Reach SOLAR ENERGY

APPENDIX **N**

WASTE MANAGEMENT

(SLR Report)

Ref: 610.17428-R03 -v3.0
August 2018

SLR

YARRABEE SOLAR PROJECT

Environmental Impact Statement - Appendix N
Waste Management

Prepared for:

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Level 16, 461 Bourke Street
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SLR Ref: 610.17428-R03
Version No-v3.0
August 2018

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BASIS OF REPORT

DOCUMENT CONTROL

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610.17428-R02-v2.0	18 July 2018	Andrew Quinn	Peter Georgiou	Suzanne Jolly
610.17428-R02-v1.0	8 June 2018	Andrew Quinn	Peter Georgiou	Suzanne Jolly

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1 Introduction

1.1 Overview

SLR Consulting Pty Ltd (SLR) has been engaged by Reach Solar energy to carry out a Waste Management Study for the proposed Yarrabee Solar Project ("the Project"), a large-scale Solar Photovoltaic (PV) Farm to be located approximately 23 km southwest of Narrandera in Western NSW.

SEARs have been issued for the Project and although they do not specifically mention waste management, a submission by Narrandera Council states that it expects the SEARs to consider:

> *"Management of large quantities of unsorted waste generated, and the processing capability of local landfill facilities, during the construction phase"*

To facilitate the Project, an Environmental Impact Statement is being prepared in accordance with Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). This study forms part of the associated planning application material. The study outlines the types of waste likely to be generated during construction and normal operations, the quantities in each case and how each waste type will be handled on-site, transported off site, recycled and disposed of, as the case may be.

1.2 Structure of Report

The remainder of this report is structured as follows:

- Section 2 describes the project and surrounding environment;
- Section 3 lists Landfills, Waste Contractors and Scrap Metal Contractors in the Project area;
- Section 4 addresses Construction Phase waste management;
- Section 5 addresses Operational Phase waste management;
- Section 6 deals with sewer-related issues;
- Section 7 provides the overall conclusions of the study.

2 Proposed Yarrabee Solar Project

2.1 Site Description

This Project will be seeking approval for a 900 MWac photovoltaic (PV) solar plant to be located within a 2,600 ha area within an overall 3,000 ha site, as illustrated in **Figure 1**.

In terms of waste management, the Project contains the following elements of interest:

- PV modules using solar panels mounted on single axis tracking systems;
- Inverter stations and low-voltage and medium voltage reticulation systems;
- Ancillary services equipment to assist the grid, including energy storage and synchronous condensers;
- A permanent office and maintenance building;
- Internal access roads and parking area;
- A substation and connection to the adjacent (existing) 330 kV Wagga Wagga to Darlington Point transmission line; and
- Security perimeter fencing.

In terms of waste management, ancillary construction activities include:

- Site clearing as required;
- Trenching for cables to a depth of approximately 1 m;
- Temporary fencing; and
- Temporary road access, and traffic management and calming as required.

The 900 MWac Project will be developed in stages which will be constructed depending upon the contractual obligations for the purchase of electricity by one or more third parties and the capacity of the high voltage transmission network to which the Project will be connected for the export of generated electricity.

A site layout for the 900 MWac Project is presented in **Figure 2**.

The present assessment assumes an initial Preliminary Works phase, involving fencing, road construction, establishment of a laydown area, preparation of the connection to the grid system and associated electrical substation. The study then assumes that the development stages of the Project are likely to be 300 MWac each, with a total construction period of approximately three years.

Based on the above, the average monthly workforce on-site is expected to be 250, peaking at 450. At this stage, it is understood that no staff will be living on-site during construction.

Once construction is completed and the facility is fully operational, between 15 and 25 permanent staff will be regularly on-site. Their work is expected to include administration, site operations, inverter maintenance, panel replacement, panel cleaning, vegetation management and fencing maintenance.

