Amendment Report

YANCO SOLAR FARM

SEPTEMBER 2019

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CONTENTS

1 INTRODUCTION

This Amendment Report accompanies the Response to Submissions report (RTS) for the Yanco Solar Farm ('the proposal'). It details the amendments to the State Significant Development (SSD) Application # 9515. The amendments to the design of the solar farm layout have been proposed to reduce noise and amenity impacts, address feedback from Leeton Shire Council and for a proposed subdivision of Lot 146 DP 751745.

Amendments to the SSD application include changes to the proposed layout (Appendix A), an updated noise and vibration assessment (Appendix B), proposed subdivision (Appendix C, Appendix D), revisions to the Aboriginal Cultural Heritage Assessment Report (ACHAR) (Appendix E) and Biodiversity Development Assessment Report (BDAR) (Appendix F), and further engagement with Leeton Shire Council.

2 AMENDMENTS

2.1 PROPOSED LAYOUT

Amendments to the proposed layout of the solar farm are described in detail in the following sections. The amendments have been updated in the maps within the ACHAR and BDAR.

2.1.1 Site Access

Proposed access to the development site from Research Road has been relocated west of the original proposed access point to allow adequate sight distance between the crossing of Research Road over the Main Canal to the east and the site access point, as requested by Leeton Shire Council. The relocation of the proposed access point is within the existing surveyed proposal footprint. Therefore, no further assessment is required for the ACHA or BDAR.

2.1.2 Solar Panels

The layout of the solar panel infrastructure has been amended to allow for further setback from the closest residential sensitive receptor to the north (receptor R07). Amendments to the solar panel layout has also occurred in the south western corner of the development site adjacent to Yate Road. The purpose for this change was to allow additional space for landscape plantings.

2.1.3 Landscape Planting

Additional landscape planting has been proposed in the south-western development site adjacent to Yate Road and residential sensitive receptors (receptor R03 and R02). Additional landscape planting is proposed along Toorak Road, adjacent to residential receptors (receptors R04, R05 and R06). Proposed landscape plantings are between 10 m and 20 m in width.

2.1.4 Inverter Units

There are three additional inverter units as part of the amended proposed layout. Two additional inverter units are located along the eastern boundary, one in Lot 150 DP 751745 and one in Lot 149 DP 751745. An additional inverter unit has been proposed in Lot 142 DP 751745 of the development site, between Yate

Road and Toorak Road. The additional unit is close to the proposed access point. The two inverter units in Lot 147 DP 751745 have been relocated further to the east, closer to the Gogeldrie Branch Canal.

2.1.5 Lot 145 and 146 DP 751745

Additional changes to the solar farm layout in these lots includes access points along Research Road, as mentioned above, the location of the internal access roads and the location of the construction compound area.

The construction compound has been relocated to the northern boundary of these lots, east of the relocated access point. The internal access road from Research Road has been relocated to reflect the relocation of the proposed access point. Road access remains to all three inverters through the central area of the section and along the eastern boundary to the switching station.

2.1.6 Switching Station

A second control building would be located in the switching station. The approximate dimensions for the switching station structure are 20 m x 5 m x 5 m. One control building would be for the solar farm and the other for the utility.

2.1.7 Internal Powerline

The internal powerline crossing Research Road has been relocated to the amended development site access point.

2.2 NOISE AND VIBRATION ASSESSMENT

An update to the Construction and Operational Noise and Vibration Assessment (Appendix B) was completed by Renzo Tonin & Associates for the changes to the proposed solar farm layout. The results of the assessment of the amended solar farm layout indicate the noise management levels (NMLs) at receptors R01 to R10 and R20 to R21 may be exceeded when construction works are conducted within close proximity to the receptors. Construction noise levels will comply with the NMLs at all the identified receptors during the construction of the easement.

The construction noise for receptor R07, adjacent to the increased setback of solar panels, for the new proposed layout is 55 dB(A) compared to 68 dB(A) for the original proposed layout. The NMLs, although still exceeded, would be reduced under the new proposed layout for receptors R02, R03, R08 and R09. Construction noise impacts at receptor R12 are now below the NMLs.

Operational noise levels comply with the nominated criteria under all meteorological conditions.

2.3 PROPOSED SUBDIVISION

A proposed subdivision of land (Appendix C) was submitted to Leeton Shire Council for consideration and approval. The subdivision would create an allotment, less than the prescribed minimum lot size of 150 ha, within Lot 146 DP 751745. There would be no proposed new dwelling. The proposed new lot (0.38 ha) would be allocated to the switching station for management by TransGrid. The residual lot (19.93 ha) would be for the purpose of the solar farm.

Leeton Shire Council does not have any objection to the subdivision of Lot 146 DP 751745 into two lots as part of the proposed solar farm development (Appendix D).

2.4 CONSULTATION

During June, July and August 2019 ib vogt continued to engage with Leeton Shire Council to further discuss Council's concerns about the proposal. On 24 July Andrew Wilkinson (ib vogt) presented to Leeton Shire Councillors to respond to issues raised in Council's submission to the DA. On 13 August Jenny Walsh and Andrew Wilkinson (ib vogt) met with the General Manager and the Mayor of Leeton Shire Council to further discuss the Council's concerns. All issue of concern raised by Leeton Shire Council are addressed in the Response to Submissions report.

During the community consultation process a number of members of the local community made contact with ib vogt staff in support of the Yanco Solar Farm proposal. Nine of these people provided letters and emails in support the proposal to ib vogt (outside the SSD process).

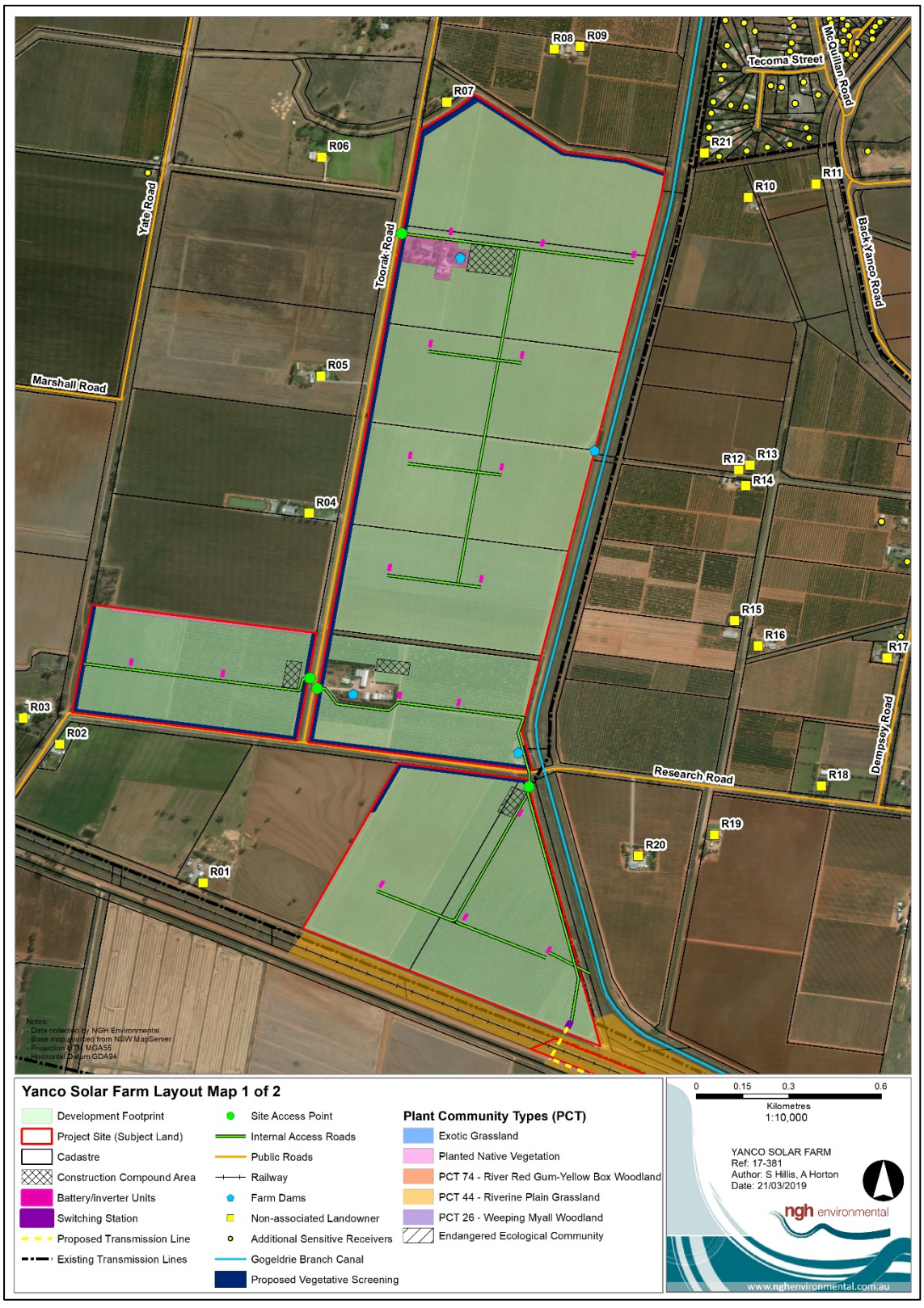
3 CONCLUSION

The changes to the proposal have been detailed in this report. Changes include amendments to the proposed layout of the solar farm, an updated noise and vibration assessment for construction and operation, a proposed subdivision and additional consultation. Letters of support were received by ib vogt, outside the SSD process, from members of the local community.

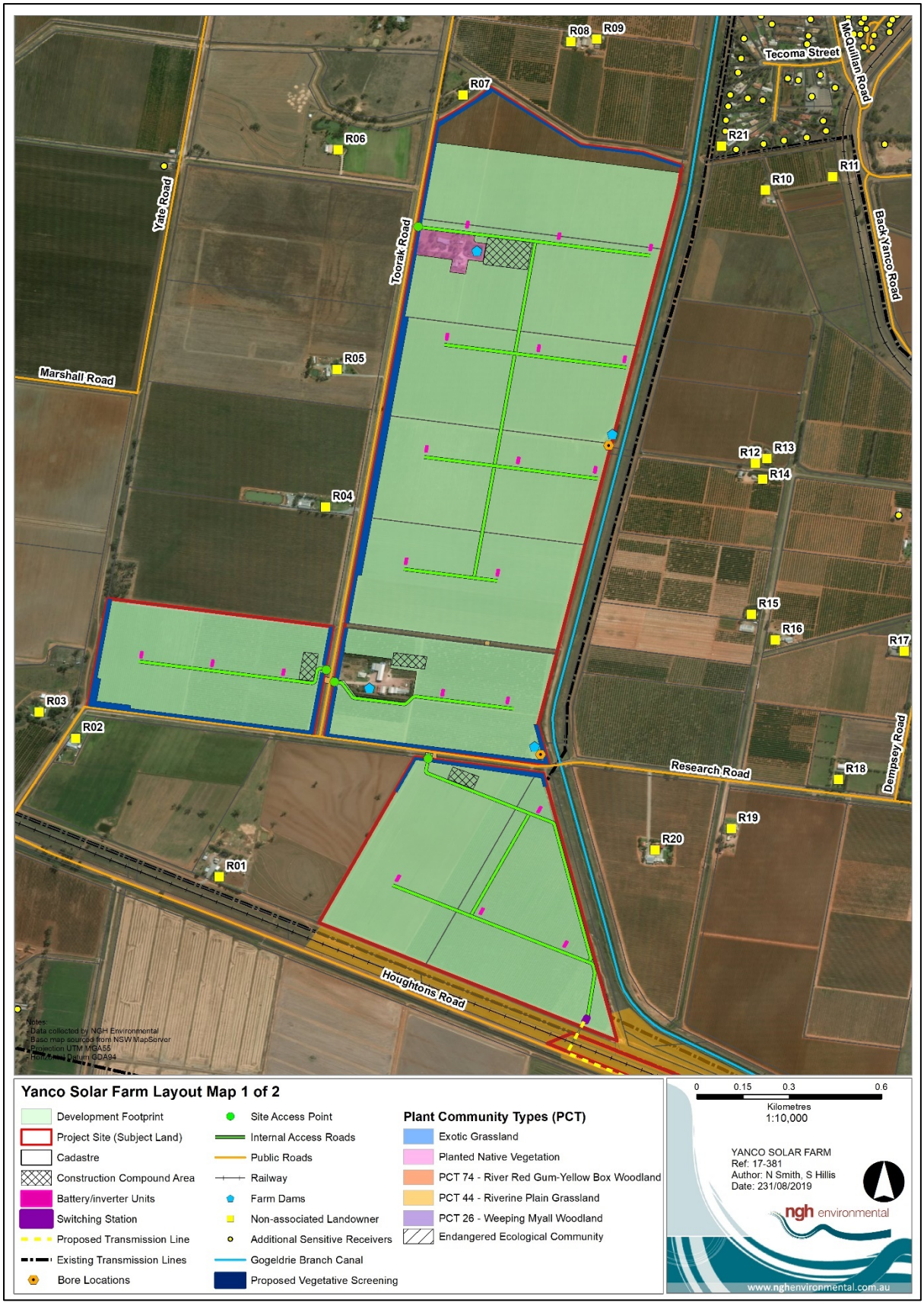
Setbacks of the solar panels from the site boundaries in the north and south-west have provided increased areas for landscape plantings adjacent to sensitive receptors. The increase in setback of solar panels from the northern boundary has decreased the construction noise impacts from 68 dB(A) to 55 dB(A) at the nearest neighbour, R07.

