEMP
63	Soil loss or stability of landform loss	Minimise impact	Thick and continuous pasture cover should be established prior to the installation of the array, and maintained at all times, including during winter and drought periods if possible.	Pre-construction Operation	CEMP OEMP

Hydrology and Water Quality

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
64	Deterioration of water quality (Surface Water)	Minimise risk	Infrastructure placement, including tracks, substations, control buildings, stockpiles, and site compounds and turnaround areas, would not be sited within 40 metres of a major drainage line or water course	Detailed design	CEMP
65	Deterioration of water quality (Surface Water)	Achieve neutral or beneficial water quality impact	The proponent would prepare a Erosion and Sediment Control Plan (ESCP) as a sub-plan of the Construction Environmental Management Plan. This plan would include the following provisions: • Sediment traps would be installed wherever there is potential for sediment to collect and enter waterways • Stockpiles generated as a result of construction activities would be bunded with silt fencing, (mulch bunds or similar) to reduce the potential for runoff from these areas • On the steeper slopes check banks or berms would be installed across the trenchline, as appropriate, following closure of the trench. These would discharge runoff to areas of stable vegetation • Stabilisation and site remediation would be undertaken as soon as practicable throughout and post construction • Soil and water management practices would be developed as set out in Soils and Construction Vol. 1 (Landcom 2004) • Monitoring of surface water quality would be undertaken following heavy rainfall events	Construction	CEMP
66	Flooding impacts	Minimise risks of flooding impacts	Advice from a Hydrologist would be sought prior to determination regarding the potential flooding risks (eg to access and location of infrastructure) and the need for a Flood Management Plan to be prepared and implemented at the site. Should a Flood Management Plan be required, it would be incorporated into the CEMP and OEMP.	Pre-determination	CEMP
67	Deterioration of water quality (Surface Water)	Achieve neutral or beneficial water quality impact	The site CEMP and OEMP could be provided to the New South Wales Office of Water for review of soil and water management measures for construction and operation, if required.	Construction Operation	CEMP OEMP
68	Water supply	Minimise risk	Undertake liaison with representatives of Cabonne Council regarding the potential supply of construction water	Construction Operation	CEMP, OEMP
69	Deterioration of water quality (Surface Water)	Minimise risk	All vehicles onsite would follow established trails and minimise onsite movements	Construction Operation	CEMP, OEMP

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
70	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Machinery would be operated and maintained in a manner that minimises risk of hydrocarbon spills	Construction Operation	CEMP OEMP
71	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Maintenance or re-fuelling of machinery would be carried out on hard-stand in accordance with industry standards for fuel transfer	Construction	CEMP
72	Deterioration of water quality (Surface and Ground Water)	Minimise risk	• Design of concrete batch plants would ensure concrete wash would not be subjected to uncontrolled release. Areas of the batching would be bunded to contain peak rainfall events and remediated after the completion of the construction phase. Waste sludge would be recovered from the settling pond and used in the production of road base manufactured onsite. The waste material would be taken from the batching plant to be blended in the road base elsewhere onsite.	Construction	CEMP
73	Deterioration of water quality (Surface and Ground Water)	Minimise risk	• Carry out dust suppression as required through either watering or chemical means (environmentally friendly polymer based additives to water).	Construction Decommissioning	CEMP
74	Deterioration of water quality (Surface Water)	Achieve neutral or beneficial water quality impact	A Site Restoration Plan (SRP) would be prepared as part of the Construction Environmental Management Plan. This would set out protocols for restoration works including: • site preparation • stabilisation • revegetation monitoring	Construction Decommissioning	CEMP
75	Deterioration of water quality (Surface and Ground Water)	Minimise risk	A Spill Response Plan would be prepared as part of the CEMP and OEMP including: • Identify persons responsible for implementing the plan if a spill of a dangerous or hazardous chemical/waste would occur • Identify all chemicals required for the proposal, including physio-chemical properties, risks posed to water quality objectives and appropriate methods of storage of these chemicals. • Locate Material Safety Data Sheets (MSDS) for all chemical inventories at on site and readily available • Comply with manufacturers recommendations in relation to application	Construction Operation Decommissioning	CEMP OEMP

