Appendix E

Desktop hydrological assessment

Hillston Sun Farm

Overland Sun Farming

Desktop Hydrological Assessment - Hillston Site

Overland Sun Farming Company Pty Ltd

Hillston, New South Wales

R05 | Rev 05

26 June 2017

Desktop Hydrological Assessment - Hillston Site

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Document history and status

Revision	Date	Description	By	Review	Approved
01	14/09/16	Desktop Hydrological Assessment – Hillston Site	Elizabeth Smolinska	Nicola Logan	Nicola Logan
02	15/09/2016	Update to site extent	Elizabeth Smolinska	Nicola Logan	Nicola Logan
03	03/03/2017	Amended information	Elizabeth Smolinska	Nicola Logan	David Sheehan
04	12/05/2017	Updated to be part of Environmental Impact Assessment	Michiel Riesenkamp	David Sheehan	David Sheehan
05	26/06/2017	Updated infrastructure layout	Michiel Riesenkamp	David Sheehan	David Sheehan

Contents

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to undertake a desktop hydrological assessment of the proposed development site in order to gain a better understanding of flooding overlays for the area, site topography and surface water flow pathways, in accordance with the scope of services set out in the contract between Jacobs and Overland Sun Farming Company Pty Ltd (the Client).

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

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1. Introduction

1.1 Purpose

The purpose of this study is to undertake a hydrological assessment of the proposed development site in order to gain a better understanding of flooding potential and flooding history of the area, site topography and surface water flow pathways across the site. The underlying objective was to identify any surface water issues that might potentially constrain development of a solar farm at the site.

1.2 Project overview

OVERLAND Sun Farming Pty Ltd (OVERLAND) proposes to develop the Hillston Sun Farm, a large-scale solar photovoltaic (PV) generation facility and associated infrastructure in the Riverina region of south-western NSW, see **Figure 1**. OVERLAND proposes to develop the project on a site within the Carrathool Shire local government area (LGA), approximately 3.5 kilometres (km) south of the township of Hillston.

The project is a State significant development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP). A development application (DA) for the project is required to be submitted under Part 4, Division 4.1 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act). The NSW Minister for Planning, or the Minister's delegate, is the consent authority.

An environmental impact statement (EIS) is a requirement of the approval process. This Hydrological Assessment forms part of the EIS.

1.3 Site description

The site is approximately 3.5 km south of the township of Hillston, on Kidman Way which runs along the site's eastern boundary. The site boundary encompasses an area of approximately 393 hectares (ha). The legal property description is given in **Table 2**.

Table 1 – Legal description of the site

Deposited Plan	Lot Number
755189	Lots 22, 43, 61, 76, 77, 85, 100 and 101

The development footprint within the site boundary, shown in **Figure 2** on page 6, is the area within the site where project infrastructure will be constructed and operate for the project life. The development footprint encompasses an area of 293 ha, which has been refined through the project design process to avoid and minimise environmental impacts.

The development footprint encompasses a corridor connecting the site to the Hillston Substation, which is immediately to the north of the site.

The site is zoned RU1 Primary Production under the Carrathool Local Environmental Plan 2012 (Carrathool LEP). It has been highly modified by past disturbances associated with land clearing, cropping and livestock grazing, and is used for broad acre cropping. While the site is largely devoid of vegetation in the areas which have been subject to cropping, there are some small stands of remnant vegetation.

1.4 Existing and Proposed Conditions

The proposed development site consists of land on the western side of Kidman Way. The proposed site has some gentle undulations in parts. Levels across the site range from 119 m AHD to 116 m AHD, sloping from north-east to south-west.

The site is currently used for broad acre cropping. It contains very sparse vegetation which only a few more heavily vegetated localised areas. The site is surrounded by large broad acre paddocks on all sides and according to aerial photography, has very few to no residential properties within its direct vicinity. There are a number of unsealed access tracks that surround the site.

The proposed use of the development land is to house a large-scale solar energy generation facility. The development would feature a number of solar panels located on piles, gravel access tracks throughout the site, as well as a small number of container buildings.

1.5 Assessment guidelines and requirements

This Hydrological Assessment has been prepared in accordance with the relevant governmental assessment requirements, guidelines and policies, and in consultation with the relevant government agencies.

The Hydrological Assessment was prepared in accordance with the requirements of the NSW Department of Planning and Environment (DP&E). These were set out in the Secretary's Environmental Assessment Requirements (SEARs) for the project, issued on 14 October 2016. The SEARs identify matters which must be addressed in the EIS. **Table 2** lists the individual requirements relevant to this Hydrological Assessment and where they are addressed in this report.

Table 2 - Relevant SEAR's addressed in this Hydrological Assessment

Requirement	Section addressed
Site plan including clear map	Section 1.3
Details of construction , operation and decommissioning	Section 2.3, Section 2.4 and Section 2.5
Assessment of likely impacts	Section 3.5 and Section 3.6
Description of erosion and sediment control measures	Section 3.7