A subdivision of Lot 146 DP 751745 is proposed for the switching station for management by TransGrid. Leeton Shire Council do not have any objection to the proposed subdivision.

APPENDIX A ORIGINAL AND AMENDED SOLAR FARM LAYOUT



Original proposed solar farm layout.



Amended proposed solar farm layout.

APPENDIX B UPDATED NOISE AND VIBRATION ASSESSMENT

RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

YANCO SOLAR FARM

Construction & Operational Noise & Vibration Assessment

4 September 2019

NGH Environmental Pty Ltd

TJ856-01F01 Noise & Vibration Assessment (r5)

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Document details

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23.01.2019	Finalise report	-	2	D Kim	M Chung	M Chung
06.02.2019	Update report	-	3	D Kim	M Chung	M Chung
02.09.2019	Updated layout	-	4	D Kim	M Chung	M Chung
04.09.2019	Finalise updated report	-	5	D Kim	M Chung	M Chung

Contents

List of tables

List of figures

1 Introduction

Renzo Tonin & Associates was engaged to conduct an environmental noise and vibration assessment of the proposed Yanco Solar Farm located approximately two kilometres northwest of the town of Yanco in New South Wales, as part of the Environmental Impact Statement (EIS) for the Project. Noise and vibration impacts from the construction and operation phases of the Project have been addressed in this report in accordance with relevant Council and EPA requirements and guidelines.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

2 Project Description

2.1 Background Information

The Yanco Solar Farm project includes the construction and operation of a solar photovoltaic (PV) plant and associated infrastructure, with a capacity of approximately 72 MW. The subject site is located approximately two kilometres northwest of the town of Yanco in New South Wales, within the Leeton Shire Council Local Government Area (LGA). A 33kV powerline will connect the solar farm to the grid from the transfer station at the southeast corner of the solar plant to the Yanco Substation at 115 Houghton Road, Yanco. It should be noted that this solar farm will not have a large high voltage transformer as it will connect into the 33kV powerline.

2.2 Regulatory Requirements

Noise and vibration impacts are assessed in accordance with the applicable policies, guidelines and standards, including:

- NSW 'Interim Construction Noise Guideline' (ICNG – DECC 2009);
- NSW 'Noise Policy for Industry' (NPfI – EPA 2017);
- 'Assessing Vibration: A Technical Guideline' (DECC 2006); and
- NSW 'Road Noise Policy' (RNP – DECCW 2011).

2.3 Receiver Locations

The nearest affected receivers were identified through aerial maps as follows:

- **Receiver R01 – 649 Ronfeldt Road, Yanco**
  Residential property located approximately 300m southwest of the project area
- **Receiver R02 – 405 Research Road, Yanco**
  Residential property located approximately 110m southwest of the project area
- **Receiver R03 – 410 Yate Road, Leeton**
  Residential property located approximately 130m southwest of the project area
- **Receiver R04 – 328 Toorak Road, Leeton**
  Residential property located approximately 110m west of the project area
- **Receiver R05 – 284 Toorak Road, Leeton**
  Residential property located approximately 140m west of the project area
- **Receiver R06 – 22 McMaster Road, Leeton**
  Residential property located approximately 250m northwest of the project area

- **Receiver R07 – 191 Toorak Road, Leeton**
  Residential property located approximately 30m northwest of the project area
- **Receiver R08 – 165 Toorak Road, Leeton (West)**
  Residential property located approximately 250m north of the project area
- **Receiver R09 – 165 Toorak Road, Leeton (East)**
  Residential property located approximately 300m north of the project area
- **Receiver R10 – 32 Back Yanco Road, Leeton**
  Residential property located approximately 240m northeast of the project area
- **Receiver R11 – 30 Back Yanco Road, Leeton**
  Residential property located approximately 410m northeast of the project area
- **Receiver R12 – 50 Maxwell Road, Leeton (West)**
  Residential property located approximately 390m east of the project area
- **Receiver R13 – 50 Maxwell Road, Leeton (East)**
  Residential property located approximately 420m east of the project area
- **Receiver R14 – 55 Maxwell Road, Leeton**
  Residential property located approximately 420m east of the project area
- **Receiver R15 – 40 Gladman Road, Leeton**
  Residential property located approximately 480m east of the project area
- **Receiver R16 – 49 Gladman Road, Leeton**
  Residential property located approximately 560m east of the project area
- **Receiver R17 – 80 Dempsey Road, Leeton**
  Residential property located approximately 910m east of the project area
- **Receiver R18 – 186 Research Road, Leeton**
  Residential property located approximately 760m southeast of the project area
- **Receiver R19 – 215 Research Road, Yanco**
  Residential property located approximately 450m southeast of the project area
- **Receiver R20 – 235 Research Road, Yanco**
  Residential property located approximately 240m southeast of the project area
- **Receiver R21 – 13 Tecoma Street, Yanco**
  Residential property located approximately 130m northeast of the project area
- **Receiver R22 – 120 Houghton Road, Yanco**
  Residential property located approximately 1,030m southeast of the project area, and approximately 430m south of the powerline easement
- **Receiver R23 – 26 Euroley Road, Yanco**
  Residential property located approximately 1,600m southeast of the project area and approximately 550m southeast of the powerline easement

Figure 1 provides details of the site, surrounds and receiver locations.

2.4 Hours of Operation

2.4.1 Construction

It is proposed that construction of the Project will take approximately ten (10) months. Construction will occur during the following standard hours of construction:

- Monday to Friday: 7:00am to 6:00pm
- Saturday: 8:00am to 1:00pm
- No work on Sundays or public holidays

2.4.2 Operation

The solar farm will operate autonomously during times when there is sunlight. This will predominantly be during day and evening periods (7am-6pm and 6pm-10pm, respectively) throughout the year and potentially part of the night time period (prior to 7am) during the summer months.

Furthermore, there will be staff on site during the following standard hours:

- Monday to Friday: 7:00am to 6:00pm
- Saturday: 8:00am to 1:00pm

Figure 1 – Site, Surrounds and Receiver, and Noise Monitoring Locations

3 Existing Noise Environment

Background noise varies over the course of any 24 hour period, typically from a minimum at 3am in the morning to a maximum during morning and afternoon traffic peak hours. Therefore, the NSW 'Noise Policy for Industry' (NPfI – Environment Protection Authority NSW 2017) requires that the level of background and ambient noise be assessed separately for the daytime, evening and night-time periods. The NSW NPfI defines these periods as follows:

- **Day** is defined as 7:00am to 6:00pm, Monday to Saturday and 8:00am to 6:00pm Sundays & Public Holidays.
- **Evening** is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays.
- **Night** is defined as 10:00pm to 7:00am, Monday to Saturday and 10:00pm to 8:00am Sundays & Public Holidays.

3.1 Noise Monitoring Locations

Noise monitoring is to be undertaken where the background and ambient noise environment is representative of the most affected sensitive receivers surrounding the site. The closest identified sensitive receiver is Receiver R07. As such, the monitoring location was established on the property boundary of Receiver R07. Details of the noise monitoring location is described below.

- **Location L1 – 191 Toorak Road, Leeton (Coordinates: -34°34'9.85", 146°22'56.82")**
  The noise monitor was installed on the boundary of Receiver R07, in the 'free field' (ie. noise monitor positioned away from building facades, solid fences or barriers, and other reflecting surfaces). Noise data represents the background and ambient noise environment for residences surrounding the project area.

To quantify the existing ambient noise environment, long term (unattended) noise monitoring was conducted at Location L1 between Tuesday 2nd October and Wednesday 17th October 2018.

Appendix A of this report presents a description of noise terms. Appendix B details the noise monitoring methodology and the graphical recorded outputs from long term noise monitoring are included in Appendix C. The graphs in Appendix C were analysed to determine an assessment background level (ABL) for each day, evening and night period in each 24 hour period of noise monitoring and based on the median of individual ABLs an overall single Rating Background Level (RBL) for the day, evening and night period is determined over the entire monitoring period in accordance with the NSW NPfI.

3.2 Existing Background & Ambient Noise Levels

Existing background and ambient noise levels are presented in Table 3.1 below. The noise monitor was positioned outdoors in the 'free-field' (ie. away from building facades). Construction and operational

noise from the site should be assessed away from the facade at the potentially most affected residential boundaries and therefore, the representative noise levels listed in Table 3.1 are directly applicable.

Table 3.1 – Measured Existing Background (L_{90}) & Ambient (L_{eq}) Noise Levels, dB(A)

Location	L_{90} Background Noise Levels			L_{eq} Ambient Noise Levels		
	Day	Evening	Night	Day	Evening	Night
L1 (-34°34'9.85", 146°22'56.82")	33	35	31	50	50	45

The identified receivers surrounding the subject site are all classified as rural under NPfI guidelines. It was found that the background noise levels were close to levels typical for a rural area, with a day RBL less than 40dB(A), an evening RBL of 35 dB(A) and a night RBL of 30 dB(A).

Based on Table 2.1 of the NPfI, where background noise levels are less than the minimum assumed RBLs, the minimum assumed RBL's are adopted instead for all receiver locations nominated in Section 2.3. Furthermore, the NPfI recommends that the project intrusiveness level for evening be set at no greater than the project intrusiveness noise level for daytime. Therefore, the background noise levels have been set at the levels detailed in the fourth column of Table 3.2 below.

Table 3.2 – Rating Background Noise Level, dB(A)

Time of Day	Measured Existing Background (L_{90})	Minimum Assumed RBLs	Rating Background Level (used for assessment)
Day	33	35	**35**
Evening	35	30	**33**
Night	31	30	**31**

4 Construction Noise Assessment

4.1 Construction Noise Management Levels

The NSW 'Interim Construction Noise Guideline' (ICNG, 2009) provides guidelines for assessing noise generated during the construction phase of developments.

The key components of the guideline that are incorporated into this assessment include:

- *Use of L_{Aeq} as the descriptor for measuring and assessing construction noise*

  NSW noise policies, including the NPfI, RNP and RING have moved to the primary use of L_{Aeq} over any other descriptor. As an energy average, L_{Aeq} provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the L_{A10} descriptor.

- *Application of reasonable and feasible noise mitigation measures*

  As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice and is practical to build given the project constraints.

  Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects.

The ICNG provides two methods for assessment of construction noise, being either a quantitative or a qualitative assessment. A quantitative assessment is recommended for major construction projects of significant duration, and involves the measurement and prediction of noise levels, and assessment against set criteria. A qualitative assessment is recommended for small projects with duration of less than three weeks and focuses on minimising noise disturbance through the implementation of reasonable and feasible work practices, and community notification.

Given the length of the construction works proposed, a quantitative assessment is carried out herein, consistent with the ICNG requirements.

4.1.1 Residential Receivers

Table 4.1 reproduced from the ICNG, sets out the noise management levels and how they are to be applied for residential receivers.

Table 4.1 – Noise Management Levels at Residential Receivers

Time of Day	Management Level $L_{eq\ (15\ min)}$	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

Table 4.2 presents the construction noise management levels established for the nearest noise sensitive residential receivers based upon the noise monitoring results presented in Table 3.1, the proposed construction hours and the above ICNG requirements. The receiver locations are marked in Figure 1.