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
			and disposal where chemicals are used • Report any spill that occurs to the Construction Manager regardless of the size of the spill • Establish clearly defined works and refuelling areas • Spill protocols in this plan would dictate when the EPA would be notified • Chemical / fuel storage areas would be identified, and be bunded to prevent loss of any pollutants Hydrocarbon spill kits would be stored at the site. A number of site staff are to be trained in the use of the spill kits		
76	Deterioration of water quality (Surface and Ground Water)	Minimise Risk	The proponent would notify the NSW DECC EPA in the event of any spill that had the potential to pollute waters	Construction Operation	CEMP OEMP
77	Protection of ground water	Minimise risk	Undertake investigations, as part of the geotechnical investigation, to ensure that the project would have no material adverse effect on groundwater/aquifers as a result of blasting activities	Pre-construction	CEMP
78	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Monitor bunded infrastructure to ensure that volume of oil could be fully contained in the event of leak	Operation	OEMP
79	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Maintain septic systems, if installed, to meet appropriate Australian standards	Construction Operation Decommissioning	CEMP OEMP

Air Quality and Climate

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
80	Air quality	Minimise risks	Dust levels at stockpile sites would be visually monitored. Dust suppression would be implemented if required. Stockpiles would be protected from prevailing weather conditions	Construction	CEMP
81	Air quality	Minimise risks	Undertake ongoing visual dust monitoring and suppression (if required) during the construction phase. Monitoring would regularly assess the effectiveness of dust suppression activities. Monitoring would regularly assess the effectiveness of dust suppression activities.	Construction	CEMP
82	Air quality	Minimise risks	Should a complaint relating to dust by a resident be received, dust monitoring would be undertaken. The proponent would assess the dust gauges and identify additional mitigation measures, where required.	Construction	CEMP
83	Air quality	Minimise risk	Vegetation cover would be maintained throughout operation.	Operation	OEMP

Waste Management and Resource Use

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
84	Waste generation	Minimise waste and maximise recycling of materials	The proponent would prepare a **Waste Management Plan** to be included within the **Construction Environmental Management Plan**. It would include but not be limited to the following: • The scope for reuse and recycling would be evaluated • Provision for recycling would be made onsite • Wastes would be disposed of at appropriate facilities • Toilet facilities would be provided for onsite workers and sullage from contractor's pump out toilet facilities would be disposed at the local sewage treatment plants or other suitable facility agreed to by Council • Excavated material would be used in road base construction where possible. Surplus material would be disposed of in appropriate locations on site (on agreement with the landowner), finished with topsoil, and revegetated.	Construction Operation	CEMP OEMP
85	Waste generation	Maximise recycling of materials	PV modules would be recycled, where possible.	Decommissioning	

Socio-economic and Community

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
86	Impact on current land use	Minimise impact	Develop, implement and monitor the effects of a Site Restoration Plan**.** The plan would aim to stabilise disturbed areas. The Plan would consider: • Appropriate stabilisation techniques across the precincts • Suitable species for re-seeding (native, locally occurring species would be given preference) in areas dominated by native cover • Monitoring for weed and erosion issues	Construction Decommissioning	CEMP
87	Impact on current land use	Minimise disruption	Liaison would be undertaken with neighbouring landowners to provide information about the timing and routes to be used during construction and decommissioning. This could be in the form of advertising and provision of a contact point for further inquiries. The aim would be to reduce the risk of interference with agricultural activities on affected roads and road verges.	Construction	CEMP
88	Impact on local community	Maximise positive impact of proposal	Liaise with local industry representatives to maximise the use of local contractors and manufacturing facilities in the construction and decommissioning phases of the project.	Construction	CEMP
89	Impact on local community	Maximise positive impact of proposal	Liaise with the local visitor information centres to ensure that construction and decommissioning timing and haulage routes are known well in advance of works and to the extent practical coordinated with local events, such as the Agricultural show.	Construction	CEMP
90	Impact on local community	Maximise positive impact of proposal	Make available employment opportunities and training for the ongoing operation of the solar farm to local residents where reasonable.	Operation	OEMP
91	Impact on local community	Provide accurate information	Dissemination of accessible and independent information on solar farm impacts.	Pre-construction	CEMP