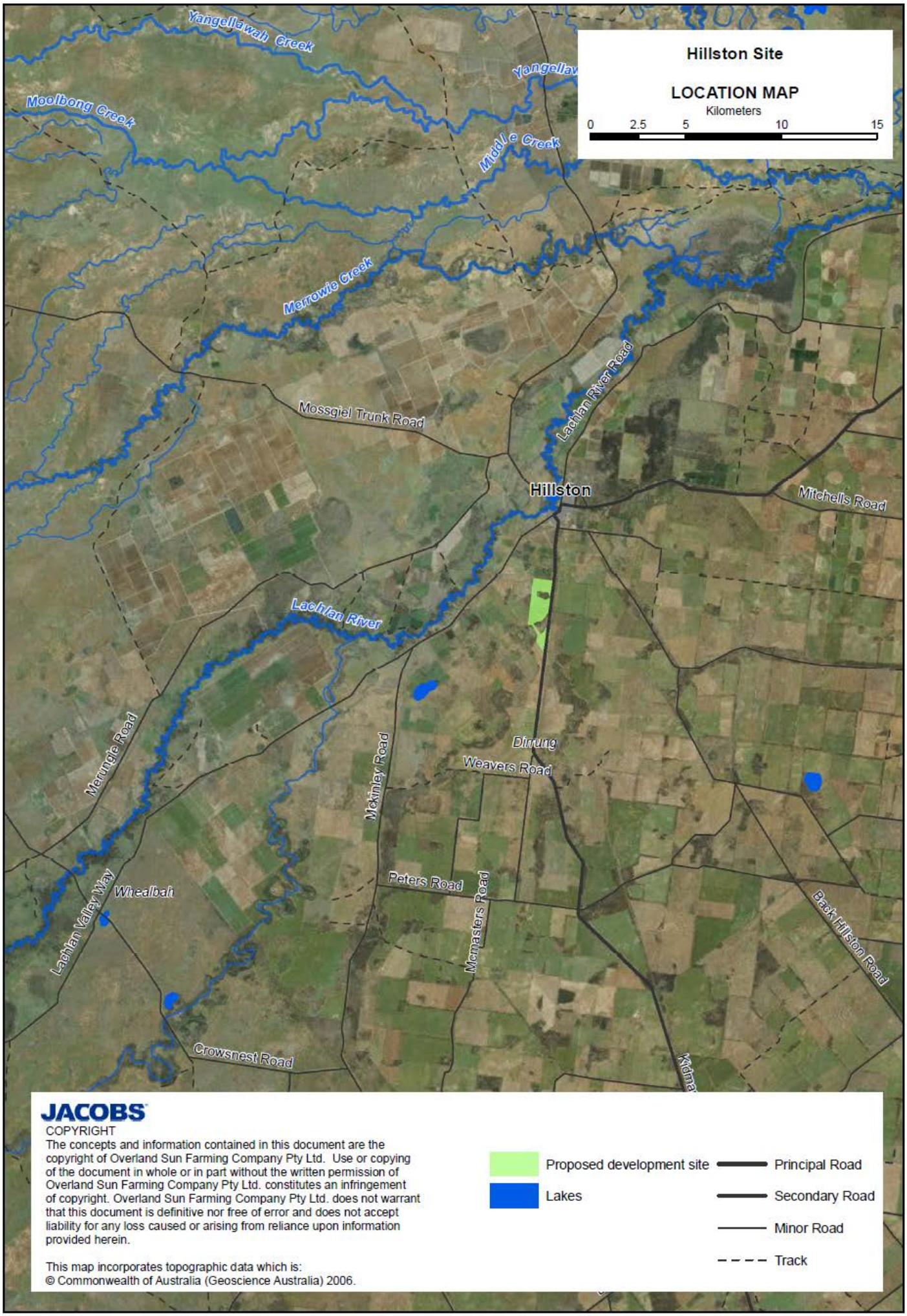

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Figure 1 - Site Location

2. Project description

2.1 Overview

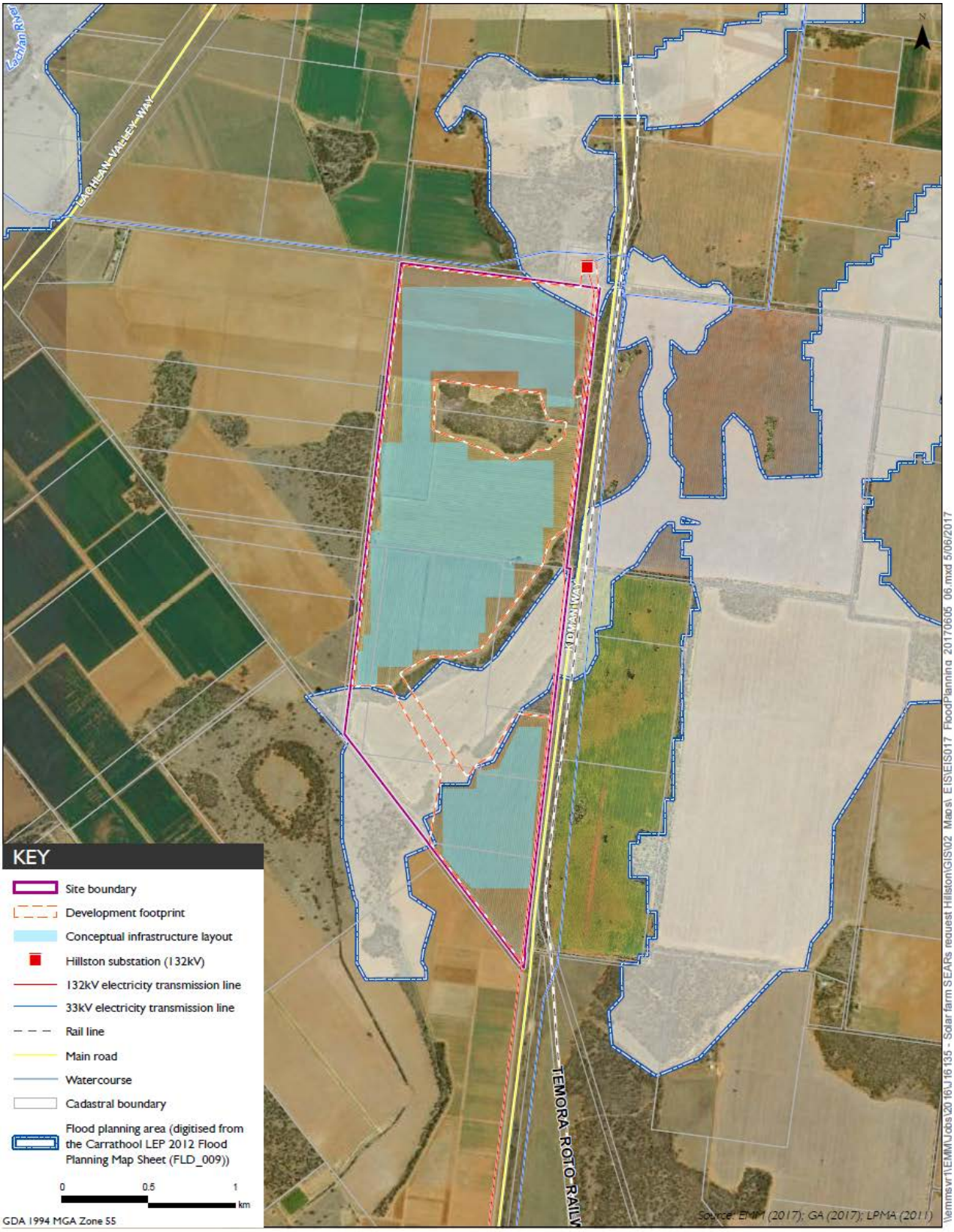
The project includes the development, construction and operation of a solar PV electricity generation facility, which comprises the installation of PV solar panels and associated infrastructure on the site.