Table 4.2 – Construction Noise Management Levels at Residential Receivers, dB(A)

Location Description	Day L_{90} Background Noise Level (RBL)	Day Noise Management Level $L_{eq(15min)}$
All residential receivers (Receivers R01 to R23)	35[1]	45

Notes: 1. Construction works occur during the daytime period only; hence, only the day period assessed

4.2 Construction Noise Sources

Table 4.3 lists typical plant and equipment likely to be used by the contractor to carry out the necessary construction works within the development envelope depicted in Figure 1, while Table 4.4 details the equipment required to construct the powerline easement for the Project.

Table 4.3 – Typical Solar Farm Construction Plant & Equipment & Sound Power Levels, dB(A)

Plant Item	Plant Description	L_{Aeq} Sound Power Levels, dB(A) re. 1pW
1	Small Pile Driver	114
2	Fixed Crane	113
3	Front End Loader	113
4	Backhoe	111
5	Grader	110
6	Vibratory Roller	109
7	Concrete Truck	109
8	Delivery Truck	108
9	Water Cart	107
10	Concrete Pump	105
11	Power Generator	103
12	Concrete Vibrator	103
13	Light Vehicles (eg 4WD)	103

Table 4.4 – Easement Construction Plant & Equipment & Sound Power Levels, dB(A)

Plant Item	Plant Description	L_{Aeq} Sound Power Levels, dB(A) re. 1pW
1	Front End Loader	113
2	Grader	110
3	Vibratory Roller	109
4	Delivery Truck	108
5	Water Cart	107
6	Light Vehicles (eg 4WD)	103

The sound power levels for the majority of activities presented in the above table are provided by the client, based on maximum levels given in Table A1 of Australian Standard 2436 - 2010 'Guide to Noise Control on Construction, Demolition and Maintenance Sites', the ICNG, information from past projects and/or information held in our library files.

4.3 Construction Noise Assessment

Noise emissions were predicted by modelling the noise sources, receiver locations, topographical features of the intervening area, and possible noise control treatments using CadnaA (version 2018) noise modelling computer program. The program calculates the contribution of each noise source at each specified receptor point and allows for the prediction of the total noise from a site.

The noise prediction models takes into account:

- Location of noise sources and receiver locations;
- Height of sources and receivers;

- Separation distances between sources and receivers;
- Ground type between sources and receivers (soft); and
- Attenuation from barriers (natural and purpose built).

Noise levels at any receptors resulting from construction would depend on the above and the type and duration of construction being undertaken. Furthermore, noise levels at receivers would vary substantially over the total construction program due to the transient nature and large range of plant and equipment that could be used.

Table 4.5 presents construction noise levels likely to be experienced at the nearby affected receivers based on the construction activities and plant equipment associated with the works conducted within the development envelope. Table 4.6 refers to the noise levels likely to be experienced at the nearby affected receivers due to the construction of the easement. The noise level ranges represent the noise source being located at the furthest to the closest proximity to each receiver location.

Table 4.5 – Predicted $L_{Aeq,15min}$ Solar Farm Construction Noise Levels at Receiver Locations, dB(A)

Plant Item	Plant Description	Predicted $L_{eq(15min)}$ Construction Noise Levels																						
		R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	R22	R23
Noise Management Level[1]		*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*
1	Small pile driver	<20-44	20-**51**	20-**49**	24-**54**	21-**51**	<20-**46**	<20-**51**	<20-42	<20-42	<20-**47**	<20-41	24-42	24-41	24-41	25-40	24-38	22-33	21-35	21-40	21-**47**	<20-**51**	<20-32	<20-26
2	Fixed Crane	<20-43	<20-**50**	<20-**48**	23-**53**	20-**50**	<20-45	<20-**50**	<20-41	<20-41	<20-**46**	<20-40	23-41	23-40	23-40	24-39	23-37	21-32	<20-34	<20-39	<20-**46**	<20-**50**	<20-31	<20-25
3	Front End Loader	<20-43	<20-**50**	<20-**48**	23-**53**	20-**50**	<20-45	<20-**50**	<20-41	<20-41	<20-**46**	<20-40	23-41	23-40	23-40	24-39	23-37	21-32	<20-34	<20-39	<20-**46**	<20-**50**	<20-31	<20-25
4	Backhoe	<20-41	<20-**48**	<20-**46**	21-**51**	<20-**48**	<20-43	<20-**48**	<20-39	<20-39	<20-44	<20-38	21-39	21-38	21-38	22-37	21-35	<20-30	<20-32	<20-37	<20-44	<20-**48**	<20-29	<20-23
5	Grader	<20-40	<20-**47**	<20-45	<20-**50**	<20-**47**	<20-42	<20-**47**	<20-38	<20-38	<20-43	<20-37	<20-38	<20-37	<20-37	21-36	20-34	<20-29	<20-31	<20-36	<20-43	<20-**47**	<20-28	<20-22
6	Vibratory Roller	<20-39	<20-**46**	<20-44	<20-**49**	<20-**46**	<20-41	<20-**46**	<20-37	<20-37	<20-42	<20-36	<20-37	<20-36	<20-36	<20-35	<20-33	<20-28	<20-30	<20-35	<20-42	<20-**46**	<20-27	<20-21
7	Concrete Truck	<20-39	<20-**46**	<20-44	<20-**49**	<20-**46**	<20-41	<20-**46**	<20-37	<20-37	<20-42	<20-36	<20-37	<20-36	<20-36	<20-35	<20-33	<20-28	<20-30	<20-35	<20-42	<20-**46**	<20-27	<20-21
8	Delivery Truck	<20-38	<20-45	<20-43	<20-**48**	<20-45	<20-40	<20-45	<20-36	<20-36	<20-41	<20-35	<20-36	<20-35	<20-35	<20-34	<20-32	<20-27	<20-29	<20-34	<20-41	<20-45	<20-26	<20-20
9	Water Cart	<20-37	<20-44	<20-42	<20-**47**	<20-44	<20-39	<20-44	<20-35	<20-35	<20-40	<20-34	<20-35	<20-34	<20-34	<20-33	<20-31	<20-26	<20-28	<20-33	<20-40	<20-44	<20-25	<20
10	Concrete Pump	<20-35	<20-42	<20-40	<20-45	<20-42	<20-37	<20-42	<20-33	<20-33	<20-38	<20-32	<20-33	<20-32	<20-32	<20-31	<20-29	<20-24	<20-26	<20-31	<20-38	<20-42	<20-23	<20
11	Power Generator	<20-33	<20-40	<20-38	<20-43	<20-40	<20-35	<20-40	<20-31	<20-31	<20-36	<20-30	<20-31	<20-30	<20-30	<20-29	<20-27	<20-22	<20-24	<20-29	<20-36	<20-40	<20-21	<20
12	Concrete Vibrator	<20-33	<20-40	<20-38	<20-43	<20-40	<20-35	<20-40	<20-31	<20-31	<20-36	<20-30	<20-31	<20-30	<20-30	<20-29	<20-27	<20-22	<20-24	<20-29	<20-36	<20-40	<20-21	<20
13	Light vehicles (eg 4WD)	<20-33	<20-40	<20-38	<20-43	<20-40	<20-35	<20-40	<20-31	<20-31	<20-36	<20-30	<20-31	<20-30	<20-30	<20-29	<20-27	<20-22	<20-24	<20-29	<20-36	<20-40	<20-21	<20
Up to 3 (noisiest) plant operating concurrently		23-**48**	24-**55**	24-**53**	28-**59**	25-**56**	21-**50**	20-**55**	<20-**46**	<20-**46**	22-**51**	22-45	28-**46**	28-45	28-45	29-44	28-42	26-37	25-39	25-44	25-**51**	21-**55**	<20-36	<20-30

Notes: 1. Noise Management Levels for day period (ie. standard construction hours)

2. **Bold** font represents exceedance of the relevant NML

Table 4.6 – Predicted $L_{Aeq,15min}$ Easement Construction Noise Levels at Receiver Locations, dB(A)

Plant Item	Plant Description	Predicted $L_{eq(15min)}$ Construction Noise Levels																						
		R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	R22	R23
Noise Management Level[1]		*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*
1	Front End Loader	21-30	<20-25	<20-24	<20-24	<20-21	<20	<20	<20	<20	<20	<20	<20-23	<20-23	<20-23	22-27	23-27	23-26	26-30	27-34	27-37	<20	30-40	24-37
2	Grader	<20-27	<20-22	<20-21	<20-21	<20	<20	<20	<20	<20	<20	<20	<20-20	<20	<20-20	<20-24	<20-24	20-23	23-27	24-31	24-34	<20	27-37	21-34
3	Vibratory Roller	<20-26	<20-21	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20-23	<20-23	<20-22	22-26	23-30	23-33	<20	26-36	20-33
4	Delivery Truck	<20-25	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20-22	<20-22	<20-21	21-25	22-29	22-32	<20	25-35	<20-32
5	Water Cart	<20-24	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20-21	<20-21	<20-20	20-24	21-28	21-31	<20	24-34	<20-31
6	Light vehicles (eg 4WD)	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20-20	<20-24	<20-27	<20	<20-30	<20-27
Up to 3 (noisiest) plant operating concurrently		23-33	<20-28	<20-26	<20-26	<20-23	<20	<20	<20	<20	<20-20	<20	21-26	21-26	22-26	25-30	25-30	26-29	29-33	30-37	29-39	<20	32-42	27-40

Notes: 1. Noise Management Levels for day period (ie. standard construction hours)

Based on the construction noise levels presented in Table 4.5 for the construction of the solar farm, the noise management levels at Receivers R01 to R10, R12 and R20 to R21 may be exceeded when construction works are conducted within close proximity to the receivers (ie. at a location within the site where construction works are closest to the corresponding receiver). For the construction of the easement, Table 4.6 indicates that construction noise levels will comply with the noise management levels at all the identified receivers. It is noted that construction noise levels at all receivers are predicted to be less than the highly noise affected level of 75dB(A) for all construction stages of the solar farm project.

In light of the predicted noise levels above, it is recommended that a feasible and reasonable approach towards noise management measures be applied to reduce noise levels as much as possible to manage the impact from construction noise. Any impacts due to construction works are temporary in nature and would not represent a permanent impact on the community and surrounding environment. The predicted noise levels are generally conservative and would only be experienced for limited periods during construction.

Impacts may be reduced through the introduction of construction noise mitigation and management measures as provided in Section 4.4 below.

4.4 Construction Noise Mitigation and Management Measures

The following recommendations provide in-principle feasible and reasonable noise control solutions to reduce noise impacts to sensitive receivers. Where actual construction activities differ from those assessed in this report, more detailed design of noise control measures may be required once specific items of plant and construction methods have been chosen and assessed on site.

The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

4.4.1 General Engineering Noise Controls

Implementation of noise control measures, such as those suggested in Australian Standard 2436-2010 "Guide to Noise Control on Construction, Demolition and Maintenance Sites", are expected to reduce predicted construction noise levels. Reference to Australian Standard 2436-2010, Appendix C, Table C1 suggests possible remedies and alternatives to reduce noise emission levels from typical construction equipment. Table C2 in Appendix C of AS2436 presents typical examples of noise reductions achievable after treatment of various noise sources. Table C3 in Appendix C of AS2436 presents the relative effectiveness of various forms of noise control treatment.

Table 4.7 below presents noise control methods, practical examples and expected noise reductions according to AS2436 and according to Renzo Tonin & Associates' opinion based on experience with past projects.

Table 4.7 – Relative Effectiveness of Various Forms of Noise Control, dB(A)

Noise Control Method	Practical Examples	Typical Noise Reduction Possible in Practice		Maximum Noise Reduction Possible in Practice	
		AS 2436	Renzo Tonin & Associates	AS 2436	Renzo Tonin & Associates
Distance	Doubling of distance between source and receiver	6	6	6	6
Screening	Acoustic barriers such as earth mounds, temporary or permanent noise barriers	5 to 10	5 to 10	15	15
Acoustic Enclosures	Engine casing lagged with acoustic insulation and plywood	15 to 25	10 to 20	50	30
Engine Silencing	Residential class mufflers	5 to 10	5 to 10	20	20
Substitution by alternative process	Use electric motors in preference to diesel or petrol	-	15 to 25	-	40

The Renzo Tonin & Associates' listed noise reductions are conservatively low and should be referred to in preference to those of AS2436.

An indicative list of the approximate minimum required distance from each construction equipment / plant to a receiver such that noise levels at the receivers comply with the Noise Management Level (NML) is provided in Table 4.8 below. It should be noted that the distances detailed below are approximate and noise monitoring may be required to confirm noise levels at the receivers.