Land Use and Mineral Resources

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
92	Impact on current land use	Minimise impacts	A Site Restoration Plan would be developed to ensure stabilisation of disturbed areas as quickly as possible. The Plan would consider: • Appropriate stabilisation techniques across the precincts. • Suitable species for re-seeding (native, locally occurring species would be given preference) in areas dominated by native cover. • Monitoring for weed and erosion issues.	Construction Decommissioning	CEMP
93	Impact on Manildra Common Pit	Minimise impacts	The proponent would consult the Cabonne Council regarding any potential traffic issues during construction of the Solar Farm, for incorporation into the Traffic Management Plan.	Pre-construction	CEMP
94	Impact on current land use	Minimise disruption	Liaison would be undertaken with neighbouring landowners and landowners adjoining access roads, to provide information about the timing and routes to be used during construction and decommissioning. This could be in the form of advertising and provision of a contact point for further inquiries. The aim would be to reduce the risk of interference with agricultural activities on affected roads and road verges.	Construction	CEMP
95	Impact on current land use	Minimise impact	Grazing of sheep within the panel areas is likely to occur. The carrying capacity is likely to be reduced, however condition of the site would be considered in relation to stocking rates.	Operation	OEMP

Health and Safety

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
96	Radiation exposure from EMFs	Minimise exposure	Adhere to standard industry approaches and policies with respect to EMF through maintenance of adequate easements around transmission lines.	Operation	OEMP
97	Radiation exposure from EMFs	Minimise exposure	The substation upgrade and transmission lines would be located as far as practical from residences, farm sheds, and yards in order to reduce the potential for both chronic and acute exposure.	Operation	OEMP

Fire and Bushfire Issues and Impacts

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing
98	Bushfire risk	Minimise risk	The proponent would prepare a Bushfire Management Plan as part of the Construction Environmental Management Plan and Operation Environmental Management Plan. The Rural Fire Service and NSW Fire Brigade would be consulted in regard to its adequacy to manage bushfire risks during construction, operation and decommissioning. The plan would as a minimum include: • Hot-work procedures, asset protection zones, safety, communication, site access and response protocols in the event of a fire originating in the solar farm infrastructure, or in the event of an external wildfire threatening the solar farm or nearby persons or property. • Fire response planning would address any potential for dangerous gas emissions from the solar farm during a fire event to affect firefighters and neighbouring residents. • Flammable materials and ignition sources brought onto the site, such as hydrocarbons, would be handled and stored as per manufacturer's instructions. • During the construction phase, appropriate fire fighting equipment would be held onsite when the fire danger is very high to extreme, and a minimum of one person on site would be trained in its use. The equipment and level of training would be determined in consultation with the local RFS. • Asset protection zones (APZs), based on the NSW policy document Planning for Bushfire Protection, would be maintained around the site buildings and in the transmission line corridor. Workplace health and safety protocols would be developed to minimise the risk of fire for workers during construction and during maintenance in the control room and amenities. • Fire extinguishers would be stored onsite in each of the site buildings.	Construction Operation Decommissioning	CEMP OEMP
99	Bushfire risk	Minimise risk	If sowing of pasture grasses in the PV array area is required, low growing species should be selected.	Construction Operation	CEMP OEMP
100	Bushfire risk	Minimise risk	Pasture would be maintained at a low height (<100mm) below the PV array using sheep grazing or slashing.	Operation	OEMP
101	Bushfire risk	Minimise risk	Appropriate firefighting equipment would be maintained on the site during the operation of the solar farm, including protective clothing. Staff would be trained in its use.	Operation	OEMP
102	Bushfire risk	Minimise risk	A formal response procedure would be developed for operation staff at the solar farm, including procedures for notification of neighbouring and downwind landholders if required.	Operation	OEMP

9 CONCLUSION

The Manildra Solar Farm would involve the establishment of a 120 hectare photovoltaic array and associated road, fencing and transmission line infrastructure on largely cleared private farmland. The 50 megawatt solar farm would have an expected life of 30-50 years. The solar performance of the site has been assessed as suitable for the construction of a viable solar farm. The site is effectively positioned next to existing electricity transmission infrastructure and close to a large population centre.