Figure 1 Yarrabee Solar Project Location Map

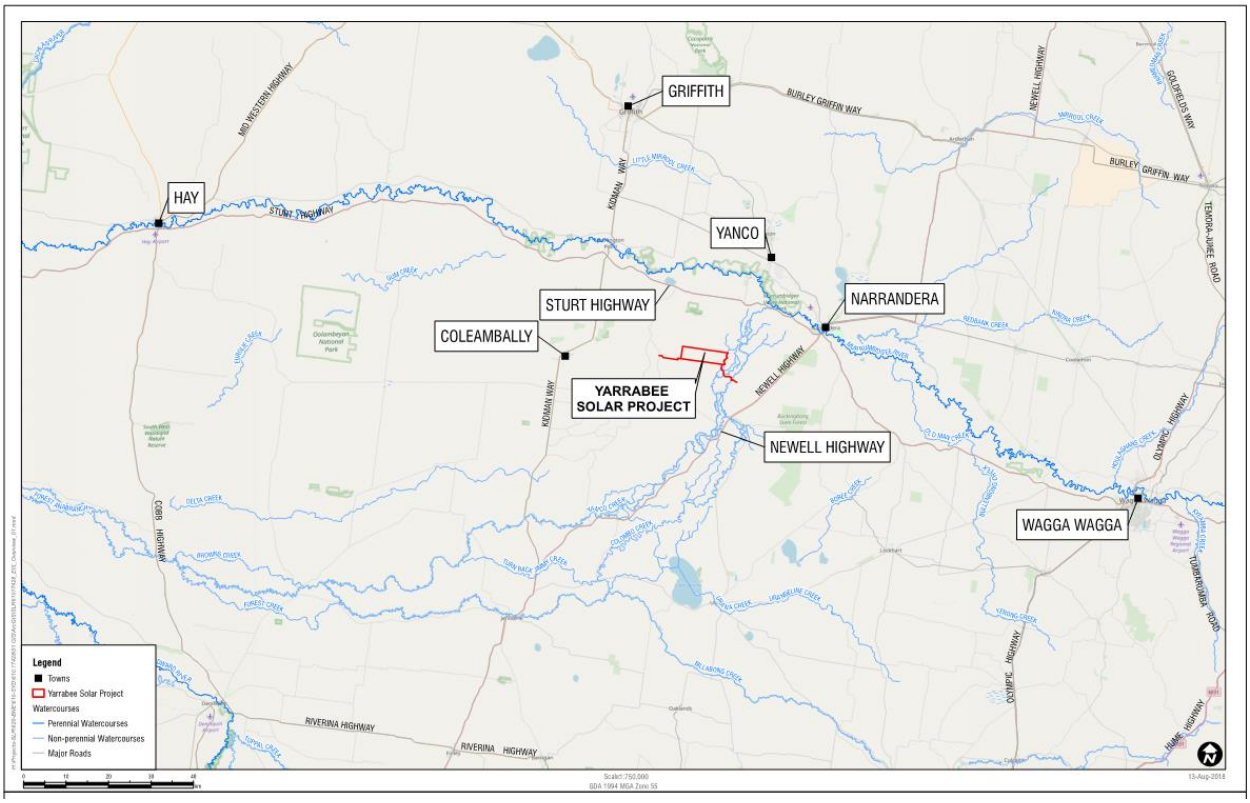
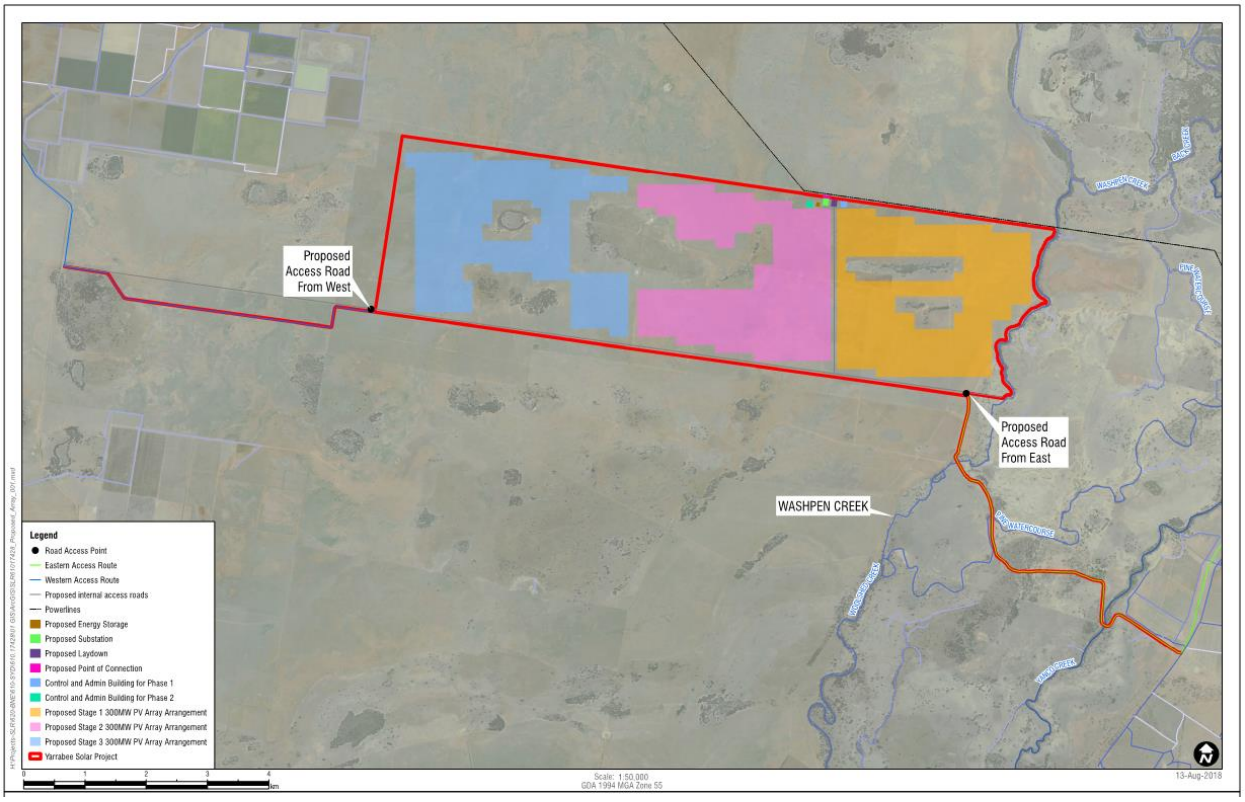


Figure 2 Yarrabee Solar Project and Indicative Solar Panel Layout Diagram



3 Project Area Waste Contractors and Disposal Sites

Despite the distance between the main urban centres in the Riverina, the area is well served by waste management contractors and facilities.