The project will connect to the Essential Energy electricity distribution network that originates at the Hillston Substation **Figure 2**. The electricity and associated environmental products generated from the project will be sold to one or more of a registered energy retailing organisation, large energy users (governmental or private) or to the National Electricity Market that is operated by the Australian Energy Market Operator.

The project will have an estimated capacity in the order of 85 MW. It comprises the following key components within the development footprint:

- a network of PV solar panel arrays;
- electrical collection systems, switchyard and control room;
- a management hub, including demountable offices and amenities and equipment sheds;
- parking and internal access roads; and
- easement and connection infrastructure to the Hillston Substation.

The conceptual infrastructure layout is illustrated in **Figure 2**. The infrastructure associated with the project will cover an area within the development footprint. During the preparation of the EIS, the development footprint has been refined on the basis of grid connection studies, environmental constraints identification and design of project infrastructure with the objective of developing an efficient project that avoids and minimises environmental impacts. Review of **Figure 2** shows that the conceptual infrastructure layout is outside the flood planning area (as digitised from the Carrathool LEW 2012 Flood Planning Map Sheet).



Flood planning area
Hillston Sun Farm
Environmental impact statement
Figure 6.11

Figure 2 - Infrastructure layout plan

2.2 Project components

2.2.1 PV solar panels

The project involves the installation of PV solar panels, arranged in a series of rows positioned to maximise the use of the solar resource available at the site. PV solar panels will be constructed in a single axis tracking configuration, which will allow the PV solar panels to rotate from east to west during the day tracking the sun's movement. Panels will be fixed to and supported by ground-mounted framing. The average height of the PV solar panel rows will be approximately 1.2 m. During the early morning and late afternoon tracking periods, the maximum height of the PV solar panel rows will be approximately 2 m.

The typical dimensions of the PV solar panels are 1.7 m by 1 m, which provides a surface area of approximately 1.65 square metres (m^2) per PV solar panel. PV solar panels will be constructed of solar glass with an anti-reflective surface treatment.

Approximately 295,200 PV solar panels could be accommodated at the site, providing an estimated capacity in the order of 85 MW. The final number of PV solar panels within the development footprint will be dependent on detailed design, availability and commercial considerations at the time of construction.

2.2.2 Electrical collection system and switchyard

The PV solar panels will be connected in series and the electricity generated by the project will be directed via underground electrical collection systems to the inverters. The inverters will connect to a central electrical switchyard, which will use the connection infrastructure to export electricity to the grid network. All electricity generated by the PV solar panels will pass through the Hillston Substation before progressing on to the grid network.

The on-site electrical collection systems will be placed underground in standard electrical conduit trenches of between 600 to 1,200 mm in depth. The electrical cabling necessary to connect the PV solar panels in series will be positioned in cable trays mounted underneath the panels.

2.2.3 Management hub

The project includes the development of a management hub, from which operation of the infrastructure will be managed. Structures will include a demountable office control building, including staff amenities, and equipment storage sheds. This will be the receival point for all equipment delivery during construction and all management activities during the project's operational period.

2.2.4 Site access

Access to the site will be via an existing access road from Kidman Way. Internal access roads of approximately 4 to 6 m width will be constructed to accommodate construction and operational traffic movements throughout the site.

During construction, a suitable number of parking spaces will be available within the temporary construction compound.

2.2.5 Connection infrastructure

The project will require the construction of a short length of 132 kV transmission line (either overhead or underground) to the Hillston Substation, adjacent to the northern site boundary, to export electricity produced at the site to the electricity grid. The transmission line will originate from a project switchyard located adjacent to the boundary of the Essential Energy substation land and will be approximately 150–300 m in length.

2.3 Construction

2.3.1 Site preparation

Due to the site's flat terrain and predominantly cleared landscape, limited site preparation and civil works will be required. Site establishment works and preparation for construction will include:

- the establishment of a temporary construction site compound in a fenced off area within the development footprint including:
  - a site office;
  - containers for storage; and
  - parking areas;
- construction of access tracks and boundary fencing;
- site survey to confirm infrastructure positioning and placement; and
- where necessary, additional geotechnical investigations to provide information specific to the selected tracking system, mountings, and foundation pile arrangement.