The proposal would comply with legislative and policy requirements and would make an important contribution to government electricity generation objectives and carbon emission targets. The environmental impacts of the proposal have been assessed in accordance with the Director- General's requirements and a range of relevant legislation and guidelines. Specifically:

- The proposal site comprises cleared cultivated agricultural land, exotic pasture and small grazed areas of native vegetation, comprising native grasses with exotic forbs, and an overstorey of predominantly isolated White Box and Yellow Box trees. Vegetation generally has low conservation value and similar vegetation is locally abundant. Fauna impacts, including the loss of hollow-bearing trees, would be partially offset by plantings, site rehabilitation after construction/decommissioning and maintenance of vegetation cover during operation.
- A single stone artefact and a scatter of artefacts were discovered at the site however, the site is assessed to be of low archaeological significance. The site of the artefact scatter would be avoided in the construction footprint.
- While some local visual impacts from the solar farm would occur, impacts would be considered low within the context of the landscape character and scenic quality of the region. The site would only be visible from largely uninhabited areas.
- Noise impacts would be confined to the eight month construction phase. The proponent would use a range of mitigation measures and liaise with local landholders to minimise these impacts.
- A comprehensive consultation plan has been developed to inform and engage the local community, interest groups and government agencies.
- The impacts of the proposal in relation to other issues are considered to be either positive or readily manageable using identified avoidance and mitigation measures.
- The proposed works are reversible and would not compromise future land and resource use options.

Set against the background of anthropogenic climate change, the proposal is considered to be consistent with the principles of Ecologically Sustainable Development. On balance, the project is considered to be a valuable and sustainable contribution to the urgent challenges of climate change and energy supply.

10 REFERENCES

ABARE (2010). *Energy in Australia 2010.* Produced from Department of Resource Energy and Tourism http://www.abare-brs.gov.au/ accessed 03 September 2010.

Alsema, E.A., de Wild-Scholten, M.J. and Fthenakis, V.M. (2006). *Environmental Impacts of PV Electricity Generation - A Critical Comparison of Energy Supply Options*. 21st European Photovoltaic Solar Energy Conference, Dresden, Germany, 4-8 September 2006.

Australian Bureau Statistics (ABS) (2006). *2006 Census QuickStats by Location* http://www.censusdata.abs.gov.au Website last accessed 24th August 2010.

Australian Collaborative Land Use and Management Program (2009). *Lachlan NRM Region*.

Australian Energy Market Operator (AEMO) (2010a). *An Introduction to Australia's National Electricity Market, July 2010*, http://www.aemo.com.au/corporate/0000-0262.pdf accessed 9 August 2010

Australian Energy Market Operator (AEMO) (2010b). *NSW Existing & Committed Scheduled & Semi Scheduled Generation* http://www.aemo.com.au/data/gendatansw.shtml

Australian Energy Market Operator (AEMO) (2010c). *Electricity Statement of Opportunities for the National Electricity Market*, Executive Briefing 2010

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) (2007). *Magnetic and electric fields from power lines* http://www.arpansa.gov.au/RadiationProtection/Factsheets/is_emf.cfm accessed 10 August 2010.

Bureau of Meteorology (2010). Climate statistics for Molong http://www.bom.gov.au accessed 10 August 2010

Cabonne Country (2010). *Cabonne Country Tourism Brochure.* http://www.cabonnecountry.com/client_images/743855.pdf Website last accessed 25th August 2010.

Cabonne Council (2010a). http://www.cabonne.nsw.gov.a accessed 6 September 2010.

Cabonne Council (2010b). *Prospects brighter for Molong gold mine.* Article last updated 26 August 2010. http://www.cabonne.nsw.gov.au/news/pages/6837.html Website accessed 27th August 2010.

Canobolas Zone Bush Fire Management Committee (2004). *Canobolas Zone Bush Fire Risk Management Plan*.

Central West Catchment Management Authority (2009). *Regional State of the Environment Report 2008-2009 Comprehensive Report*

CSIRO (2006). ASRIS (Australian Soil Resource Information System) database http://www.asris.csiro.au accessed 4 August 2010

Department of Climate Change and Energy Efficiency (DCCEE) (2010a) *Impacts of climate change,* http://www.climatechange.gov.au/climate-change/impacts.aspx, accessed 02 September 2010

Department of Climate Change and Energy Efficiency (DCCEE) (2010b) *National Greenhouse Gas Inventory accounting for the KYOTO target May 2010*, accessed 02 September 2010 at http://www.climatechange.gov.au/en/climate-change/~/media/publications/greenhouse-acctg/national-greenhouse-gas-inventory-2008.ashx