3.1 Landfills

Table 1 lists the waste disposal facilities within a reasonable distance of the site.

Table 1 Landfills in the Riverina District

Site	Location	Opening Hours	Distance
Gregadoo Waste Management Centre, Wagga Wagga	132 Ashfords Road, Wagga Wagga	Open seven days a week, 7.00am to 4.30pm. Closed Christmas Day, Boxing Day, New Years Day, Good Friday, Easter Sunday and Anzac Day.	Approx 120 km 1 hour 30 min by road
Narrandera Waste Depot	16 Red Hill Road, Narrandera	Open Tuesday, Wednesday and Friday 9am-5pm, Saturday and Sunday 10am-5pm, closed Monday and Thursday.	Approx 30 km 30 min by road
Leeton Landfill and Recycling Depot	732 Corbie Hill Rd, Corbie Hill	Open Monday – Friday: 8am to 4:40pm Saturday, Sunday and Public Holidays Closed Good Friday, Anzac Day, Christmas Day and Boxing Day	Approx 50 km 45 min by road
Collingullie Rural Transfer Station	Lockhart Road, Collingullie	Wednesday: 1:00pm to 4:45pm Sunday: 8:00am to 11:45am	Approx 85 km 1 hour by road
Currawarna Rural Transfer Station	Between Old Narrandera Rd and Gunmara Rd	Saturday: 1:00pm to 4:00pm	Approx 100 km 1 hour 10 min by road
Galore Rural Transfer Station	Off Osborne Street, Galore	Saturday: 8:30am to 11:30am	Approx 50 km 40 min by road

Gregadoo Waste Management Centre is the largest landfill in the region. The facility will accept a range of waste and recyclables, including most of those generated by this development, and hence appears to be the most likely destination for waste generated during construction. The other sites are very small and designed to receive waste only from local residents and small businesses. These sites would only be suitable for disposing of small amounts of waste during ongoing operations.

3.2 Waste and Recycling Contractors

Table 2 lists major waste contractors operating within a reasonable distance of the site.

All but one is based in Wagga Wagga, but all can provide a range of services to the site.

Table 2 Local Contractors in the Riverina District

Name	Location	Phone
MIA Quikskips and MIA Quik Waste	20 Jensen Road, Griffith	0429 627 717
Smallmon Brothers Waste	Unit 2 358 Edward Street, Wagga Wagga	0427 800 033
Chim-Cheroo Pty Ltd	Wagga Wagga	0418 457 859
SUEZ	25 Bomen Road, Bomen	(02) 6921 4627
Cleanaway	2 Saxon Street, Wagga Wagga	(02) 5908 4400

Table 3 lists several scrap metal merchants operating in the Riverina. Scrap metal can be delivered to these operators either personally by staff or contractors, or alternatively, by waste contractors. These operators may also be able to arrange bins for metals to be delivered to, and collected from, the site.

Table 3 Scrap Metal Merchants in the Riverina District

Name	Location	Phone
Primo Metal	18 Calrose Street, Leeton	(02) 6953 4298
D & M Scrap Metal	35 Hammersley Road, Corowa	(02) 6033 5372
Wagga Scrap Metals	163-165 Fernleigh Road, Wagga Wagga	(02) 6931 2102
M & S Metals Pty Ltd	8-10 Lawson Street, Wagga Wagga	0438 312 084

4 Construction Waste Management

4.1 General Waste

4.1.1 Types and Quantities

No staff will be living on-site during the construction phase of the Project.

On this basis, the following is assumed:

- General waste will be mostly lunch waste and consist of wrapping materials such as plastic film and paper and cardboard.
- Workers will most likely bring their lunch from home each day.
- A lunch truck will also visit site to provide lunches and refreshments.
- General waste may be generated at a maximum of about 1 litre (L) per person per day.
- Assuming six days per week operation, and an average of 250 people per day, this is 250 L per day or 1,500 L per week during most of the construction period.
- A peak of 450 workers is expected at times. On days when this many people are on-site, as much as 450 L per day or 2,700 L per week could be generated.

4.1.2 Handling and Disposal

All waste that cannot be, or is not, recovered or recycled as described in this document will be placed in bins and collected by a licenced contractor for disposal at a site lawfully able to accept it. A list of contractors operating in nearby centres that can service the site is provided in **Table 2**.

Contractors would be able to provide, for example a 1.5 m^3 front lift bin (refer **Figure 3**), which could be collected weekly. This would most likely be an adequate service during normal construction periods. During peak periods a larger bin could be provided, such as a 3 m^3 front-lift bin (refer **Figure 3**), for weekly collection, or a 1.5 m^3 bin could be emptied two or three times per week. These bins will not be used for construction waste.