2.3.2 Installation of infrastructure

Upon completion of the site establishment and pre-construction activities described above, construction will typically be as follows:

- posts will be driven or screwed into the ground (depending on the outcomes of the geotechnical survey and the condition of the ground during construction) to provide support for the mounting framework required for the PV solar panels;
- foundations for the inverter blocks, switchyard and management hub structures will be prepared;
- underground cabling will be installed between the PV solar panels and the collection circuit (this cabling will carry power throughout the site, between the inverters and central electrical switchyard, which will be located in the management hub);
- PV solar panel frames will be assembled and mounted on top of the piles;
- PV solar panels, inverters, transformers and switchgear units will be installed;
- an overhead transmission line will be constructed between the project electrical switchyard and the Hillston 132 kV Substation;
- the management hub will be constructed;
- permanent fencing and security will be constructed; and
- the temporary construction site compound will be removed.

2.3.3 Construction plant and equipment

The plant and equipment required for the construction of the project will include:

- earthmoving machinery and equipment for site preparation;
- cable trenching and laying equipment;
- post-driving equipment;
- assisted material handling equipment (forklifts and cranes);
- machinery and equipment for connection infrastructure establishment; and
- water trucks for dust suppression.

2.3.4 Delivery of construction materials and infrastructure

Construction materials and infrastructure will likely be transported to the site via road, however the use of the adjacent rail network will be considered during detailed design and construction planning, and in consultation with the rail authority. Heavy vehicles up to 19 m in length will require access to the site. Construction materials and infrastructure delivered to the site will include:

- PV solar panels;
- piles, mounting structures and frameworks;
- electrical equipment and infrastructure including cabling, inverters, switchgear, transformer;
- construction and permanent buildings and associated infrastructure; and
- earthworks and lifting machinery and equipment.

Oversized vehicle movements may be required for the delivery of the 33 kV/132 kV transformer that will be located at the project electrical switchyard.

2.3.5 Construction duration and hours

Construction of the project will take approximately 12 months from the commencement of site establishment works. Construction activities will be undertaken during the standard daytime construction hours of:

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

In general, no construction activities will occur on Sundays or public holidays. Exceptions to these hours may be required on limited occasions. The local council and surrounding landholders will be notified of any exceptions.

2.3.6 Construction workforce

During the peak construction period, a workforce of approximately 150 people will be required on site. It is anticipated that the average construction workforce throughout the 12 month construction period will be approximately 70 people.

2.4 Operation

Following construction, the project will begin operating with the production of electricity for contribution to the grid network. The PV solar panels will operate during daylight hours, seven days per week, 365 days per year. The operational lifespan of the project may be in the order of 30 years, depending on the nature of solar PV technology and energy markets.

An operational workforce of between two and five full-time equivalents (FTE) will be required to maintain the project once construction has been completed and the operational stage of the project commences.

Throughout the operational stage of the project, ongoing maintenance of the site and project infrastructure will be required. This will include the following ongoing tasks:

- site maintenance including:
  - vegetation maintenance;
  - weed and pest management;
  - fence and access road management; and
  - landscaping;
- infrastructure maintenance including:
  - panel cleaning;

- panel repair (if required); and
- equipment, cabling, substation and communications system inspection and maintenance.

To ensure the optimal electricity production output from the project, the PV solar panels may need to be washed periodically to remove dirt, dust and other matter. Water for panel cleaning will be transported to the site via water trucks. Washing will not require any detergent or cleaning agents.

The operational workforce will also be responsible for ongoing security monitoring of the site and project infrastructure.

2.5 Decommissioning

Once the project reaches the end of its investment and operational life, the project infrastructure will be decommissioned and the site returned to its pre-existing land use, or other land use in consultation with the landowners, as far as practicable.

Decommissioning of the site will involve the removal and recycling of the materials on site including:

- PV solar panels and mounting frames;
- metals from posts and cabling; and
- all other equipment including inverters and transformers.

During decommissioning, all above ground facilities will be removed from the site.

3. Hydrological Assessment

3.1 Introduction

The following three items have been considered in this assessment:

- Whether any development on the site is likely to be inundated in a 100 year ARI (Average Recurrence Interval) flood event
- Whether any development on the site might obstruct 100 year ARI flood flows and impact on peak water levels
- Whether the development is likely to have any hydrological impacts external to the site

The 100 year ARI flood event is defined as an event that has a 1% chance of being equalled or exceeded in any one year.

No readily accessible 100 year ARI flood extent data is available for the site and therefore this desktop hydrological assessment presents other relevant information that was able to be accessed. This includes previous flood study information for the area, historical flooding extents (when available), aerial photography and also the Land Subject to Inundation Overlay (LSIO) layer from Geoscience Australia. A consultation with the local Council has also been undertaken in order to access all available data.

According to Geoscience Australia, the LSIO layer is based on the definition of low lying land and is usually adjacent to lakes or streams. This low lying land is defined as regularly covered with flood water for short periods of time, either annually or for at least one year in ten years on average.

3.2 LSIO Layer

The proposed development site is located approximately 3 kilometres to the east of the Lachlan River at its closest point. The site is not shown as covered by the LSIO extents. There is no LSIO extent visible along the Lachlan River along the section around Hillston and the proposed development site.

3.3 Surface Water Flows

Based on an assessment of the topography of the area it can be concluded that land around the site generally slopes from north-east to south-west. **Figure 3** below presents arrows showing indicative directions of surface water flows across the site. These are shown to enter the site from north-east and flow through the site in various directions, predominantly south and west.

There are no major lakes or swamplands visible on aerial photography in the direct vicinity of the site. There is a farm dam to the south-west of the site and this dam is shown on **Figure 3** below.