Department of Climate Change and Energy Efficiency (DCCEE) (2010c) *State and Territory Greenhouse Gas Inventories 2008*, accessed 02 September 2010 at http://www.climatechange.gov.au/climate-change/~/media/publications/greenhouse-acctg/state-territory-inventory-2008.ashx

Department of Environment and Conservation (DEC) (2004a). *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities*

Department of Environment and Conservation (DEC) (2004b). *Interim Community Consultation Guidelines for Applicants.*

Department of Environment and Conservation and Department of Primary Industries (DEC/DPI) (2005). *Draft Guidelines for Threatened Species Assessment for Part 3A applications*.

Department of Environment and Conservation (DEC) (2005). *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation*

Department of Environment and Climate Change (DECC) (2007). *Threatened species assessment guidelines: the assessment of significance, August 2007*

Department of Environment and Climate Change (DECC) (2008a). *BioMetric 2.0 A Terrestrial Biodiversity Assessment Tool for the NSW Native Vegetation Assessment Tool* (formerly Property Vegetation Plan Developer) Operational Manual. Gibbons, P., Ayers, D., Seddon, J., Doyle, S. and Briggs, S. July 2008

Department of Environment and Climate Change (DECC) (2008b). *Managing Urban Stormwater Soils and Construction Volume 2C Unsealed roads*, January 2008

DECCW (2009). *Interim Construction Noise Guidelines* http://www.environment.nsw.gov.au/resources/noise/09406cnginfo.pdf accessed on 3rd September 2010.

DECCW (2010a). *The Bioregions of New South Wales – their biodiversity, conservation and history: South Western Slopes*

DECCW (2010b). Record of EPA notices http://www.environment.nsw.gov.au/prclmapp/searchregister.aspx website accessed 5 August 2010

Department of Environment, Water, Heritage and the Arts (2010). http://www.ga.gov.au/renewable/ website accessed 4 August 2010

Department of Land and Water Conservation (DLWC) (1994). *Guidelines for the planning, construction and maintenance of tracks*, Maitland June 1994

Department of Lands (2010). Six Viewer

Department of Natural Resources (DNR) (2010). SPADE Atlas

Department of Planning (DoP) (2007a). *Critical infrastructure, major projects assessment system: fact sheet 7*

Department of Planning (DoP) (2007b) .*Guidelines for major project community consultation*, October 2007

Department of Planning (DoP) (2009). *Major projects assessment system Sheet 2: Steps in the Part 3A assessment process*

Department of Planning (DoP) (2010). *Discussion Paper on Planning for Renewable Energy Generation – Solar Energy*, Sydney.

Department of Primary Industries (DPI) (2008). *Threatened species assessment guidelines - The assessment of significance*, February 2008

Department of Primary Industries (DPI) (2010). MinView http://www.minerals.nsw.gov.au/mv2web/mv2?

Department of Water and Energy (DWE) (2008a). *Water Management Act 2000 Guidelines for controlled activities - In-stream works, February 2008*

Department of Water and Energy (DWE) (2008b). *Water Management Act 2000 Guidelines for controlled activities – riparian corridors, February 2008*

Department of Water and Energy (DWE) (2008c). *Water Management Act 2000 Guidelines for controlled activities – watercourse crossings, February 2008*

EMFs.info (2010). *Information* http://www.emfs.info/Sources+of+EMFs/Overhead+power+lines/specific/132+kV+overhead+magnetic.htm accessed 18 August 2010.

Federal Energy Regulatory Commission, California State Lands Commission February (2002). *Draft Environmental Impact Statement/Environmental Impact Report Kern River 2003 Expansion Project*.

Fallding, M. (2002). *Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands*. Natural Heritage Trust, NSW National Parks and Wildlife Service and Land and Environmental Planning.

Frankl, P., Menichetti, E., Raugei, M., Lombardelli, s. and Prennushi, G. (2006). *Final report on technical data, costs and life cycle inventories of PV applications*

Frisson, Lieten, K. Burton, T. Declerq, K. Szlufcik, J. De Moor, H. Goris, M. Benali, A. Aceves, O. (2000). *Recent Improvements in Industrial PV Module Recycling. 16th European Photovoltaic Solar Energy Conference* May 1-5, 2000, Glasgow, UK.