Figure 3 Typical Bins for General Waste - Weekly or Twice-Weekly Servicing

1.5 m^3 Front Lift Bin

3.0 m^3 Front Lift Bin

4.2 Food Waste

4.2.1 Types and Quantities

Food waste will form a proportion of the general waste as described above. Only small quantities are expected per person, of the order of 100 g per day. With an average of 250 people this will amount to, at most, 25 kg per day or 150 kg per week assuming six days per week operation. During peak periods, up to 45 kg of food could be generated per day or 270 kg per week.

4.2.2 Handling and Disposal

The quantities of food likely to be generated are large enough that small scale worm farms or composting bins are not likely to have the capacity to process them. A larger scale organics processing system would be required.

The number of workers expected on-site at times and the transient presence that contractors and sub-contractors will have on-site presents challenges for the separation of food waste. Given this and the likely cost and complexity of processing these quantities of food waste on-site, food waste processing is not recommended during construction. As a result, any food will be disposed of in the general waste as described above.

4.3 Contaminated Soil

4.3.1 Types and Quantities

In February 2018, during preparation of the Scoping Report, a review of the EPA's Contaminated Land Register 2017 was undertaken. No recorded contaminated sites were found in the Narrandera local government area and therefore none on the project site. Since that time, soil sampling has been undertaken and has confirmed the absence of contaminated sites to the extent made possible by the sampling.

4.4 Chemicals and Hazardous Waste

4.4.1 Types and Quantities

Only small quantities of chemicals or dangerous goods are likely to be present at the project site during construction. No toxic chemicals or processes will be involved in, or used during, the construction phase of the project – refer also EIS Appendix J covering Hazards and Risks.

There will be a first aid station on site during construction and small amounts of clinical waste may be produced during that period.

4.4.2 Handling and Disposal

Any clinical waste generated will be stored safely by medical or first-aid staff and disposed of at Narrandera District Hospital or another suitable facility as required.

4.5 Road Construction Waste

4.5.1 Types and Quantities

Up to 15 km of roadworks is planned for construction during the Preliminary Works stage. During operational use there will also be a car parking area for 30 cars, with an area of approximately 1,080 m^2.

At a width of 9 m and length of 15 km, roadwork will comprise an area of 135,000 m^2.

Table 4 lists the assumptions and figures for waste generation from road construction. **Table 4** shows that approximately 5,800 tonnes or 3,200 m^3 of road construction waste would be generated, comprising gravel, bitumen, concrete waste, piping.

Table 4 Road Construction Waste

Element	Sub-element	Quantity	Unit	Waste %age	Weight (t)	Volume (m^3)
Bulk excavation	None					
Pavement	Subgrade approx 300mm – DGS	270	m^3	5%	24	13.5
	Base and wearing course to 150 mm	135	m^3	5%	12	7
	Two coat bituminous seal	14	m^3	5%	1.5	0.7
Kerbs and gutters	None					
Crossings	None					
Footpaths	None					
Drainage	Excavation	5.4	m^3	(100% [1])	(0.0081)	(5.4)
	Bedding	0.4	m^3	5%	0.00005	0.02
	RC Pipe	3.0	m^3	5%	0.124	0.04
	Concrete headwalls	2.0	No.	0%	0	0
Signage, lighting landscaping	None					
Total	**Per 100 m linear**				**39**	**21.5**
Total	**Per square metre road area**				**0.043**	**0.024**
Total	**15 km x 9 m wide road**				**5,800**	**3,200**

Note 1 excavation waste will not be taken from site, but used for backfilling or stockpiled for the ultimate rehabilitation stage of the Project

Table 5 shows the assumptions and figures for waste generation from car park construction, indicating that approximately 119 tonnes or 73.5 m^3 of construction waste would be generated, comprising asphalt, gravel, sand.

Table 5 Car Park Waste

Element	Sub-element	Quantity	Unit	Waste %age	Weight (t)	Volume (m^3)
Bulk excavation	None					
Pavement	Subgrade approx 300 mm - DGS	450	m^3	10%	72.0	45.0
	Base and wearing course to 150 mm	225	m^3	10%	36.0	22.5
	Two coat seal	23	m^3	10%	3.6	2.3
Kerbs and gutters	Concrete	6	m^3	10%	1.44	0.60
	Reinforcement	100	m^2	10%	0.03	0.01
	Formwork	60	m^2	15%	0.08	0.23
Footpaths	Concrete	24	m^3	10%	5.76	2.40
	Reinforcement - mesh	240	m^2	10%	0.07	0.02
	Formwork	20	m^2	15%	0.01	0.08
Drainage	Excavation [1]	5	m^3	(100%)	(0.0008)	(0.54)
	Bedding	0.4	m^3	10%	0.0001	0.04
	RC Pipe	3	m^3	10%	0.25	0.08
	Pits & Grates	2	No	0%	0	0
Signage	No waste					
Lighting	No waste					
Landscaping	Topsoil	20	m^3	5%	0.0015	1.0
	Turf	200	m^2	10%	0.05	2.0
Total	**Per square metre area**				**0.11**	**0.07**
Total	**1080 m^2 car park**				**119**	**73.5**

Note 1 excavation waste will not be taken from site, but used for backfilling or stockpiled for the ultimate rehabilitation stage of the Project

4.5.2 Handling and Disposal

All trades people and contractors engaged for construction work will be required to take any waste generated from their activities off-site for appropriate disposal. This condition will be included in the construction contractor and sub-contractors' agreements.