Based on an assessment of the topography of the area and aerial photography it appears that if not designed and constructed appropriately, the development of the site could potentially obstruct flood or overland flow paths for the area. However, as the solar panels are raised over one metre above ground level on a support structure, little impact on existing overland flow is expected.

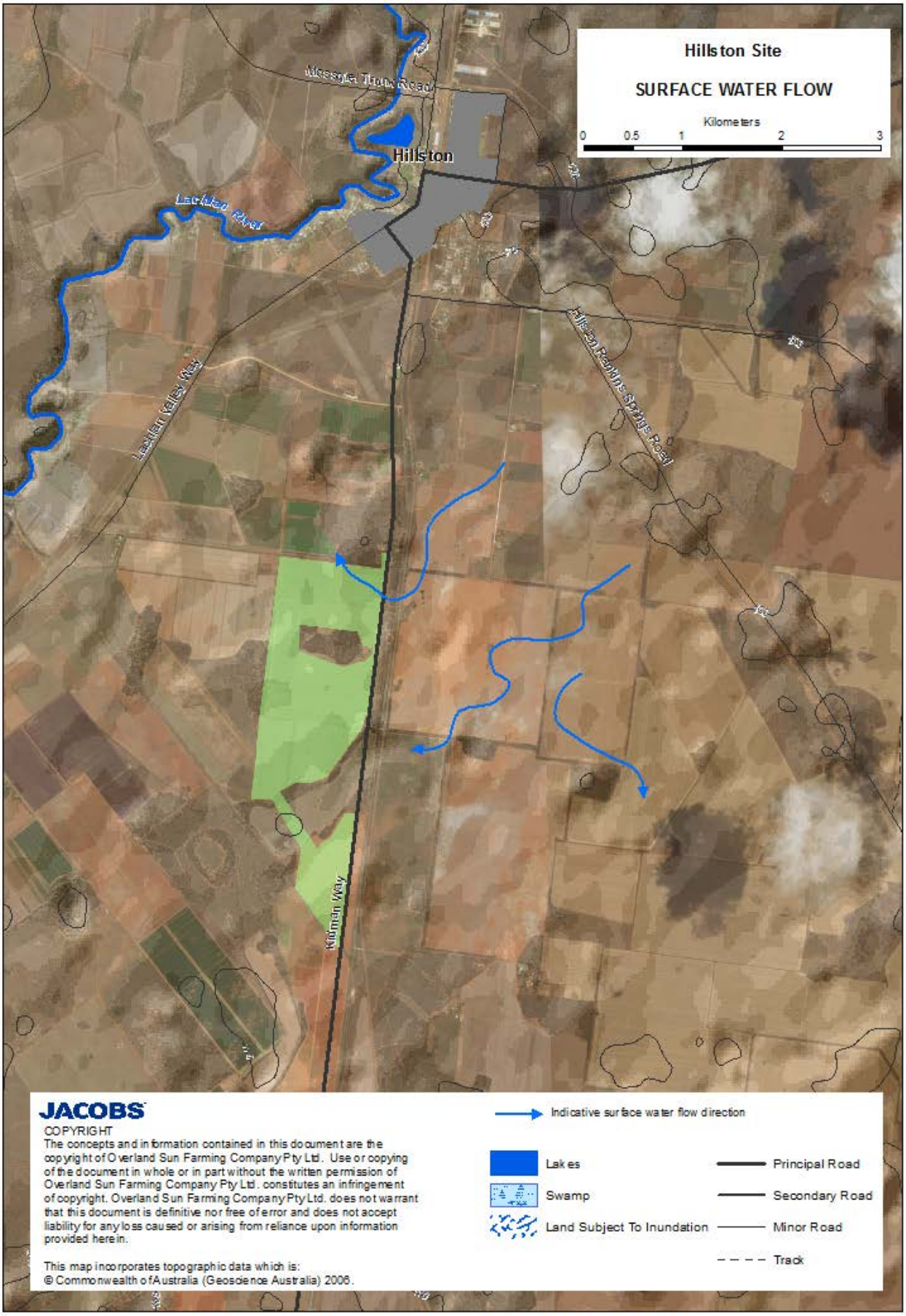


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Figure 3 - Surface Water Flows

3.4 Inundation risk

According to the *Hillston Floodplain Risk Management Study Final Report and Floodplain Risk Management Plan* (June, 2005) Hillston has been affected by a number of floods with the most significant recorded events being in 1956 and 1990.

The *Lachlan River Hillston Floodplain Management Plan Lake Brewster to Whealbah (October, 2005)* states that during larger flood events there is a series of breakouts from the Lachlan River onto the floodplain, the most substantial of these being the outflows into Gum Swamp which activates flow paths to the east of Hillston.

The *Hillston Floodplain Risk Management Study (2005)* presents previous flood modelling results, including a 1990 modelled flood extent which is shown on **Figure 4** below and presents areas around Hillston covered by the extent. This modelled design event is reported to represent the 100 year ARI event. An indicative site location has been provided on **Figure 4** and is shown in a yellow outline. The flood extent is shown to cover portions north and south of proposed development site with a surface water flowpath running through the site. As can be seen in this figure, the proposed development is located almost entirely outside the modelled flood extent. As can be seen in **Figure 2**, no actual infrastructure is proposed in the flowpath running through the site.

As the proposed infrastructure is above the 100 year ARI flood level, the probability of any infrastructure being inundated by flooding is assessed to be less than 1% in any given year.

3.5 Impact on flood levels

As all the infrastructure on site is proposed to be located outside the modelled flood extent, no impacts on floods up to the 100 year ARI flood event are expected from the development.