Table 4.8 – Minimum Required Construction Plant Distance to Receiver for Noise Compliance

Plant Item	Plant Description	Minimum Required Distance for Compliance with NML (m)
1	Small Pile Driver	305
2	Fixed Crane	275
3	Front End Loader	275
4	Backhoe	220
5	Grader	195
6	Vibratory Roller	175
7	Concrete Truck	175
8	Delivery Truck	155
9	Water Cart	140
10	Concrete Pump	100
11	Power Generator	80
12	Concrete Vibrator	80
13	Light Vehicles (eg 4WD)	80

Notes: 1. Minimum construction plant distances to receivers are indicative and approximate only. Noise monitoring required to confirm noise levels at receivers.

Table 4.9 below identifies possible noise control measures, which are applicable on the construction plant likely to be used on site.

Table 4.9 – Noise Control Measures for Likely Construction Plant

Plant Description	Screening	Acoustic Enclosures	Silencing	Alternative Process
Small pile driver	✔	✖	✔	✔
Fixed Crane	✔	✔	✔	✖
Front End Loader	✔	✖	✔	✖
Backhoe	✔	✖	✔	✖
Grader	✔	✖	✔	✖
Vibratory Roller	✔	✖	✔	✖
Concrete Truck	✔	✖	✔	✖
Delivery Truck	✔	✖	✔	✖
Water Cart	✔	✖	✔	✖
Concrete Pump	✔	✔	✔	✔
Power Generator	✔	✔	✔	✖
Concrete Vibrator	✔	✖	✖	✖
Light vehicles (eg 4WD)	✔	✖	✖	✖

4.4.2 Noise Management Measures

In addition to physical noise controls, the following general noise management measures should be followed.

- Use less noisy plant and equipment, where feasible and reasonable.
- Plant and equipment should be properly maintained.
- Provide special attention to the use and maintenance of 'noise control' or 'silencing' kits fitted to machines to ensure they perform as intended.
- Strategically position plant on site to reduce the emission of noise to the surrounding neighbourhood and to site personnel.
- Avoid any unnecessary noise when carrying out manual operations and when operating plant.
- Any equipment not in use for extended periods during construction work should be switched off.
- In addition to the noise mitigation measures outlined above, a management procedure would need to be put in place to deal with noise complaints that may arise from construction activities. Each complaint would need to be investigated and appropriate noise amelioration

measures put in place to mitigate future occurrences, where the noise in question is in excess of allowable limits.

- Good relations with people living and working in the vicinity of a construction site should be established at the beginning of a project and be maintained throughout the project, as this is of paramount importance. Keeping people informed of progress and taking complaints seriously and dealing with them expeditiously is critical. The person selected to liaise with the community should be adequately trained and experienced in such matters.

Where noise level exceedances cannot be avoided, then consideration may be given to implementing time restrictions and/or providing periods of repose for residents, where feasible and reasonable. That is, daily periods of respite from noisy activities may also be scheduled for building occupants during construction hours.

Some items of plant may exceed noise limits even after noise treatment is applied. To reduce the overall noise impact, the use of noisy plant may be restricted to within certain time periods, where feasible and reasonable and to be negotiated with Council and the residents. Allowing the construction activities to proceed, despite the noise exceedance may be the preferred method in order to complete the works expeditiously.

5 Operational Noise Assessment

5.1 Operational Noise Criteria

Noise impact from the general operation of the proposed solar farm is assessed against the NSW 'Noise Policy for Industry' (NPfI, 2017). The assessment procedure in terms of the NPfI has two components:

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

In accordance with the NPfI, noise impact should be assessed against the project noise trigger level which is the lower value of the project intrusiveness noise levels and project amenity noise levels.

5.1.1 Intrusive Noise Impacts

According to the NPfI, the intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the $L_{Aeq,15min}$ descriptor) does not exceed the background noise level measured in the absence of the source by more than 5dB(A). The project intrusiveness noise level, which is only applicable to residential receivers, is determined as follows:

$L_{Aeq,15minute}$ Intrusiveness noise level = Rating Background Level (RBL) plus 5dB(A)

Based on the RBLs set in Table 3.2, the intrusiveness noise levels for the residential receivers are determined in Table 5.1.

Table 5.1 – NPfI Intrusive Noise Levels at Residential Receivers, dB(A)

Period	Rating Background Level	Intrusiveness Noise Level, $L_{Aeq,15min}$
Daytime	35	35+5 = **40**
Evening	33	33+5 = **38**
Night-time	31	31+5 = **36**

5.1.2 Protecting Noise Amenity

The project amenity noise levels for different time periods of a day are determined in accordance with Section 2.4 of the NSW NPfI. The NPfI recommends amenity noise levels ($L_{Aeq, period}$) for various receivers including residential, commercial, industrial receivers and sensitive receivers such as schools, hotels, hospitals, churches and parks. These "recommended amenity noise levels" represent the objective for **total** industrial noise experienced at a receiver location. However, when assessing a **single** industrial development and its impact on an area, "project amenity noise levels" apply.

To ensure that the total industrial noise level (existing plus new) remain within the recommended amenity noise levels for an area, the project amenity noise level that applies for each new industrial noise source is determined as follows:

$$L_{Aeq,period}\ \textbf{Project amenity noise level} = L_{Aeq,period}\ \textbf{Recommended amenity noise level} - \textbf{5dB(A)}$$

Furthermore, given that the intrusiveness noise level is based on a 15 minute assessment period and the project amenity noise level is based on day, evening and night assessment periods, the NPfI provides the following guidance on adjusting the $L_{Aeq,period}$ level to a representative $L_{Aeq,15min}$ level in order to standardise the time periods.

$$L_{Aeq,15min} = L_{Aeq,period} + 3\text{dB(A)}$$

The policy, in accordance with the NPfI, applies an adjustment of (+3 dB) to the recommended noise levels ($L_{Aeq,\ period}$) in order to standardise the time periods for the intrusiveness and amenity noise levels. The project amenity noise levels ($L_{Aeq,\ 15min}$) applied for this project are reproduced in Table 5.2.

It is noted that the residential receivers in the vicinity of the site have been categorised as being in a 'rural' area in accordance with Table 2.3 of the NPfI.

Table 5.2 – NPfI Project Amenity Noise Levels, dB(A)

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended Noise Level	
			$L_{Aeq,\ Period}$	$L_{Aeq,\ 15min}$
Residence	Rural	Day	50 – 5 = 45	45 + 3 = **48**
		Evening	45 – 5 = 40	40 + 3 = **43**
		Night	40 – 5 = 35	35 + 3 = **38**

Notes: 1. Monday to Saturday – Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am
2. On Sundays and Public Holidays, Daytime 8.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 8.00 am

5.2 Summary of Project Noise Trigger Levels

In accordance with the NPfI the project noise trigger level, which is the lower (ie. more stringent) value of the project intrusiveness noise level and project amenity noise level, has been determined and reproduced in Table 5.3 below.

Table 5.3 – Project Noise Trigger Levels, dB(A)

Receiver Location	$L_{Aeq,\ 15min}$ Project Noise Trigger Levels		
	Day	Evening	Night
Receiver R01 - 649 Ronfeldt Road, Yanco	40	38	36
Receiver R02 - 405 Research Road, Yanco	40	38	36
Receiver R03 - 410 Yate Road, Leeton	40	38	36
Receiver R04 - 328 Toorak Road, Leeton	40	38	36

Receiver Location	$L_{Aeq, 15min}$ Project Noise Trigger Levels		
	Day	Evening	Night
Receiver R05 - 284 Toorak Road, Leeton	40	38	36
Receiver R06 - 22 McMaster Road, Leeton	40	38	36
Receiver R07 - 191 Toorak Road, Leeton	40	38	36
Receiver R08 - 165 Toorak Road, Leeton (West)	40	38	36
Receiver R09 - 165 Toorak Road, Leeton (East)	40	38	36
Receiver R10 - 32 Back Yanco Road, Leeton	40	38	36
Receiver R11 - 30 Back Yanco Road, Leeton	40	38	36
Receiver R12 - 50 Maxwell Road, Leeton (West)	40	38	36
Receiver R13 - 50 Maxwell Road, Leeton (East)	40	38	36
Receiver R14 - 55 Maxwell Road, Leeton	40	38	36
Receiver R15 - 40 Gladman Road, Leeton	40	38	36
Receiver R16 - 49 Gladman Road, Leeton	40	38	36
Receiver R17 - 80 Dempsey Road, Leeton	40	38	36
Receiver R18 - 186 Research Road, Leeton	40	38	36
Receiver R19 - 215 Research Road, Yanco	40	38	36
Receiver R20 - 235 Research Road, Yanco	40	38	36
Receiver R21 - 13 Tecoma Street, Leeton	40	38	36
Receiver R22 - 120 Houghton Road, Yanco	40	38	36
Receiver R23 - 26 Euroley Road, Yanco	40	38	36

Notes: 1. Monday to Saturday – Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am
2. On Sundays and Public Holidays, Daytime 8.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 8.00 am

5.3 Operational Noise Sources

The proposed solar farm will operate solar panels installed on single-axis trackers that are driven by motors that track the arc of the sun to maximise the solar effect. Hence, the tracking motors are a potential source of mechanical noise and therefore, has been included for a more conservative assessment. Up to a total of 4,300 tracking motors (NexTracker or equivalent) will be employed to drive the solar panels and are to be evenly distributed across the PV footprint area depicted in Figure 1. The tracking motors would turn no more than five (5) degrees every 15 minutes and would operate no more than one (1) minute out of every 15 minute period.

In addition to the trackers, the site will require the operation of up to 20 containerised inverter / transformer units (SMA MV PS 5500SC or equivalent) and 20 containerised Energy Storage Systems (ESS) with associated converters which are distributed across the PV footprint. The ESS will also utilise air conditioning units to maintain stable temperatures for the batteries, which have also been identified as a potential noise source. Furthermore, the solar farm will also incorporate a synchronous condenser at the south-eastern corner of the site.

During operations, it is assumed that three (3) staff members will attend site daily during the day time period to inspect the equipment and will travel around the site using light vehicles.

Based on the above, the following table lists associated plant and equipment likely to be used for the operation of the proposed solar farm and their corresponding sound power levels.

Table 5.4 – Typical Operational Plant and Equipment & Sound Power Levels

Plant Item	Plant Description	L_{Aeq} Sound Power Levels, dB(A) re. 1pW
1	Tracker Motor (up to 4,300 in total; model NexTracker or equivalent)	50 (each)
2	Inverter / Transformer[1] (20 in total; model SMA MVPS 5500SC)	88 (each)
3	Energy Storage Facility Converter (20 in total; model Freemaq DC/DC TD0500)	74 (each)
4	Energy Storage Facility Air Conditioning Units (20 in total)	75 (each)
5	Synchronous Condenser (1 in total)	93 (each)
6	Light vehicle (3 in total)	103 (each)

Notes: 1. Sound power level based on similar solar plant inverters (Ingeteam 1640TL B630 Inverter)

The sound power levels for the plant and equipment presented in the above table are provided by the client, manufacturer, information from past projects and/or information held in our library files.

5.4 'Modifying Factor' Adjustments

Further to the above and in accordance with the NPfI, where the character of the noise in question is assessed as particularly annoying (ie. if it has an inherently tonal, low frequency, impulsive or intermittent characteristic), then an adjustment of 5dB(A) for each annoyance aspect, up to a total of 10dB(A), is to be added to the predicted value to penalise the noise for its potential increase in annoyance.

Table C1 in Fact Sheet C of the NSW NPfI provides definitive procedures for determining whether a penalty or adjustment should be applied from increased annoyance. For the assessment of the solar farm, the noise from the condenser, inverters and transformers (storage and substation) are considered to be tonal in nature. Therefore, a 5dB(A) penalty has been applied individually to the predicted noise contributions from the condenser, inverters and transformers.

5.5 Operational Noise Assessment

Noise emissions were predicted by modelling the noise sources, receiver locations, topographical features of the intervening area, and possible noise control treatments using CadnaA (version 2018) noise modelling computer program. The program calculates the contribution of each noise source at each specified receptor point and allows for the prediction of the total noise from a site.

The noise prediction models takes into account:

- Location of noise sources and receiver locations;
- Height of sources and receivers;
- Separation distances between sources and receivers;
- Ground type between sources and receivers (soft); and
- Attenuation from barriers (natural and purpose built).