Contractors and sub-contractors can arrange their own waste collection service from those waste companies operating in the area - refer **Table 2**.

Alternatively, if they have small quantities, they could take their waste to one of the landfills in the area, which are listed in **Table 1**. Some of these sites have separate areas for disposal of construction waste.

4.6 Fencing

4.6.1 Types and Quantities

A 30 km perimeter fence is proposed. This is assumed to be a 2500 mm high wire mesh fence. This will result in about 75,000 m^2 of mesh fence. Assuming 0.5 kg of waste per 100 m^2 of mesh (40 m of linear fence), about 375 kg of waste may be generated during construction.

4.6.2 Handling and Disposal

All trades people and contractors engaged for construction work will be required to take any waste generated from their activities off-site for appropriate disposal. This condition will be included in the construction contractor and sub-contractors' agreements.

Contractors and sub-contractors can arrange their own waste or scrap metal collection service from those waste companies operating in the area – refer **Table 2** and **Table 3**. Alternatively, they could take their waste to one of the landfills in the area (refer **Table 1**). Some of these sites have separate areas for disposal of metals and construction waste.

4.7 Timber Pallets

4.7.1 Types and Quantities

Solar panels will be delivered in crates or pallets that consist of a combination of materials including timber.

For the currently proposed Project development scenario:

- Approximately 3 million panels would be required for the entire 900 MWac Project, to be delivered over an estimated 4-5 year period;
- As noted previously, the likely development scenario is for the Project to be constructed in three stages, 300 MWac each, with a construction period for each stage of approximately one year;
- Panels will be delivered on pallets in shipping containers - 25 panels per pallet;
- Container capacity is 12 pallets per 40' GP Container; 24 pallets per 40' HC Container;

On the basis of the above, an average of 2,250 panels would be delivered each working day on 90 pallets during each of the development stages of the Project, assuming a typical working week of six days and an allowance of ten public holidays per year;

It is estimated that each pallet contains approximately 60 L of timber or about 9.36 kg;

Accordingly, a total of 842 kg of timber will be delivered each typical working day;

When chipped this could amount to about 3 m^3 per day or approximately 90 m^3 per month.

4.7.1.1 Handling and Disposal

When the packaged panels are unwrapped, the constituent materials of the packaging, including timber will be separated. Timber will be stockpiled until there is enough for a chipping contractor to be brought to site. Stockpiled timber will be chipped and the chipped material used on-site, including for walkway surfaces and landscaping. If all chipped timber cannot be used on site, a contractor will remove excess material from the site for use at other sites where possible.

Once the panel contractor and panel transportation contractor are selected, it will be necessary to confirm that the pallet timber has not been treated in a manner that precludes on-site usage, in which case, removal from site may need to be considered.

4.8 Cardboard

4.8.1.1 Types and Quantities

It is estimated that each pallet contains approximately 2 kg of cardboard.

On the basis of 90 pallets being delivered to site each working day, this will generate approximately 178 kg of cardboard per day.

4.8.1.2 Handling and Disposal

When the packaged panels are unwrapped, the constituent materials of the packaging, including cardboard will be separated. Cardboard will be baled using a baler (refer **Figure 4**), kept on-site during construction for this purpose, and stockpiled until there is enough for a contractor to come to site to remove. Baling is preferable to placing cardboard in bins for the following reasons:

- It can be compacted quite densely so that larger quantities can be stored before transport is required;
- Bins can hold only a fraction of the material that can be stored by baling;
- Bales can be moved by forklift and transported on any flatbed truck; and
- Bins required specialised waste collection vehicles to be emptied.

The baler shown in **Figure 4** produces bales of cardboard of about 300 kg each. Accordingly, assuming 267 kg of cardboard generated per day, one bale of cardboard will be produced each day. Each bale has a footprint of about 1 m^2. Bales will be stored on site until there are enough for a recycler to come to site and collect them. Bales will be moved and stacked using a forklift.

Figure 4 Mil-tek 2509 Cardboard and Plastic Baler

4.9 Plastic Film

4.9.1 Types and Quantities

It is estimated that each pallet contains approximately 1 kg of plastic film.

On the basis of 90 pallets being delivered to site each working day, this will generate approximately 90 kg of cardboard per day.

4.9.2 Handling and Disposal

When the packaged panels are unwrapped, the constituent materials of the packaging, including plastic film will be separated. Plastic film will be baled using a baler (refer **Figure 4**) kept on-site for this purpose during construction and stockpiled until there is enough for a contractor to be brought to site to remove. As noted previously, baling is preferable to placing plastic film in bins for the following reasons:

- Plastic film can be compacted quite densely so that larger quantities can be stored before transport is required;
- Bins can hold only a fraction of the material that can be stored by baling;
- Bales can be moved by forklift and transported on any flatbed truck; and
- Bins required specialist waste collection vehicles to be emptied.