3.6 Changes in runoff characteristics

The Carrathool Local Environmental Plan (2012) contains a Wetlands Map which takes into account land that is connected by the floodway network. The plan states that any development within the areas covered by the 'wetlands' extent needs to be designed, sited and managed appropriately in order to avoid, minimise or mitigate any significant environmental impacts caused by the proposed development. The Wetlands Map is presented within **Figure 5** and shows a very similar flood extent to that of **Figure 4** around the vicinity of the site.

Although not included in the Carrathool Local Environmental Plan (2012), upon consultation the Carrathool Shire Council provided a Flood Planning Land map which presents draft flood mapping for the LEP. It presents areas included in the 'flood planning area' layer based on 100 year ARI plus 0.5 m freeboard. The Flood Planning Map contains a note which states that other land that is subject to the 100 ARI flood event is not shown on the map. This map is presented in **Figure 6** and corresponds to the extent previously presented within **Figure 5** presenting the wetlands layer. The proposed infrastructure of the development is located largely outside the flood extents with water flowpath running through the site.

The expected impacts of the proposed development in regards to runoff from the site are small. Unlike most conventional developments including concrete slabs, which prevents any infiltration of water at the location of the development, the existing surface under the solar panels area remains pervious. This means the area of the site that allows storm water to be infiltrated is virtually unchanged, leading to no or little changes in runoff characteristics.

As no significant changes in runoff are expected, no further mitigation is recommended.

3.7 Soil and Contamination Management

Review of the activities in the Construction Phase, Operational Phase and Decommissioning Phase in **Section 2.3, Section 2.4** and **Section 2.5** identified spills and leaks and erosion as the main risk in any phase of the project.

The storage and handling of hazardous substances will be an important consideration during the construction phase. Spills/leaks from chemical or hydrocarbon storage areas, as well as discharge of treated or untreated wastewater from on-site waste water treatment facilities will be managed through prescribed controls and measures documented in a site specific EMP.

A range of mitigation measures are identified to minimise these potential impacts, summarised as follows:

- Implementation of best practice erosion and sediment control measures during the construction phase (including dust control);
- Safe storage of hydrocarbon materials (e.g. away from waterways and drainage lines), to ensure that any spillages are contained;
- Re-vegetation of soil beneath solar panels with native or naturalised perennial species, to stabilise the land, reduce peak stormwater flows and reduce sediment discharge via stormwater runoff;
- Use of glyphosate-based products (or similar non-residual and non-persistent herbicides) to manage weeds on-site, to minimise the potential risk of harmful herbicide by-products entering the surface water receiving environment;
- Design, construction and maintenance of stream crossings in accordance with industry best practice; and
- Installation and operation of a septic tank to service the operations and maintenance building; this will be designed and operated in accordance with relevant statutory requirements and Australian Standards. Regulated wastes will be removed from site and disposed in a suitable facility by a licensed operator.

Overall, it is considered that the potential soil and contamination impacts associated with the project can be appropriately managed by developing and implementing an erosion and sediment control plan that contains best practice drainage, erosion and sediment controls for the various stages of work.