Gekas, V., Frantzeskaki, N., Tsoutsos, T. (2002). *Environmental Impact Assessment of Solar Energy Systems Results from a Life Cycle Analysis in Proc. International Conference on the Protection and Restoration of the Environment* VI Skiathos, July 1-5, 2002, Pages 1569-1576

Geoscience Australia and ABARE (GA and ABARE) (2010). *Australian Energy Resource Assessment*, Canberra.

GHD (2007). *Short Flour Mill Environmental Assessment Air Quality & Environmental Management Report.* Available from:

http://www.manildra.com.au/community/proposed_mill/Annexure%20G%28i%29.pdf Last Accessed 3rd September 2010.

GHD (2008). *Councils of Blayney, Cabonne and Orange City: Sub-regional rural and industrial land use strategy.* Draft strategy

Google Earth (2009).

Greenhouse Gas Reduction Scheme (GGAS) (2010). *Fact Sheet: The NSW Pool Coefficient* http://www.greenhousegas.nsw.gov.au/documents/FS-Comp-PoolCoeff-May10.pdf

Habdank (2010). *Habdank pv mounting systems* http://www.hpvm.com/en/ accessed 6th September 2010.

Hafemeister, D.W. (1996). *Resource Letter BELFEF-1: Biological Effects of Low-Frequency Electromagnetic Fields* **American Journal of Physics** 64.8: 974-981.

Health Protection Agency United Kingdom (2004). *Electricity substations and power lines* http://www.hpa.org.uk/Topics/Radiation/UnderstandingRadiation/UnderstandingRadiationTopics/ElectromagneticFields/ElectricitySubstationsAndPowerLines/

Infigen Energy (2009) *The Capital Wind Farm*, brochure accessed online, 19 July 2010 at http://infigenenergy.com/media/413636/capital%20brochure.pdf

Infigen Energy (2010a). http://infigenenergy.com/about-us.aspx, website accessed 20 July 2010.

Infigen Energy (2010b). *Manildra Photovotaic Solar Farm* brochure http://www.infigenenergy.com/media/417305/manildra%201.pdf accessed 2 September 2010

Intergovernmental Panel on Climate Change (IPCC) (2008). *Climate Change 2007: Synthesis Report*

Kovac, M. And Lawrie, J.A. (1990). *Soil Landscapes of the Bathurst 1:250 000 Sheet*. Soil Conservation Service of NSW, Sydney

Lachlan Catchment Management Authority (2006). *Lachlan Catchment Action Plan*. http://www.lachlan.cma.nsw.gov.au/about/catchmentactionplan.aspx Accessed 3rs September 2010.

Landcom (2004). Managing Urban Stormwater: Soils and Construction, (the 'Blue Book') 4th edition

MacKay D.J.C. (2009). *Sustainable Energy – Without the Hot Air.* UIT, Cambridge, http://www.withouthotair.com/ accessed 20 August 2010

National Pollution Inventory (NPI) (2010). http://www.npi.gov.au website accessed 4 August 2010.

National Parks and Wildlife Service (NPWS) (1997). *Draft Aboriginal cultural heritage standards and guidelines kit.*

NSW Rural Fire Services (2006). *Planning for Bush Fire Protection*.

ORER (2010). Office of the renewable energy regulator http://www.orer.gov.au/ website accessed 3 September 2010.

Quiet Revolution (2008). The relationship between background noise levels and acoustic impact of the qr5 wind turbine.

Parliament of Australia (PoA) (2010). *Renewable Energy Target (RET),* Parliamentary Library website, http://www.aph.gov.au/library/pubs/ClimateChange/governance/domestic/national/mandatory.htm, accessed 02 September 2010.

Pfennigwerth S., (2008) *Minimising the swift parrot collision threat Guidelines and recommendations for parrot-safe building design*. WWF Australia. http://www.wwf.org.au/publications/swift-parrot-report/

Prider, J., N. and Facelli, J., M. (2004) *Interactive Effects of Drought and Shade on Three Arid Zone Chenopod Shrubs with Contrasting Distributions in Relation to Tree Canopies*. Functional Ecology Vol. 18, No. 1 (Feb., 2004), pp. 67-76

SAS (2010) http://www.sas.com/presscenter/ccf09/#photos accessed 14 September 2010

Schleisner, L. (2000). 'Life cycle assessment of a wind farm and related externalities', *Renewable Energy*, vol. 20, pp. 279-288.