The baler shown in **Figure 4** produces bales of plastic film of about 400 kg each. If 90 kg of plastic film is generated per day, one bale of plastic film will be produced every four days. Each bale has a footprint of about 1 m^2. Bales will be stored on site until there are enough for a recycler to come to site and collect them. Bales will be moved and stacked using a forklift.

4.10 Excavated Soil

4.10.1 Types and Quantities

The construction phase of the project involves some ground works for access tracks, cable trenching and solar panel platforms. Cable trenches will be dug along every row of panels. Trench depth will be up to 700 mm, with cables laid at about 650 mm. It is also likely that soil will be excavated for the high-voltage substation and replaced with suitable fill.

4.10.1.1 Handling and Disposal

Cables will be laid on the original soil and excavated soil replaced as infill. No waste soil will be generated. Any other excavated soil will be used for any necessary backfilling activities or stockpiled to be available for use during the rehabilitation phase of the Project. No soil will leave the site.

4.11 Concrete

4.11.1 Types and Quantities

The construction phase of the project involves construction of concrete pads for hard stands, main control building, sub-station among others. The total concreted area is expected to be of the order of approximately 1,000 m^2 and to a depth of 300 mm. This is equivalent to approximately 300 m^3 of concrete of which about 5% (15 m^3) is anticipated to be waste. Substantial concrete foundations will be laid for the high-voltage substation.

The amounts of concrete waste estimated for the entire Project site is about 37.5 tonnes. This will vary in terms of the rate it is generated in relation to the development stages, for example, the sub-station for the entire site will be built during the first (approximately 300 MWac) stage of the Project. Construction stage concrete waste generation will therefore vary from stage to stage and have a peak of approximately 20 tonnes of concrete per year, that is, the first year.

Posts to hold the tracking system and panels will be piled into the ground and will require no concreting (refer **Figure 5**). As a result, no concrete waste will be generated from the installation of the tracking system or the panels.

Figure 5 Posts Supporting the Tracking System

4.11.1.1 Handling and Disposal

All trades people and contractors engaged for construction work will be required to take any waste generated from their activities off-site for appropriate disposal. This condition will be included in the construction contractor and sub-contractors' agreements.

Contractors and sub-contractors can arrange their own waste collection service from those waste companies operating in the area – refer **Table 2**. Alternatively, they could take their waste to one of the landfills in the area (refer **Table 1**). Some of these sites have separate areas for disposal of metals and construction waste.

4.12 Metals

4.12.1 Types and Quantities

Posts to hold the tracking system and panels are made of galvanised steel (refer **Figure 5**). There is an average of seven panels per post. If 3,333 panels are installed per day, 476 posts would be installed per day.

During construction just over 1% of posts are estimated to be damaged, or rejected for other reasons, and not able to be used. This will yield an average rejection rate of about 4.7 posts per day. Each post weights 20 kg which results in an average rejection rate of 95 kg of metal posts per day.

The wiring and electrical systems for the cells consist of pre-constructed looms that plug into the panels. No cutting of wires or cables takes place at this point so there will be no wire or cable waste from the installation of the panels. Small amounts of wire and cable off-cuts will be generated at other parts of the project.

4.12.2 Handling and Disposal

All trades people and contractors engaged for construction work will be required to take any waste generated from their activities off-site for appropriate disposal. This condition will be included in the construction contractor and sub-contractors' agreements.

Contractors and sub-contractors can arrange their own scrap metal collection service from those waste companies operating in the area – refer **Table 3**. Alternatively, they could take their waste to one of the landfills in the area (refer **Table 1**). Some of these sites have separate areas for disposal of metals and construction waste.

5 Operational Waste Management

5.1 General Waste

5.1.1 Types and Quantities

No staff will be living on-site once the facility is fully operational. General waste will be mostly lunch waste and consist of wrapping materials such as plastic film and paper and cardboard. As there will be no food retailers on-site, other than possibly a vending machine, staff will most likely bring their lunch from home. General waste may be generated at a maximum of about 1 L per person per day. Assuming seven days per week presence on-site by operational staff, and a maximum of 25 people on-site per day, this is 25 L per day or 175 L per week. The average waste generation would likely be around 100 L per week.

5.1.2 Handling and Disposal

General waste will be placed in bags and taken as required by staff to Narrandera Shire Council's waste disposal facility at 16 Red Hill Road, Narrandera.

5.2 Food waste

5.2.1 Types and Quantities

No staff will be living on-site. Food waste will be mostly uneaten lunch or lunch waste. Only small quantities are expected per person, perhaps 100 g per person per day. With a maximum of 25 people on-site per day, this will amount to, at most, 2.5 kg per day or 17.5 kg per week assuming seven days per week operation. The average waste generation would likely be around 10 kg per week.

5.2.2 Handling and Disposal

Food waste will be separated by staff and placed in a worm farm or compost bin located in a landscaped area.

5.3 Office Paper

5.3.1.1 Types and Quantities

As many as 25 people could be on site each day. Assuming each person generates between one and two waste sheets per day, there could be around 1,000 waste sheets of paper per month. At 80 gsm per A4 sheet, this would generate approximately 5 kg[1] of paper waste.