Furthermore, in accordance with the NPfI noise predictions were prepared for each of the following meteorological conditions:

1. **Calm & isothermal conditions (acoustically neutral)** – no wind and no temperature inversion
2. **Slight to gentle breeze** – 3m/s wind velocity at 10m from ground level between each noise source and each noise receiver (as per NPfI default wind conditions). Wind direction was based on wind travelling from the source to the receiver.
3. **Moderate temperature inversion** – applicable for noise predictions during night time periods only

Table 5.5 below present the predicted noise levels for the worst case scenario based on concurrent operation of all the plant and equipment shown in Table 5.4. The tracker motors were time corrected based on their operation of one (1) minute out of a 15 minute period.

Table 5.5 – Predicted $L_{Aeq,15min}$ Operational Noise Levels at Residential Receiver Locations, dB(A)

Receiver Location	Project Noise Trigger Levels			Predicted Operational Noise Levels, $L_{Aeq, 15min}$			Comply? (Yes/No)
	Day	Evening	Night	Calm & Isothermal Conditions	Slight to Gentle Breeze	Moderate Temperature Inversion[1]	
Receiver R1	*40*	*38*	*36*	26	31	31	Yes
Receiver R2	*40*	*38*	*36*	27	31	31	Yes
Receiver R3	*40*	*38*	*36*	26	30	30	Yes
Receiver R4	*40*	*38*	*36*	31	34	34	Yes
Receiver R5	*40*	*38*	*36*	29	33	33	Yes
Receiver R6	*40*	*38*	*36*	25	29	29	Yes
Receiver R7	*40*	*38*	*36*	25	29	29	Yes
Receiver R8	*40*	*38*	*36*	23	27	27	Yes
Receiver R9	*40*	*38*	*36*	22	27	27	Yes
Receiver R10	*40*	*38*	*36*	25	30	30	Yes
Receiver R11	*40*	*38*	*36*	23	28	28	Yes
Receiver R12	*40*	*38*	*36*	26	31	31	Yes
Receiver R13	*40*	*38*	*36*	26	31	31	Yes
Receiver R14	*40*	*38*	*36*	26	31	31	Yes
Receiver R15	*40*	*38*	*36*	25	30	30	Yes

Receiver Location	Project Noise Trigger Levels			Predicted Operational Noise Levels, $L_{Aeq, 15min}$			Comply? (Yes/No)
	Day	Evening	Night	Calm & Isothermal Conditions	Slight to Gentle Breeze	Moderate Temperature Inversion[1]	
Receiver R16	*40*	*38*	*36*	25	30	30	Yes
Receiver R17	*40*	*38*	*36*	22	27	27	Yes
Receiver R18	*40*	*38*	*36*	24	29	29	Yes
Receiver R19	*40*	*38*	*36*	27	32	32	Yes
Receiver R20	*40*	*38*	*36*	30	34	34	Yes
Receiver R21	*40*	*38*	*36*	25	29	29	Yes
Receiver R22	*40*	*38*	*36*	20	26	26	Yes
Receiver R23	*40*	*38*	*36*	<20	22	22	Yes

Notes: 1. Applicable for the night time period only

Based on the predicted operational noise levels presented in the table above, predicted noise levels at the nearest receivers comply with the nominated criteria under all meteorological conditions.

Therefore, no further reasonable and feasible noise mitigation measures are required to reduce operational noise impacts.

5.6 Sleep Disturbance Assessment

To assess the likelihood of sleep disturbance, the potential of maximum noise level events from operation of the solar farm during the night time period has been considered in this assessment. In accordance with the NPfI, a detailed maximum noise level event assessment should be undertaken where the subject development night time noise levels at a residential location exceed:

- $L_{Aeq,15min}$ 40dB(A) or the prevailing RBL plus 5dB, whichever is the greater, and/or
- L_{AFmax} 52dB(A) or the prevailing RBL plus 15dB, whichever is the greater.

Where there are noise events found to exceed the initial screening level, further analysis is undertaken to identify:

- The likely number of events that might occur during the night assessment period,
- The extent to which the maximum noise level exceeds the rating background noise level.

During the night time period (before 7am during summer months) only mechanical plant will be operating, including the tracking motors, inverters, air conditioning units for the EES and transformers. Noise emissions from these plant items are considered to be continuous with no potential for high peak noise level events. Therefore, the L_{Amax} noise levels experienced at the identified receivers will be similar to the predicted $L_{Aeq,15min}$ noise levels shown in Table 5.5. Hence, it is expected that both the $L_{Aeq,15min}$ and L_{AFmax} will be well below the nominated sleep disturbance criteria of 40dB(A) and 52dB(A), respectively.

6 Vibration Assessment

Vibration generating activities would occur only during the construction phase of the project. There are no vibration generating activities expected during the operational phase. As the nearest identified receivers unrelated to the project are in excess of 30m from the proposed construction activities, structural damage due to vibration is not expected. Assessment for vibration impact on human comfort is assessed in accordance with EPA requirements.

6.1 Vibration Criteria

Assessment of potential disturbance from vibration on human occupants of buildings is made in accordance with the EPA's *'Assessing Vibration; a technical guideline'* (DECC, 2006). The guideline provides criteria which are based on British Standard BS 6472-1992 *'Evaluation of human exposure to vibration in buildings (1-80Hz)'*. Sources of vibration are defined as either 'Continuous', 'Impulsive' or 'Intermittent'. Table 6.1 provides definitions and examples of each type of vibration.

Table 6.1 – Types of Vibration

Type of Vibration	Definition	Examples
Continuous vibration	Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time)	Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).
Impulsive vibration	A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.
Intermittent vibration	Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer, this would be assessed against impulsive vibration criteria.

Source: Assessing Vibration; a technical guideline, Department of Environment & Climate Change, 2006

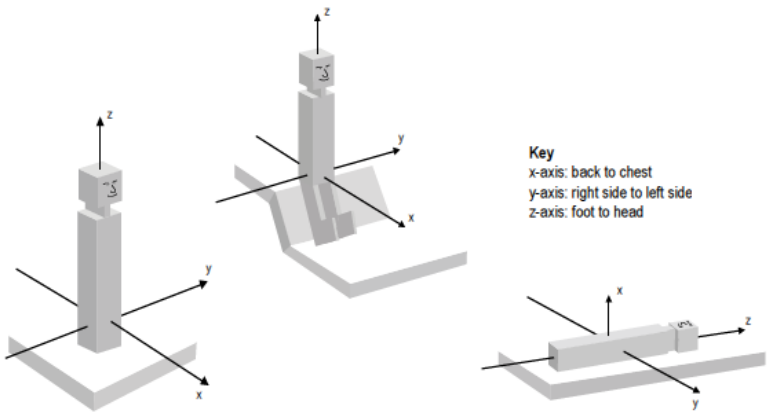
The vibration criteria are defined as a single weighted root mean square (rms) acceleration source level in each orthogonal axis. Section 2.3 of the guideline states:

> *"Evidence from research suggests that there are summation effects for vibrations at different frequencies. Therefore, for evaluation of vibration in relation to annoyance and comfort, overall weighted rms acceleration values of the vibration in each orthogonal axis are preferred (BS 6472)."*

When applying the criteria, it is important to note that the three directional axes are referenced to the human body, i.e. x-axis (back to chest), y-axis (right side to left side) or z-axis (foot to head). Vibration may enter the body along different orthogonal axes and affect it in different ways. Therefore,

application of the criteria requires consideration of the position of the people being assessed, as illustrated in Figure 2. For example, vibration measured in the horizontal plane is compared with x- and y-axis criteria if the concern is for people in an upright position, or with the y- and z- axis criteria if the concern is for people in the lateral position.

Figure 2 – Orthogonal Axes for Human Exposure to Vibration



The preferred and maximum values for continuous and impulsive vibration are defined in Table 2.2 of the guideline and are reproduced in Table 6.2 for the applicable receiver type.

Table 6.2 – Preferred and Maximum Levels for Human Comfort

Location	Assessment Period[1]	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration (weighted RMS acceleration, m/s^2, 1-80Hz)					
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Impulsive vibration (weighted RMS acceleration, m/s^2, 1-80Hz)					
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14

Notes: 1. Daytime is 7:00am to 10:00pm and Night-time is 10:00pm to 7:00am

The acceptable vibration dose values (VDV) for intermittent vibration are defined in Table 2.4 of the guideline and are reproduced in Table 6.3 for the applicable receiver type.

Table 6.3 – Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Daytime[1]		Night-time[1]	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Residences	0.20	0.40	0.13	0.26

Notes: 1. Daytime is 7:00am to 10:00pm and Night-time is 10:00pm to 7:00am

6.2 Potential Vibration Impacts

Based on the proposed plant items presented in Table 4.3 and Table 4.4, vibration generated by construction plant was estimated and potential vibration impacts are summarised in Table 6.4 below. The assessment is relevant to the identified receiver locations.

Table 6.4 – Potential Vibration Impacts for Identified Receivers

Receiver Location	Approx. Distance to Nearest Buildings from Works	Type of Nearest Sensitive Buildings	Assessment on Potential Vibration Impacts	Vibration Monitoring
Receiver R1	300m	Residential	Very low risk of adverse comments	Not required
Receiver R2	110m	Residential	Very Low risk of adverse comments	Not required
Receiver R3	130m	Residential	Very low risk of adverse comments	Not required
Receiver R4	110m	Residential	Very low risk of adverse comments	Not required
Receiver R5	140m	Residential	Very low risk of adverse comments	Not required
Receiver R6	250m	Residential	Very low risk of adverse comments	Not required
Receiver R7	150m	Residential	Very low risk of adverse comments	Not required
Receiver R8	250m	Residential	Very low risk of adverse comments	Not required
Receiver R9	300m	Residential	Very low risk of adverse comments	Not required
Receiver R10	240m	Residential	Very low risk of adverse comments	Not required
Receiver R11	410m	Residential	Very Low risk of adverse comments	Not required
Receiver R12	390m	Residential	Very low risk of adverse comments	Not required
Receiver R13	420m	Residential	Very low risk of adverse comments	Not required
Receiver R14	420m	Residential	Very low risk of adverse comments	Not required
Receiver R15	480m	Residential	Very low risk of adverse comments	Not required
Receiver R16	560m	Residential	Very low risk of adverse comments	Not required
Receiver R17	910m	Residential	Very low risk of adverse comments	Not required
Receiver R18	760m	Residential	Very low risk of adverse comments	Not required
Receiver R19	450m	Residential	Very low risk of adverse comments	Not required

Receiver Location	Approx. Distance to Nearest Buildings from Works	Type of Nearest Sensitive Buildings	Assessment on Potential Vibration Impacts	Vibration Monitoring
Receiver R20	240m	Residential	Very low risk of adverse comments	Not required
Receiver R21	130m	Residential	Very low risk of adverse comments	Not required
Receiver R22	430m[1]	Residential	Very low risk of adverse comments	Not required
Receiver R23	550m[1]	Residential	Very low risk of adverse comments	Not required

Notes: 1. Distance to easement construction works

The potential for adverse comments to vibration impacts during the construction works was determined to be very low to low due to the large distances between the receiver locations and the construction activities. Furthermore, it was noted that at the closest receiver, Receiver R7, the approximate distance to the nearest building has been conservatively determined from the boundary of the solar farm and it is expected that any works are expected to be undertaken at larger distances based on the PV footprint. Therefore, additional vibration mitigation measures and vibration monitoring are not required at the identified receiver locations during construction works associated with the Project.

7 Road Traffic Noise Assessment

Noise impact from the potential increase in traffic on the surrounding road network due to construction and operational activities is assessed against the NSW 'Road Noise Policy' (RNP). The RNP sets out criteria to be applied to particular types of road and land uses. These noise criteria are to be applied when assessing noise impact and determining mitigation measures for sensitive receivers that are potentially affected by road traffic noise associated with the construction and operation of the subject site, with the aim of preserving the amenity appropriate to the land use.

Vehicle access to the subject site will be via three access points on Toorak Road and one access point on Research Road. Vehicles will access Toorak Road from the north via Canal Street (see Figure 3). Based on the traffic numbers provided by the client, the peak vehicle movements during the construction stage of the project are presented in the following table. Furthermore, vehicle movements will only occur during the day time period when construction works occur.