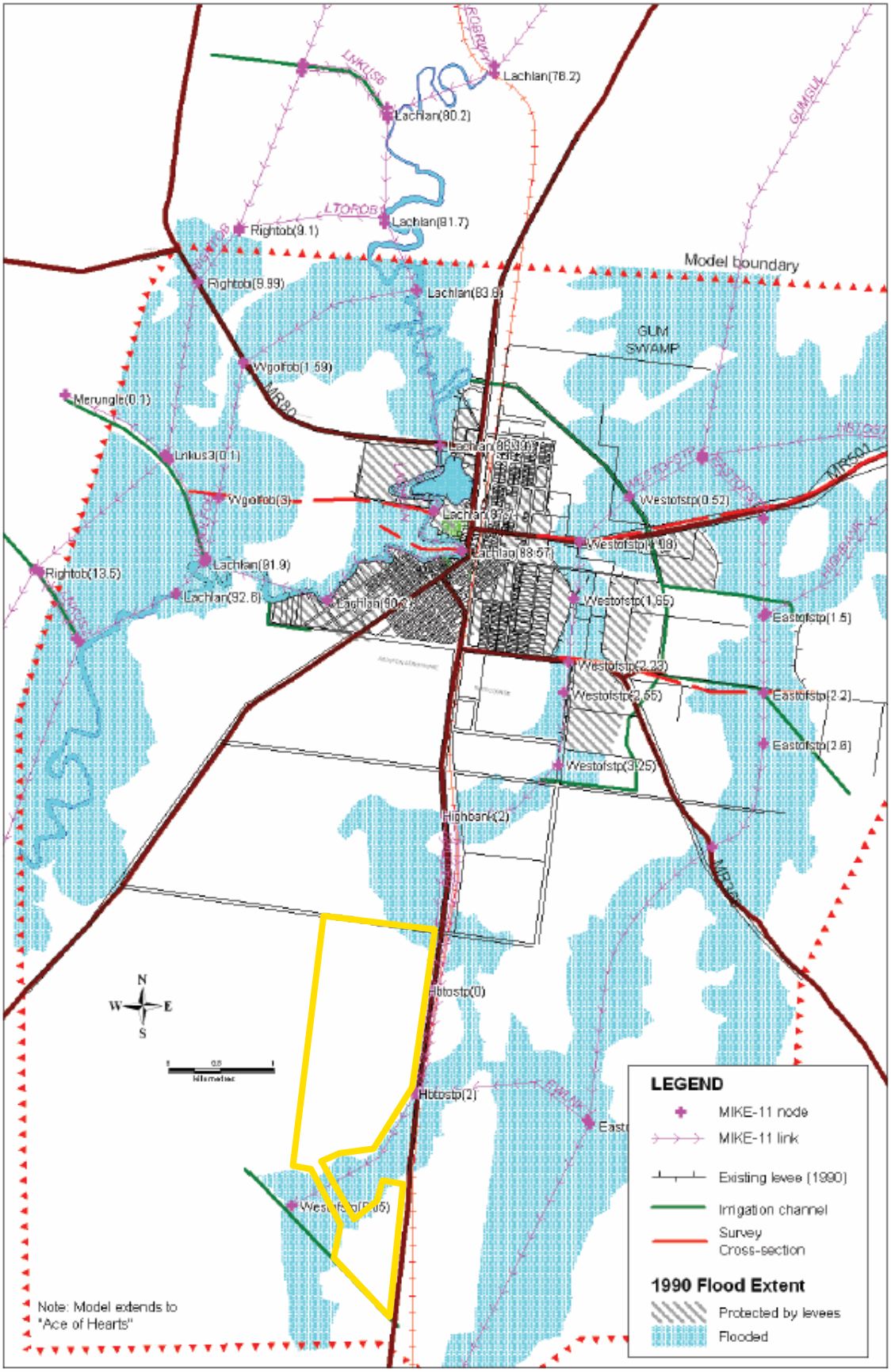
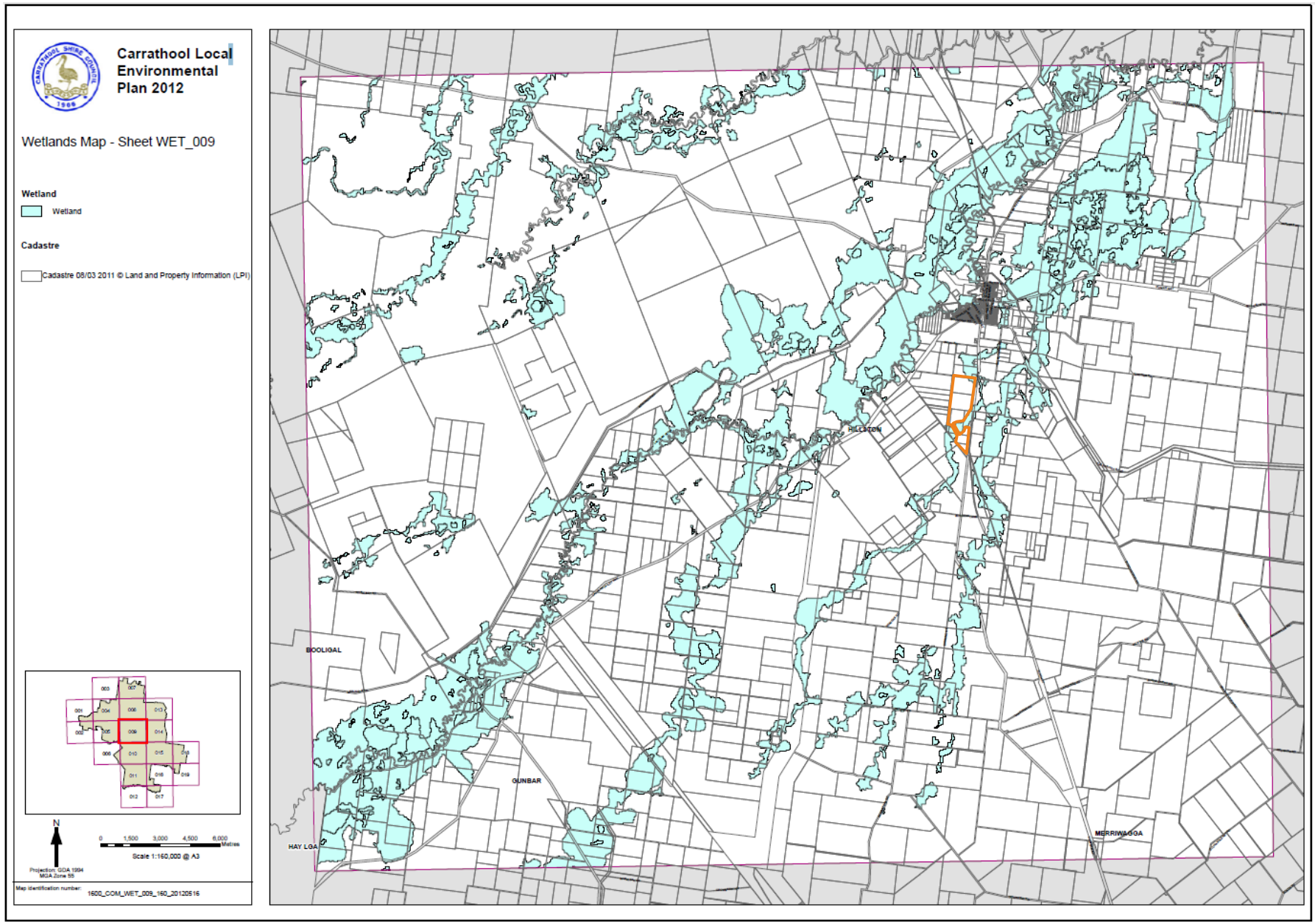


Figure 4 - 1990 Modelled Flood Extent (source: Hillston Floodplain Risk Management Study, 2005)



R05 Figure 5 – Wetlands Map (source: Carrathool Environmental Plan, 2012)