5.3.1.2 Handling and Disposal

A collection service for such small quantities of paper is unlikely to be viable. Office paper and any other paper and cardboard waste will therefore be placed into recycling bags or bins, bearing appropriate labels and signs, and taken as required by staff to Narrandera Shire Council's waste disposal facility at 16 Red Hill Road, Narrandera where there are paper and cardboard recycling facilities.

[1] One A4 sheet weights about 5 g.

5.4 Chemicals and Hazardous Waste

5.4.1 Types and Quantities

No waste chemicals are envisaged to be produced during operation. Small quantities may be stored on-site for use as described below but these are expected to be used entirely, leaving no waste.

Each solar panel may be washed once per year and possibly less frequently than that. Generally only soap and water is used.

Vegetation under the panels will be managed to avoid shading of the panels. This is done in one or more of the following ways:

- Planting of limited-height plant species
- Mowing
- Spraying with 'growth regulator' type herbicides and/or
- Grazing livestock (sheep).

5.4.2 Handling and Disposal

Any hydrocarbons, chemicals and hazardous materials that may be required on-site during the operational phase of the project will be managed in accordance with a yet-to-be-written Operational Environmental Management Plan (OEMP) and all relevant EPA and OEH guidelines. The OEMP will provide guidance in this regard, specifically in relation to the potential use of herbicides and storage of chemicals.

5.5 Timber, Cardboard and Plastic Film

5.5.1 Types and Quantities

Sections 4.7, 4.8 and 4.9 above describe the composition of the packaging in which solar cells will be delivered to the site along with the types and quantities of waste materials likely to be generated.

Assuming a failure and damage rate of one cell per 10,000 (0.01%), about 100 panels may need to be replaced each year. At 25 panels per pallet this would require four pallets of replacement panels per year.

The quantity of waste materials generated each year therefore would be; 37.4 kg of timber, 4 kg of plastic film and 8 kg of cardboard.

5.5.2 Handling and Disposal

Assuming one or more pallets of cells are kept on site to be used to replace failed or damaged cells, when each pallet is emptied, a collection service for such small quantities of timber, cardboard and plastic film will not be viable. This waste will therefore, be taken as required by staff to Narrandera Shire Council's waste disposal facility at 16 Red Hill Road, Narrandera where there are recycling facilities.

5.6 Concrete

5.6.1.1 Types and Quantities

Small amounts of waste concrete may be generated during maintenance.

5.6.1.2 Handling and Disposal

All trades people and contractors engaged for maintenance work will be required to take any waste generated from their activities off-site for appropriate disposal. This condition will be included in any maintenance agreements.

Contractors and sub-contractors will take small amounts of concrete waste to one of the landfills in the area, which are listed in **Table 1**. Some of these sites have separate areas for disposal of construction waste.

5.7 Metals

5.7.1 Types and Quantities

Small amounts of metal, wire and cable off-cuts may be generated during maintenance activities.

5.7.2 Handling and Disposal

All trades people and contractors engaged for maintenance work will be required to take any waste generated from their activities off-site for appropriate disposal. This condition will be included in the maintenance agreements.

Contractors and sub-contractors can take small amounts of concrete waste to one of the landfills in the area, which are listed in **Table 1**. Some of these sites have separate areas for disposal of construction waste.

5.8 Summary

Table 6 below summarises the expected waste types, estimated quantities and propose handling and recycling and disposal methods.

Table 6 Waste quantities and disposal methods

Phase	Waste Type	Estimated Quantity	Handling Method	Disposal or Recycling	Locations
Construction	General waste	1500 L – 2700 L per week	Front lift bins collected by a contractor	Disposal	Likely Wagga Wagga
	Food waste	150 kg – 270 kg per week	In with general waste	Disposal	Likely Wagga Wagga
	Contaminated soil	Nil	N/a	N/a	N/a
	Chemicals and hazardous waste	Small quantities	Clinical waste to a hospital	Disposal	Possibly Narrandera District Hospital
	Road construction waste	5,800 t or 3,800 m^3 total	Taken off site by contractors	Recycling	Likely Wagga Wagga

Phase	Waste Type	Estimated Quantity	Handling Method	Disposal or Recycling	Locations
	Car park waste	119 t or 73.5 m^3 total	Taken off site by contractors	Recycling	Likely Wagga Wagga
	Fencing	375 kg total	Taken off site by contractors	Recycling	Likely Wagga Wagga
	Timber pallets	842 kg per day (3 m^3 per day chipped)	Chipped, some used on site, remainder collected by contractor	Recycling	Likely Wagga Wagga
	Cardboard	178 kg per day	Baled and stored for collection by a contractor	Recycling	Wagga Wagga
	Plastic film	90 kg per day	Baled and stored for collection by a contractor	Recycling	Wagga Wagga
	Excavated soil	N/a	Reused on site	Reuse	On-site
	Concrete	20 t total per year	Taken off site by contractors	Recycling	Likely Wagga Wagga
	Metals	95 kg per day	Taken off site by contractors	Recycling	Wagga Wagga
Operations	General waste	100 L per week	Taken to landfill by staff	Disposal	Narrandera waste facility
	Food waste	10 kg per week	Placed in worm farm by staff	Vermiculture	On-site
	Office paper	5 kg per month	Taken to waste facility by staff	Recycling	Narrandera waste facility
	Chemicals and hazardous waste	Small quantities	Handled according to OEMP		
	Timber, cardboard and plastic film	37.4 kg 8 kg 4 kg	Taken to waste facility by staff	Recycling	Narrandera waste facility
	Concrete	Small amounts	Taken off site by contractors	Recycling	Likely Wagga Wagga
	Metals	Small amounts	Taken off site by contractors	Recycling	Likely Wagga Wagga

6 Sewer

6.1 Construction Phase

The site is not connected to sewer. Portable toilets will be hired for the duration of the construction period.