Table 7.1 – Summary of the Estimated Construction Traffic Volumes During Peak Construction

Vehicle Type	Movements Per Day (Peak)	Average Hourly Movements[1]
Cars/ light vehicles	20 (10 in / 10 out)	2
Trucks/ heavy vehicles	72 (36 in / 36 out)	7

Notes: 1. Average hourly movements based on movements per day / 11 (representing construction hours from 7am to 6pm)

During the operational stage, vehicle access to the site will be maintenance vans and delivery trucks (3 x site staff light vehicle and 5 x miscellaneous courier deliveries per week) which would occur on an irregular basis. Therefore, traffic noise impacts during the operational stage of the project would be minimal and insignificant and will not be assessed further.

Figure 3 – Site, Surrounding Roads and Site Access Points

7.1 Road Traffic Noise Criteria

Based on functionality, Toorak Road and Research Road are categorised as a local roads. For existing residences affected by additional traffic on existing local roads generated by land use developments, the following RNP road traffic noise criteria apply.

Table 7.2 – RNP Road Traffic Noise Criteria, dB(A)

Road Category	Type of Project/Land Use	Assessment Criteria	
		Day 7am – 10pm	Night 10pm – 7am
Local road	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq,(1\ hour)}$ 55 (external)	$L_{Aeq,(1\ hour)}$ 50 (external)

7.2 Predicted Road Traffic Noise

Results of the road traffic noise predictions are presented in the table below. It is noted that the predicted noise levels represent the traffic noise contribution from the vehicle movements associated with the construction works and does not take into account existing traffic noise levels as existing traffic volumes along Toorak Road and Research Road are unknown.

Table 7.3 – Predicted Road Traffic Noise Contribution Levels Along Public Roads, dB(A) $L_{Aeq(1\ Hour)}$

Receiver	Criteria	Traffic Movements	Speed (km/h)	Approx. Distance to Road	Predicted Noise Level	Comply?
Nearest receivers	$L_{Aeq,\ (1\ hour)}$ 55	As per Table 7.1	60	13m[1]	54	Yes

Notes: 1. Assumed distance to closest receiver to Toorak Road.

From the above table, traffic noise levels from the additional traffic during the construction stage of the Project is predicted to comply with the applicable noise criterion at the nearest affected receivers along Toorak Road and Research Road.

As the construction traffic noise levels are temporary and comply with the RNP criteria set above, it indicates that the traffic noise levels due to the construction works for the solar farm would not adversely affect the existing residences along Toorak Road and Research Road.

8 Conclusion

Renzo Tonin and Associates has completed an environmental noise and vibration assessment for the proposed Yanco Solar Farm.

Noise emissions from the construction phase of the project were predicted to generally comply with the construction noise management levels at the nearest affected receivers; however, some exceedances were predicted for Receivers R1 to R10, R12 and R20 to R21 during the construction of the solar farm while construction works are undertaken in close proximity to the receiver. In-principle recommendations were provided in Section 4.4 to limit the potential impact of noise generated during construction works to acceptable levels.

Noise emissions from the operational phase of the solar farm were predicted to comply with the nominated criteria at the nearest affected receivers.

Given the large separation distance between the nearest affected receivers and the subject site, vibration impacts resulting in structural damage to buildings at the nearest affected receivers were determined to be negligible and there would be low risks of adverse comments from occupants of dwellings due to construction vibration.

Road traffic noise impacts on residential properties along the access route were found to comply with the relevant RNP criteria.

APPENDIX A Glossary of Terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 110dB Operating a chainsaw or jackhammer 120dB Deafening
dB(A)	A-weighted decibels. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.

L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Long-Term Noise Monitoring Methodology

B.1 Noise Monitoring Equipment

A long-term unattended noise monitor consists of a sound level meter housed inside a weather resistant enclosure. Noise levels are monitored continuously with statistical data stored in memory for every 15-minute period.

Long term noise monitoring was conducted using the following instrumentation:

Description	Type	Octave Band Data	Logger Location(s)
RTA04 (CESVA SC310)	Type 1	1/1	L1

Notes: All meters comply with AS IEC 61672.1 2004 "Electroacoustics - Sound Level Meters" and designated either Type 1 or Type 2 as per table, and are suitable for field use.

The equipment was calibrated prior and subsequent to the measurement period using a Bruel & Kjaer Type 4231 calibrator. No significant drift in calibration was observed.

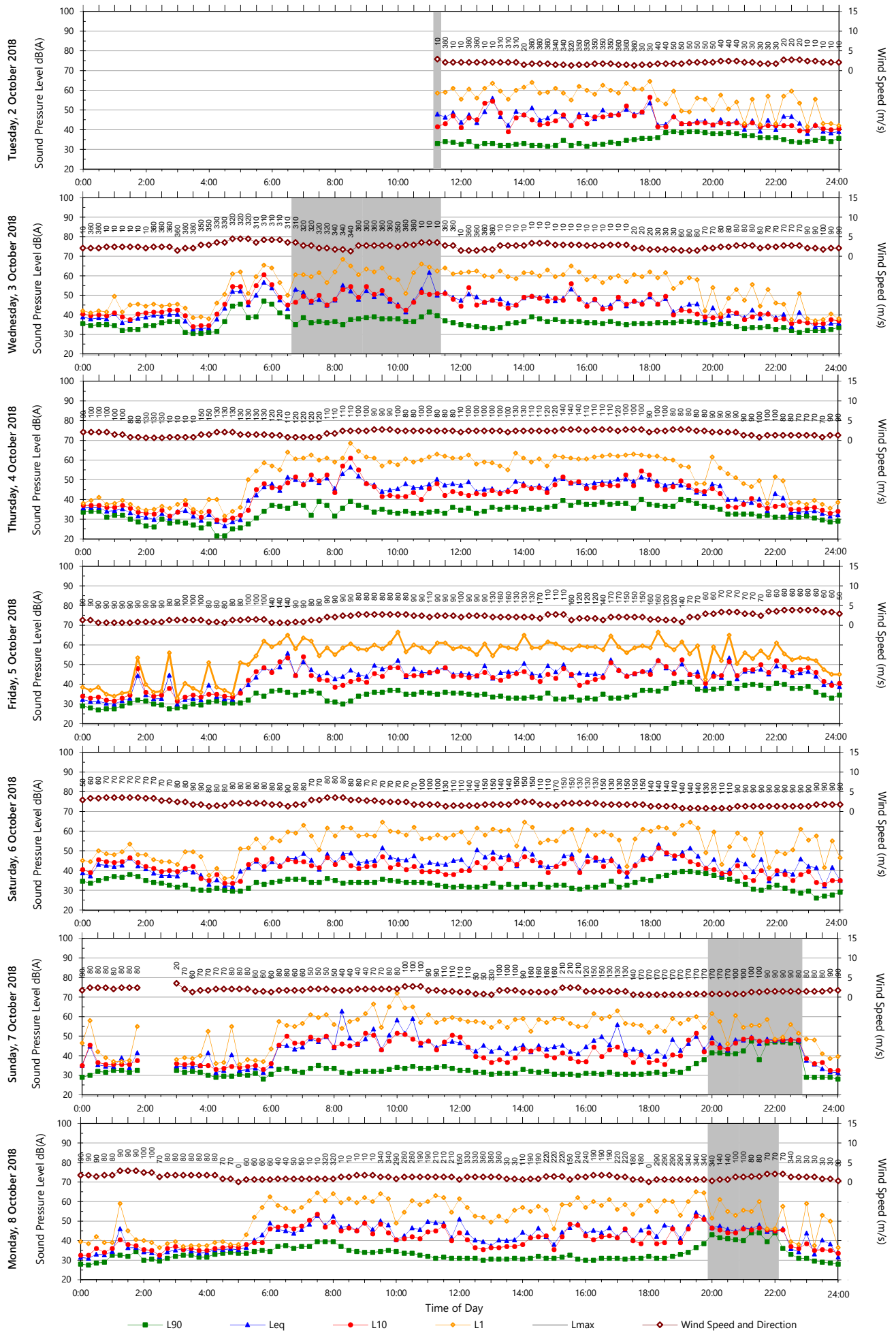
B.2 Meteorology During Monitoring

Measurements affected by extraneous noise, wind (greater than 5m/s) or rain were excluded from the recorded data in accordance with the NSW NPfI. Determination of extraneous meteorological conditions was based on data provided by the Bureau of Meteorology (BOM), for a location considered representative of the noise monitoring location(s). However, the data was adjusted to account for the height difference between the BOM weather station, where wind speed and direction is recorded at a height of 10m above ground level, and the microphone location, which is typically 1.5m above ground level (and less than 3m). The correction factor applied to the data is based on Table C.1 of ISO 4354:2009 '*Wind actions on structures*'.

B.3 Noise vs Time Graphs

Noise almost always varies with time. Noise environments can be described using various descriptors to show how a noise ranges about a level. In this report, noise values measured or referred to include the L_{10}, L_{90}, and L_{eq} levels. The statistical descriptors L_{10} and L_{90} measure the noise level exceeded for 10% and 90% of the sample measurement time. The L_{eq} level is the equivalent continuous noise level or the level averaged on an equal energy basis. Measurement sample periods are usually ten to fifteen minutes. The Noise -vs- Time graphs representing measured noise levels, as presented in this report, illustrate these concepts for the broadband dB(A) results.

APPENDIX C Long Term Noise Monitoring Results



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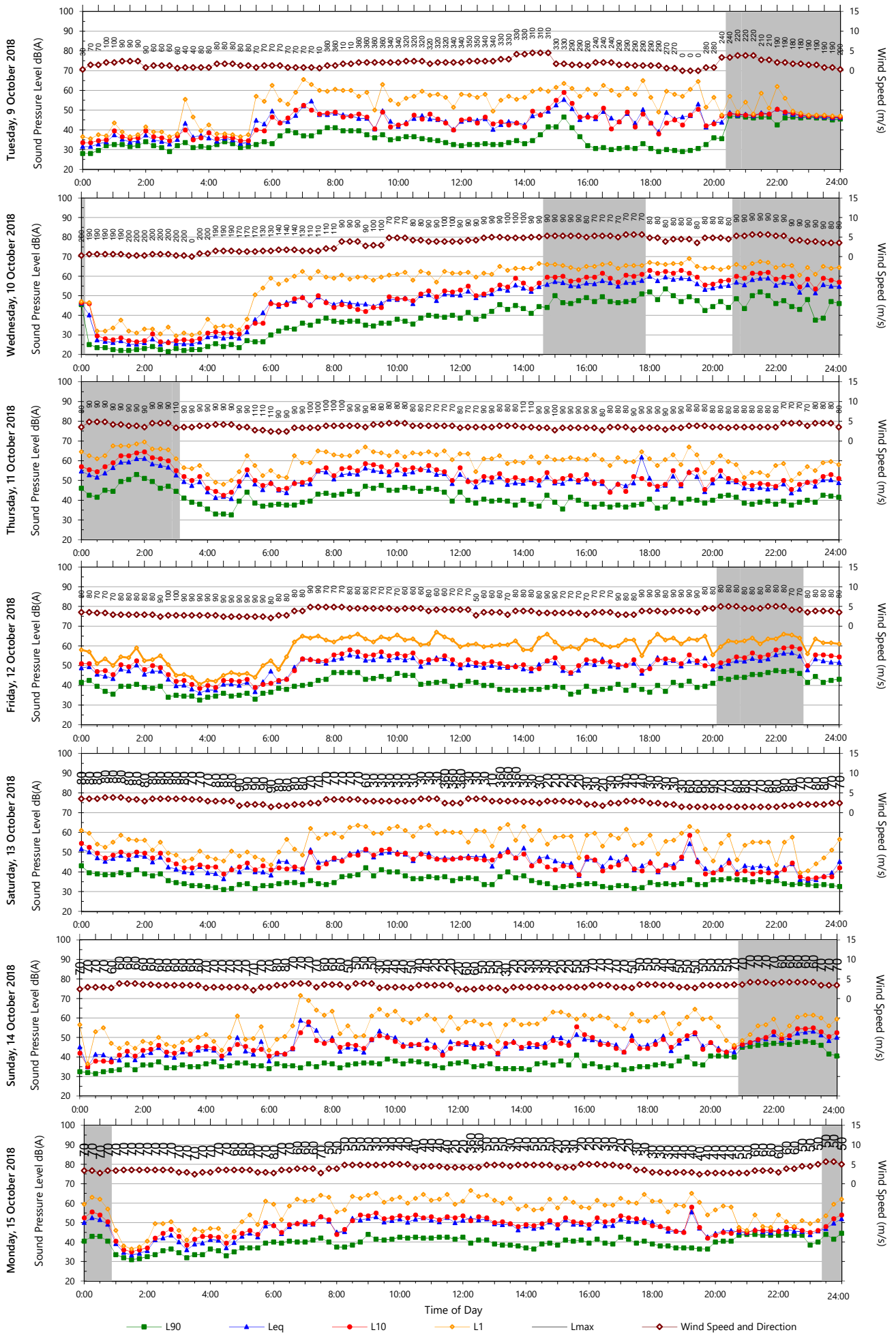
Template: QTE-26 (rev 22) Logger Graphs Program