Suntech (2010a). http://am.suntech-power.com/en/about.html website accessed 14 September 2010.

Suntech (2010b) http://ap.suntech-power.com/en/products.html accessed 14 September 2010

Terra Consulting (2003). *Statement of Environmental Effects: Manildra 132/11 kV Zone Substation* prepared for Country Energy.

Tetra Tech Inc (2003). Potential Health and Environmental Impacts Associated with the Manufacture and Use of Photovoltaic Cells Final Report November 2003 prepared for EPRI and the California Energy Commission.

U.S. Department of Energy (US DoE) (2004). *PV FAQs,*

Western Power Corporation (2004) *Proposed 330kV transmission line from Southern Terminal, Bibra Lake to Cannington Terminal, Cannington*, Amended Project Referral to the Environmental Protection Authority

Wikipedia (2010) http://en.wikipedia.org/wiki/Solar_cell# accessed 14 September 2010

World Health Organisation (2010). What are Electromagnetic Fields? http://www.who.int/peh-emf/about/WhatisEMF/en/ website accessed 17 August 2010.

Wright, M. and Hearps, P. (2010). *Australian Sustainable Energy Zero Carbon Australia Stationary Energy Plan*, University of Melbourne Energy Research Institute Beyond Zero Emissions.

van der Ree, R. (1999), '*Barbed wire fencing as a hazard for wildlife'*, The Victorian Naturalist, 116, 210-217.

11 ASSESSMENT PERSONNEL

This report was prepared by **ngh**environmental. Specific sections were drawn from consultants' reports or from the proponent, as detailed in Table 11-1.

Table 11-1: Preparation of the Environmental Assessment

Section		Author
	Executive summary	**ngh**environmental
1	Introduction	**ngh**environmental
2	Proposal description and justification	**ngh**environmental and Infigen Energy
3	Legislative context	**ngh**environmental
4	Consultation	**ngh**environmental and Infigen Energy
5	Risk Assessment	**ngh**environmental
6	Assessment of key issues	
6.1	Biodiversity	**ngh**environmental
6.2	Aboriginal heritage	NSW Archaeology
6.3	Visual Amenity	Moir Landscape Architecture
6.4	Noise	**ngh**environmental and Heggies
7	Lesser issues	
7.1	Traffic and access	**ngh**environmental
7.2	Soils and landforms	**ngh**environmental
7.3	Historic heritage	**ngh**environmental
7.4	Hydrology and water quality	**ngh**environmental
7.5	Air quality and climate	**ngh**environmental
7.6	Waste management and resource use	**ngh**environmental
7.7	Socio-economic and community	**ngh**environmental
7.8	Land use and mineral resource impacts	**ngh**environmental
7.9	Health and safety	**ngh**environmental
7.10	Fire and bushfire issues and impacts	**ngh**environmental
7.11	Cumulative impacts	**ngh**environmental
8	Environmental management	**ngh**environmental
9	Conclusion	**ngh**environmental

Authors	Experience
Nicholas Graham-Higgs *B App Sc*	Nick has worked as an environmental planning consultant since 1992, specialising in environmental impact assessment and natural resource management. His work demands an in-depth knowledge of current planning and environmental legislation coupled with a comprehensive understanding of development-related impacts, especially those relating to the development of sustainable power generation facilities, including hydro and wind generated electricity. Nicholas has acquired his knowledge in this field over the last 17 years, during which he has worked with a number of land management organisations within and outside Australia. Much of the work undertaken has been within sensitive areas, including major works for infrastructure development: the augmentation of water supplies at Perisher Range and Adaminaby, the development of mini-hydro plants at Jounama, Khancoban and Geehi and environmental assessment for a wind farm on the Snowy Plains, near Kosciuszko National Park.
Kate Carroll *B Sc (Hons)*	Kate has extensive experience in environmental assessment and management with **ngh**environmental. Kate has prepared a number of environmental assessments for including Review of Environmental Factors and Flora and Fauna Assessments. She has undertaken Development Applications including Statement of Environmental Effects for industrial developments and a variety of Environmental Management Plans for major and minor works. Kate has also worked on large Part 3A Environmental Assessment Reports.