Table 7 below shows a list of portable toilet hire operators in Wagga Wagga.

Table 7 Portable Toilet Hire in Wagga Wagga

Name	Location	Phone
MIA Quikskips and MIA Quik Waste	20 Jensen Road, Griffith	0429 627 717
Smallmon Brothers Waste	Unit 2 358 Edward Street, Wagga Wagga	0427 800 033
Chim-Cheroo Pty Ltd	Wagga Wagga	0418 457 859
Suez	25 Bomen Road, Bomen	(02) 6921 4627
Cleanaway	2 Saxon Street, Wagga Wagga	(02) 5908 4400

Figure 6 shows options for portable toilets, individual units or mobile ablutions blocks

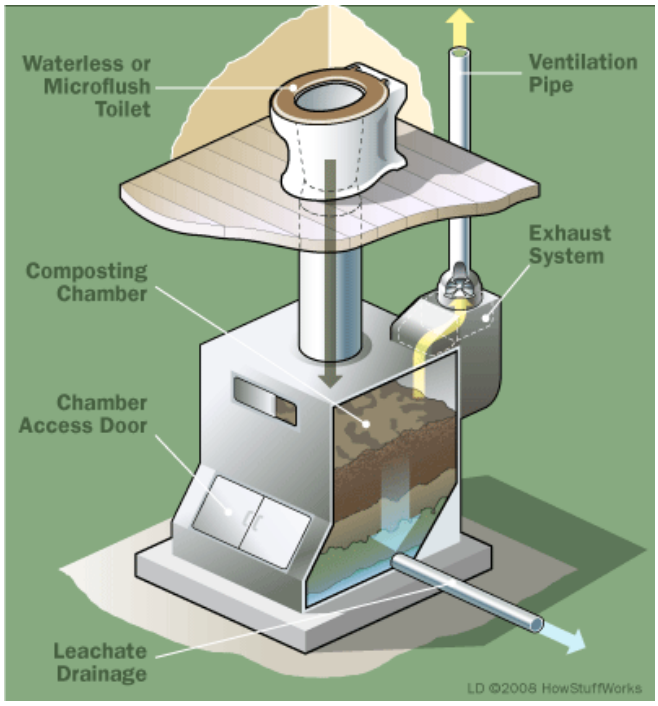
Figure 6 Portable Toilet Options

6.2 Operational Phase

Water-less composting toilets will be used during ongoing operations. At least one, and possibly two, will be installed.

Composting toilets work by collecting solid waste in a small discrete compost chamber directly beneath the toilet pedestal. An electric fan continually circulates air through the chamber speeding the composting process and eliminating odours. Liquids are separated from solids and evaporated by the fan. Any excess liquid is dispersed into a small trench. This is shown in **Figure 7**.

Figure 7 Self-Contained Composting Toilets – Working Diagram and Appearance



The three standard types of composting toilets are described in Table 8 below.

Table 8 Composting Toilet Types

Type	Function Descriuption
Batch Composting	These systems have least two composting chambers. After one is filled, it is put aside to continue composting, and the second chamber is used. When it is time to change chambers again, the contents of the first chamber are composted. The compost is removed and used for landscaping. The empty chamber is re-used.
Continuous Composting	In this system, waste materials are continuously composted in process in one large chamber. Older, fully composted material settles to the bottom of the chamber where it is easily removed through an access hatch.
Hybrid	In this system compost is continually added to a 'bio-drum' but when half full some is fed into a 'finishing tray' by rotating a handle. The compost sits in isolation in this finishing tray until it is removed as humus and used as required.

7 Conclusions

SLR Consulting Pty Ltd (SLR) has been engaged by Reach Solar energy to carry out a Waste Management Study for the proposed Yarrabee Solar Project ("the Project"), a large-scale Solar Photovoltaic (PV) Farm to be located approximately 23 km southwest of Narrandera in Western NSW.

During the Construction Phase, the Project is expected to generate significant quantities of timber, cardboard and plastic film, with smaller amounts of building material waste, such as concrete and steel, and organic waste, food waste associated with construction crews.

Emphasis has been placed on re-use and recycling of the bulk of this material and those that generate it being responsible for its disposal.

The Riverina is well served for waste contractors and waste facilities and these will adequately handle all waste generated during the construction phase and which will be disposed off-site.

During its Operational Phase, the Project is expected to generate only a few types of waste and only in very small quantities. Emphasis again is placed on re-use and recycling of this material.

Riverina waste contractors and waste facilities will easily handle all waste generated on site during the operational phase which must be disposed off-site.

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