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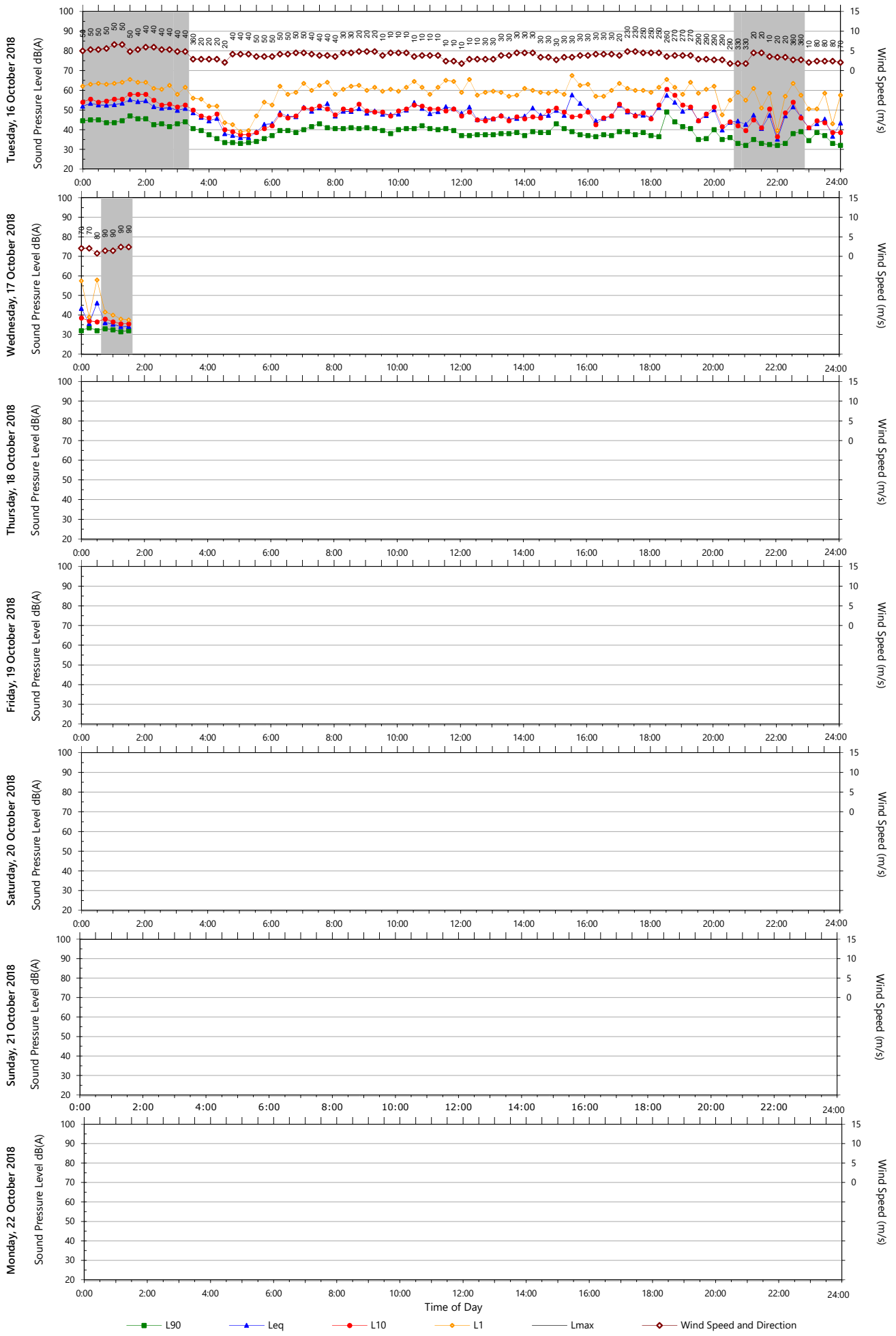

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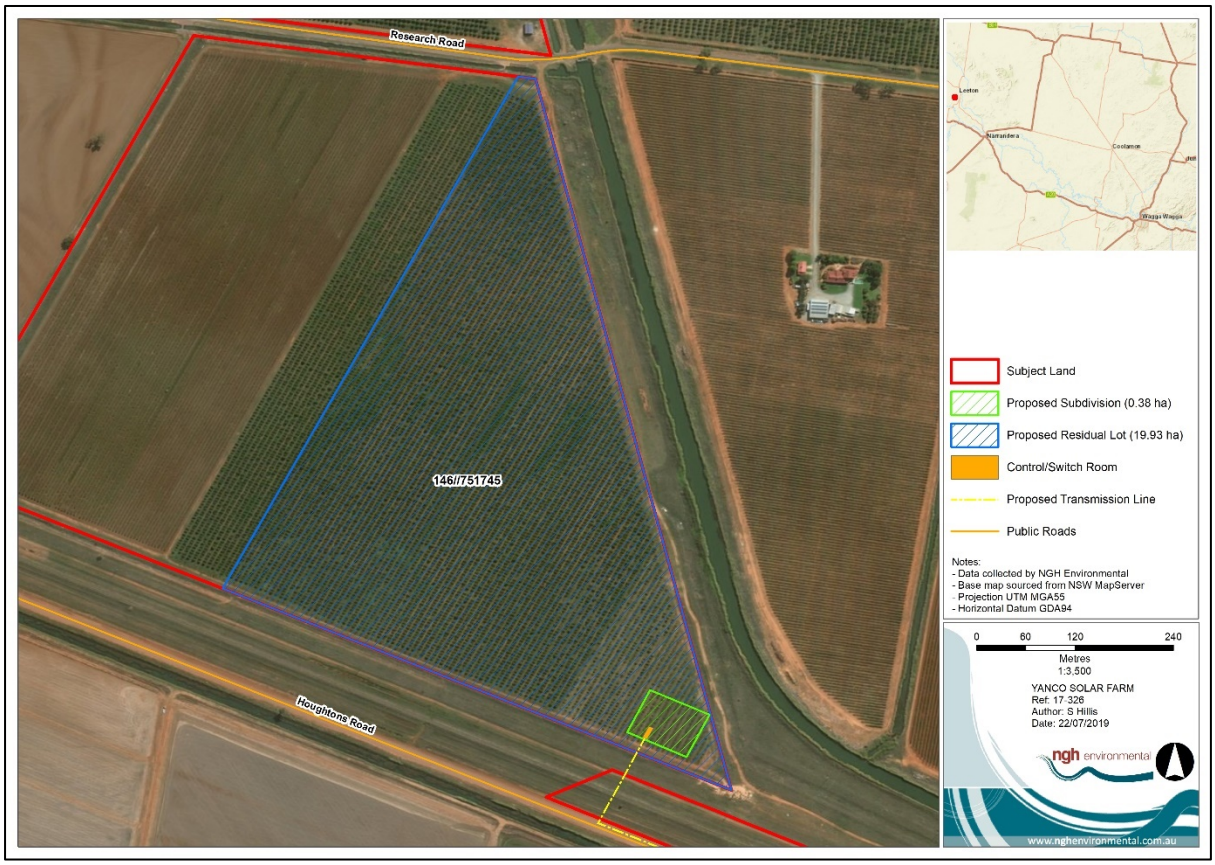
Template: QTE-26 (rev 22) Logger Graphs Program

APPENDIX C PROPOSED SUBDIVISION



APPENDIX D SUBDIVISION APPROVAL LETTER

GS/KT/EF10/503

3 September 2019

LEETON
SHIRE COUNCIL

Lizzie Olesen–Jensen
Principal Town Planner
NGH Environmental
Suite 1, 39 Fitzmaurice Street
WAGGA WAGGA NSW 2650

ATTENTION: NICOLA SMITH

Dear Madam

SUBJECT: PROPOSED SUBDIVISION LOT 146 DP 751725 RESEARCH ROAD YANCO

Council has reviewed your letter of 29 July 2019 that seeks a response from Council concerning the proposed subdivision of the above land.

In consideration of this situation Council understands that:

1. This proposed subdivision will result in Lot 146 being subdivided into two (2) lots; a lot of 0.38 ha in size on which it is intended to construct an electricity switch room associated with the solar farm and a lot of 19.93 ha on which solar panels will be erected.

2. The proposed subdivision will not result in either of the new lots having a dwelling constructed upon on them.

3. The overall solar farm development is a State Significant Development (SSD) and as such Council is not the relevant consent authority.

4. NSW Planning Industry and Environment have indicated that they will approve the subdivision as part of the SSD despite being inconsistent with an LEP development standard.

Having regard to these matters, Council therefore advises that it does not have any objection to the subdivision of Lot 146 DP 751745 into two lots as part of the proposed solar farm development in Research Road Yanco.

Yours faithfully

G Stoll
Manager Planning Building & Health

LEETON SHIRE COUNCIL T. (02) 6953 0911 F. (02) 6953 0977 23-25 Chelmsford Place Leeton NSW 2705
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APPENDIX E REVISED ACHA REPORT

Office of Environment & Heritage

Aboriginal Cultural Heritage Assessment Report Cover Sheet

Report Title	Aboriginal Cultural Heritage Assessment Yanco Solar Farm- Final
Author(s) Name	Amy Ziesing, Kirsten Bradley and Matthew Barber
Author(s)' Organisation Name (if applicable)	NGH Pty Ltd
Author(s) contact details	Email: matthew.b@nghconsulting.com.au Phone: 02 6153 6320
Address of Subject Area	Lots 142, Lots 145 – 152 DP751745; and Lot 6650 DP 1197165 Suburb: Yanco State: NSW Postcode: 2703 Title Reference: Local Government Area: Leeton Local Government Area Other:
Report prepared for	Company Name: ib vogt GmbH Contact Person: Jenny Walsh Address: Level 6 201 Kent Street, Sydney NSW, 2095 Email: jenny.walsh@ibvogt.com Phone: 0438 799 970
Date of Report	23 August 2019

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Aboriginal Cultural Heritage Assessment

YANCO SOLAR FARM FINAL ACHA

AUGUST 2019

Document Verification

ngh environmental	Project Title:	Yanco Solar Farm FINAL ACHA

Project Number: 17-326

Project File Name: Yanco Solar Farm FINAL ACHA

Revision	Date	Prepared by (name)	Reviewed by (name)	Approved by (name)
Draft	19/11/18	Amy Ziesing and Kirsten Bradley	Kirsten Bradley	Matthew Barber
Final	17/01/19	Amy Ziesing	Matthew Barber	Matthew Barber
Final v.1	12/06/19	Amy Ziesing	Matthew Barber	Matthew Barber
Final v.2	23/08/19	Amy Ziesing	Matthew Barber	Matthew Barber

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CONTENTS

TABLES

FIGURES

PLATES

EXECUTIVE SUMMARY

INTRODUCTION

NGH Pty Ltd (NGH) has been contracted by ib vogt GmbH (ib vogt) to prepare an Aboriginal Cultural Heritage Assessment Report (ACHAR). This document will be incorporated into a wider Environmental Impact Statement (EIS) for a proposed commercial scale solar farm located at Yanco in the Leeton Local Government Area (LGA).

The area of investigation covers 204 hectares (ha) encompassing Lots 142 and 145 – 152 DP 751745 and Lot 6650 DP 1197165 (proposal area), located 2.4 km south west of the town of Leeton, NSW. The proposed transmission line would connect to an existing TransGrid substation adjacent to the proposal area, located 1 km to the south-east. Some minor upgrades will also be required to the substation to allow for the solar farm connection.

The solar farm proposal would involve ground disturbance that has the potential to impact on Aboriginal heritage sites and objects which are protected under the NSW *National Parks and Wildlife Act 1974* (NPW Act). The purpose of the Aboriginal Cultural Heritage Assessment (ACHA) is therefore to investigate the presence of any Aboriginal sites and to assess the impacts and management strategies that may mitigate any impact.