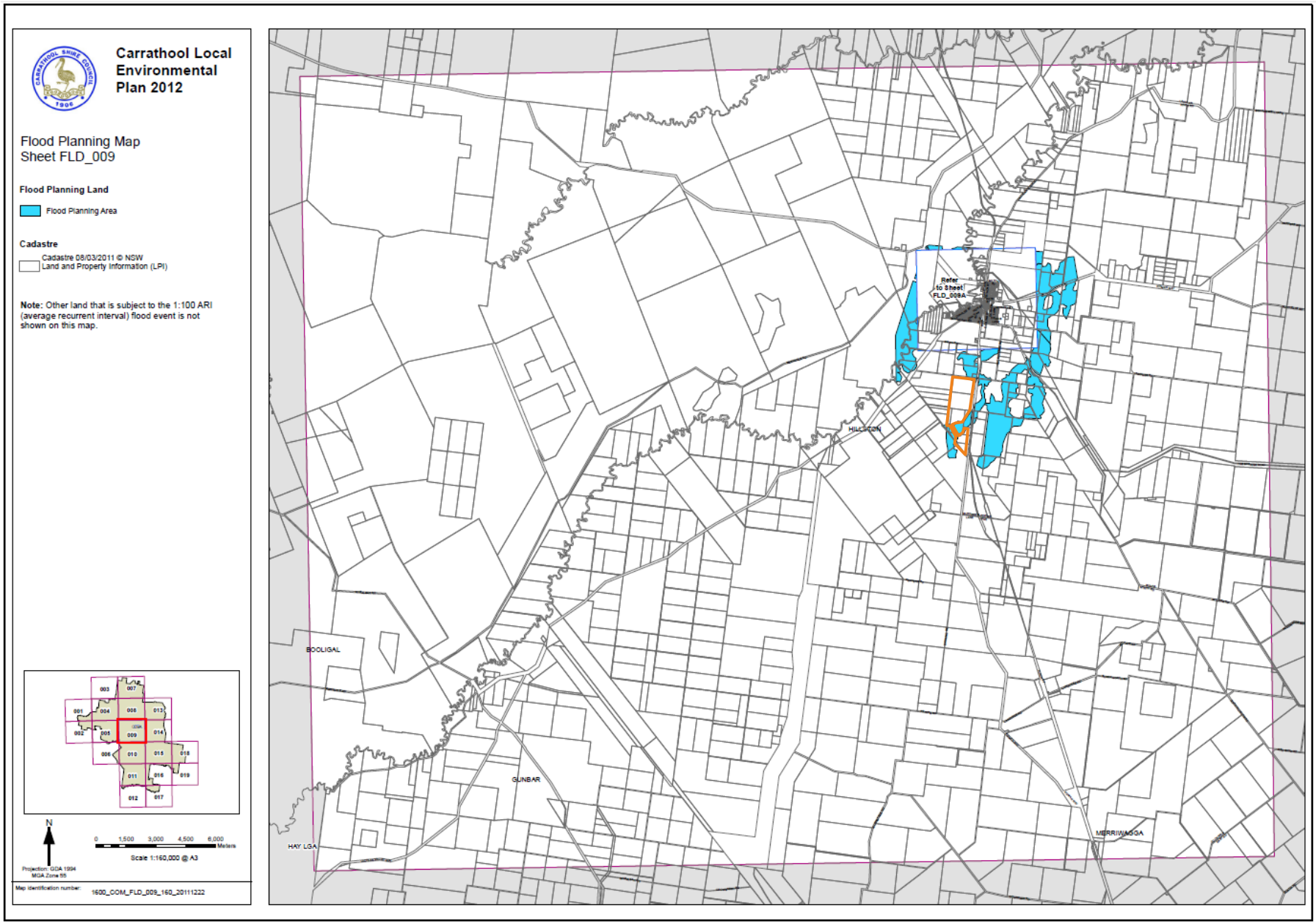


Figure 6 – Flood Planning Area (source: Carrathool Shire Council)

4. Conclusions

The purpose of this study was to undertake a hydrological assessment of the proposed development site in order to gain a better understanding of flooding potential and flooding history of the area, site topography and surface water flow pathways across the site. The underlying objective was to identify any surface water issues that might potentially constrain development of a solar farm at the site.

No readily accessible 100 year ARI flood extent data is available for the site and therefore this desktop hydrological assessment presents and is based on other relevant information that was able to be accessed. This includes previous flood study information for the area, historical flooding extents, aerial photography, and also the Land Subject to Inundation overlay (LSIO) layer from Geoscience Australia.

Based on the desktop hydrological assessment, the infrastructure area within the site is located outside the flood extent. This indicates the likelihood of the infrastructure on the site being flood affected is less than a 100 year ARI. As the infrastructure area is above the 100 year ARI flood level, no change on flood levels is expected due to the development on the site.

Runoff from the site in not expected to significantly increase due to the fact that the percentage impervious ground is not significantly increased by the development. Unlike most conventional developments including concrete slabs, which prevents any infiltration of water at the location of the development, the existing surface under the solar panels area remains pervious. Therefore, infiltration of surface water will be unaffected by the solar panels. As no significant changes in runoff are expected, no further mitigation is recommended.

Sedimentation and erosion control are considered to be a risk that need to be managed. It is considered that the potential soil and contamination impacts associated with the project can be appropriately managed by developing and implementing an erosion and sediment control plan that contains best practice drainage, erosion and sediment controls for the various stages of work.

5. References

NSW Government Department of Natural Resources, October 2005, *Lachlan River Hillston Floodplain Management Plan Lake Brewster to Whealbah.*

Carrathool Shire Council, June 2005, *Hillston Floodplain Risk Management Study, Final Study Report and Floodplain Risk Management Plan,* prepared by Cardno Willing (NSW) Pty Ltd, Gordon.

Carrathool Shire Council, 2012, *Carrathool Local Environmental Plan 2012,* http://www.legislation.nsw.gov.au/EPIs/2012-332.pdf, accessed online 08/09/2016.