The Secretary of the DPE Environmental Assessment Requirements (SEARs) relating to Aboriginal heritage were as follows:

> Include an assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development, including adequate consultation with the local Aboriginal community (SEARS for Yanco Solar Farm 30/08/18).

This ACHA Report was prepared in line with the following:

- *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH 2011);
- *Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales* (OEH 2010a), and
- *Aboriginal cultural heritage consultation requirements for proponents 2010* (ACHCRP) (OEH 2010b) produced by the NSW Office of Environment and Heritage (OEH)

PROJECT PROPOSAL

The Yanco Solar Farm proposal area is 204 ha and the land is currently being utilised as an orange orchard and vineyard. The Yanco Solar Farm proposal would comprise the installation of a solar farm with a capacity of approximately 72 MW (DC) The power generated will be fed into the National Electricity Market (NEM) at the transmission level from the adjacent Yanco Substation.

The proposal would consist of the following components:

- Single axis tracker photovoltaic solar panels;
- Electrical cables and conduits;
- Inverter/transformer units;
- Battery storage units;

- Control room and switchgear to connect the solar farm to a new underground or overhead powerline, including synchronous condenser, other associated structures, lightening protection masts, control and protection equipment;
- Communications tower (20 m high), adjacent to the control room;
- Site office, vehicle parking areas, access tracks and perimeter fencing;
- Operations and maintenance buildings with associated car parking;
- Vegetative screening;
- An overhead or underground 33kv electrical transmission line to connect the proposal to the Yanco substation;
- Extension works within existing Yanco substation footprint to allow for solar farm connection;
- Widening access routes along Research Road and Toorak Road and intersection upgrades at Toorak Road and Canal Street, Irrigation Way and Canal Street, Toorak Road and Research Road and all associated access points and channel crossings into the proposed solar farm;
- Site access from Research Road, east of the existing Gogeldrie Branch Canal crossing;
- Internal access tracks; and
- Lighting, CCTV system, security fencing.

ABORIGINAL CONSULTATION

The consultation with Aboriginal stakeholders was undertaken for the proposed solar farm in accordance with clause *80C of the National Parks and Wildlife Amendment (Aboriginal Objects and Aboriginal Places) Regulation 2010* following the consultation steps outlined in the (ACHCRP) guide provided by OEH.

The full list of consultation steps, including those groups and individuals that were contacted are provided in a consultation log in Appendix A.

As a result of this process a single group, the Leeton & District Local Aboriginal Lands Council (Leeton LALC), contacted the consultant to register their interest in the proposal. No other party registered their interest.

The fieldwork was organised, and the sole registered party was asked to participate in the fieldwork.

A copy of the draft report was provided to the registered party for comment. No comments were received.

ARCHAEOLOGICAL CONTEXT

The assessment included a review of relevant information relating to the landscapes within the proposal area. Included in this was a search of the OEH AHIMS database. No Aboriginal sites have previously been recorded within the proposal area. The closest sites are three scarred trees located approximately 1 km to the north of the proposal boundary. There is a dominance of scarred trees in the wider region especially where there are remnant stands of native trees.

The results of previous archaeological surveys in the Yanco region demonstrate that there is a strong, complex and varied pattern of human use and movement through the landscape. This behaviour is recorded as a range of artefact and site types distributed and concentrated in specific landforms across the region. There does appears however to be a strong association between the presence of potential resources for Aboriginal use and the presence of archaeological sites. Areas directly associated with water and or elevated ground appear to have the greatest potential for identification of Aboriginal cultural material.

Based on the previous archaeological investigations and knowledge of Wiradjuri cultural practices and traditional activities the proposal area has a possibility of containing archaeological sites, given that

Aboriginal people have lived in the region for tens of thousands of years. This would most likely be in the form of stone artefacts and scarred trees.

SURVEY RESULTS

The survey strategy was to cover as much of the ground surface as possible within the proposal area. Survey transects were undertaken on foot to achieve maximum coverage. Over the course of the field survey approximately 25 km of transects were walked by each participant. Allowing for an effective view width of 5 m for each person, this equates to a total surface area examined of 52 ha. However, allowing for the visibility restrictions, the effective survey coverage was reduced.

A subsequent survey was completed for the relocated transmission line, south of Houghton Road. Moderate to high degrees of disturbance and low ground visibility were encountered along the 1.2 km length of the road reserve and channel bank. Despite this one isolated find (YSF_IF_001) was identified in an exposure on the channel bank.

Overall, it is considered that the surface survey of the Yanco Solar Farm proposal area had sufficient and effective survey coverage. The results identified in this report are considered a true reflection of the nature of the Aboriginal archaeological record present within the proposal area.

Given that the majority of the proposal area has been levelled and subject to extensive modification the lack of newly identified Aboriginal sites was not unexpected. The absence of Aboriginal scarred trees in the proposal area was expected and corresponds directly with the lack of remnant old growth trees within and adjacent to the immediate proposal area.

Based on the land use history of the proposal area, and an appraisal of the results from the field survey it was concluded that there was negligible potential for the presence of intact subsurface deposits with high densities of objects or cultural material within the Yanco Solar Farm proposal area.

Based on discussions with ib vogt during the production of this assessment, it was determined that the location of the proposed transmission line would be the original northern route between Houghton's Road and the canal to the north (*per Comms.* Jenny Walsh 20/12/18).

POTENTIAL IMPACTS

Only one new Aboriginal heritage site, isolated find (YSF_IF_001) was identified across the proposed Yanco Solar farm project area and this site will be avoided by utilising the northern transmission line route. No areas of archaeological potential were identified during the survey of the proposal area. Therefore, the potential impacts to archaeological material are nil.

RECOMMENDATIONS

It is recommended that:

1. Avoidance of isolated artefact (YSF_IF_001) be achieved by utilising the proposed northern transmission line route (Figure 9).
2. Installation of visible barrier fencing, including a 5 m buffer zone, around isolated artefact (YSF_IF_001) to prevent any inadvertent harm during the construction works.
3. If the route is altered to the southern transmission line option in the future, then this site should be salvaged and reburied outside of the impact corridor in consultation with the Leeton & District LALC.

4. NGH Pty Ltd does not believe it is warranted to undertake monitoring for ground disturbance associated with the proposed Yanco Solar Farm, based on the results of the surveys and level of previous disturbance across the site.
5. ib vogt should prepare an Unexpected Finds Protocol (UFP) to deal with construction activity and the inadvertent discovery of Aboriginal objects. An example UFP has been provided in Appendix D in case of finds.
6. ib vogt should prepare a Cultural Heritage Management Plan (CHMP) in consultation with Registered Aboriginal Parties (RAPs) and OEH which will include a heritage site induction for all contractors and works crews. The CHMP should include the UFP, heritage site induction information and mitigation strategy listed in Recommendation 2 to ensure that YSF_IF_001 is not harmed during the construction works.
7. In the unlikely event that human remains are discovered during the construction, all work must cease in the immediate vicinity. OEH and the local police should be notified immediately. Further assessment would be undertaken to determine if the remains were Aboriginal or non-Aboriginal. If the remains are determined to be Aboriginal in origin, then the Registered Aboriginal Parties (RAPs) and local Aboriginal community should be informed of the find.
8. Further archaeological assessment would be required if the proposal activity extends beyond the area of the current investigation. This would include consultation with the registered Aboriginal party and may include further field survey.

1 INTRODUCTION

ib vogt GmbH (ib vogt) proposes to develop a solar farm at Yanco, approximately 2.4 km south west of the township of Leeton, NSW in the Leeton Local Government Area (LGA) (see Figures 1 -2). The proposal area covers 204 hectares (ha) encompassing Lots 142 and 145 – 152 DP 751745 and Lot 6650 DP 1197165. The proposal involves the construction of a ground-mounted photovoltaic solar array generating approximately 72 MW (DC) of renewable energy. The proposed transmission line would connect to an existing TransGrid substation adjacent to the proposal area, located 1 km to the south-east. Some minor extensions are required within the substation footprint to allow for the solar farm connection.

NGH Pty Ltd (NGH) has been contracted by ib vogt GmbH (ib vogt) to prepare an Aboriginal Cultural Heritage Assessment Report (ACHAR) to investigate and examine the presence, extent and nature of any Aboriginal heritage sites within the proposal area as part of an Environmental Impact Statement (EIS)

The solar farm proposal would involve ground disturbance that has the potential to impact on Aboriginal heritage sites and objects which are protected under the NSW *National Parks and Wildlife Act 1974* (NPW Act). The purpose of the Aboriginal Cultural Heritage Assessment (ACHA) is therefore to investigate the presence of any Aboriginal sites and to assess the impacts and provide management strategies that may mitigate any impact.

1.1 DEVELOMENT CONTEXT

The development of renewable energy projects is one of the most effective ways to achieve the commitments of Australia and a large number of other nations under the Paris Agreement to reduce greenhouse gas emissions. The Yanco Solar Farm would provide the following benefits:

- Reduction in greenhouse gas emissions from energy generation (when compared with fossil fuel generating sources).
- Provision of embedded electricity generation to supply into the Australian grid close to a main consumption centre.
- Provision of social and economic benefits through the provision of direct employment opportunities.

The establishment of a solar farm would therefore have both local, National and International benefits.

As part of the development impact assessment process, the proposed development application will be assessed under part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The proposed solar farm is classified as “state significant development” (SSD) under Part 4 of the EP&A Act. SSDs are major projects which require approval from the Minister for Planning and Environment. The EIS has been prepared in accordance with the requirements of the Secretary of the Department of Planning and Environment (DPE).

The Secretary of the DPE Environmental Assessment Requirements (SEARs) relating to Aboriginal heritage were as follows:

> Include an assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development, including adequate consultation with the local Aboriginal community (SEARS for Yanco Solar Farm 30/08/18).

1.2 PROJECT PROPOSAL

The Yanco Solar Farm assessment area is 204 ha and the land is currently being utilised as an orange orchard and vineyard. The Yanco Solar Farm proposal would comprise the installation of a solar farm with a capacity

of approximately 72 MW (DC) The power generated will be fed into the National Electricity Market (NEM) at the transmission level from the adjacent Yanco Substation.

The proposal would consist of the following components:

- Single axis tracker photovoltaic solar panels;
- Electrical cables and conduits;
- Inverter/transformer units;
- Battery storage units;
- Control room and switchgear to connect the solar farm to a new underground or overhead powerline, including synchronous condenser, other associated structures, lightening protection masts, control and protection equipment;
- Communications tower (20m high), adjacent to the control room;
- Site office, vehicle parking areas, access tracks and perimeter fencing;
- Operations and maintenance buildings with associated car parking;
- Vegetative screening;
- An overhead or underground 33kv electrical transmission line to connect the proposal to the Yanco substation;
- Extension works within existing Yanco substation footprint to allow for solar farm connection;
- Widening access routes along Research Road and Toorak Road and intersection upgrades at Toorak Road and Canal Street, Irrigation Way and Canal Street, Toorak Road and Research Road and all associated access points and channel crossings into the proposed solar farm;
- Site access point off Research Road, east of Gogeldrie Branch Canal crossing;
- Internal access tracks; and
- Lighting, CCTV system, security fencing.

The proposed development footprint is shown below in Figures 1 and 2. This includes all land likely to be directly impacted by the construction, operation and decommissioning of the proposal, including auxiliary construction facilities (site compound, laydown, stockpiling etc.), access and all considered options. It is important to note that the development footprint is indicative only and will be refined as part of the EIS process.

The proposal is expected to operate for around 30 years. The construction phase of the proposal is expected to take approximately 10 months. After the initial operating period, the solar farm would either be decommissioned, removing all above ground infrastructure and returning the site to its existing land capability, or upgraded with new PV equipment.

1.3 PROJECT PERSONNEL

The initial field work for this assessment was undertake by NGH archaeologists Amy Ziesing, Kirsten Bradley and Brett Chalmers. Amy Ziesing completed the research, Aboriginal community consultation, GIS mapping and report preparation. Kirsten Bradley and Mathew Barber reviewed the report.

The subsequent transmission survey to the south of Houghton Road was completed by Amy Ziesing and the Leeton & District LALC.

Consultation with the Aboriginal community followed the process outlined in OEH's *Aboriginal cultural heritage consultation requirements for proponents 2010* (Section 2). A single group, the Leeton & District Local Aboriginal Lands Council (Leeton LALC), registered their interest in the proposal.

Courtney Davy and David Watts from the Leeton LALC participated in the fieldwork.

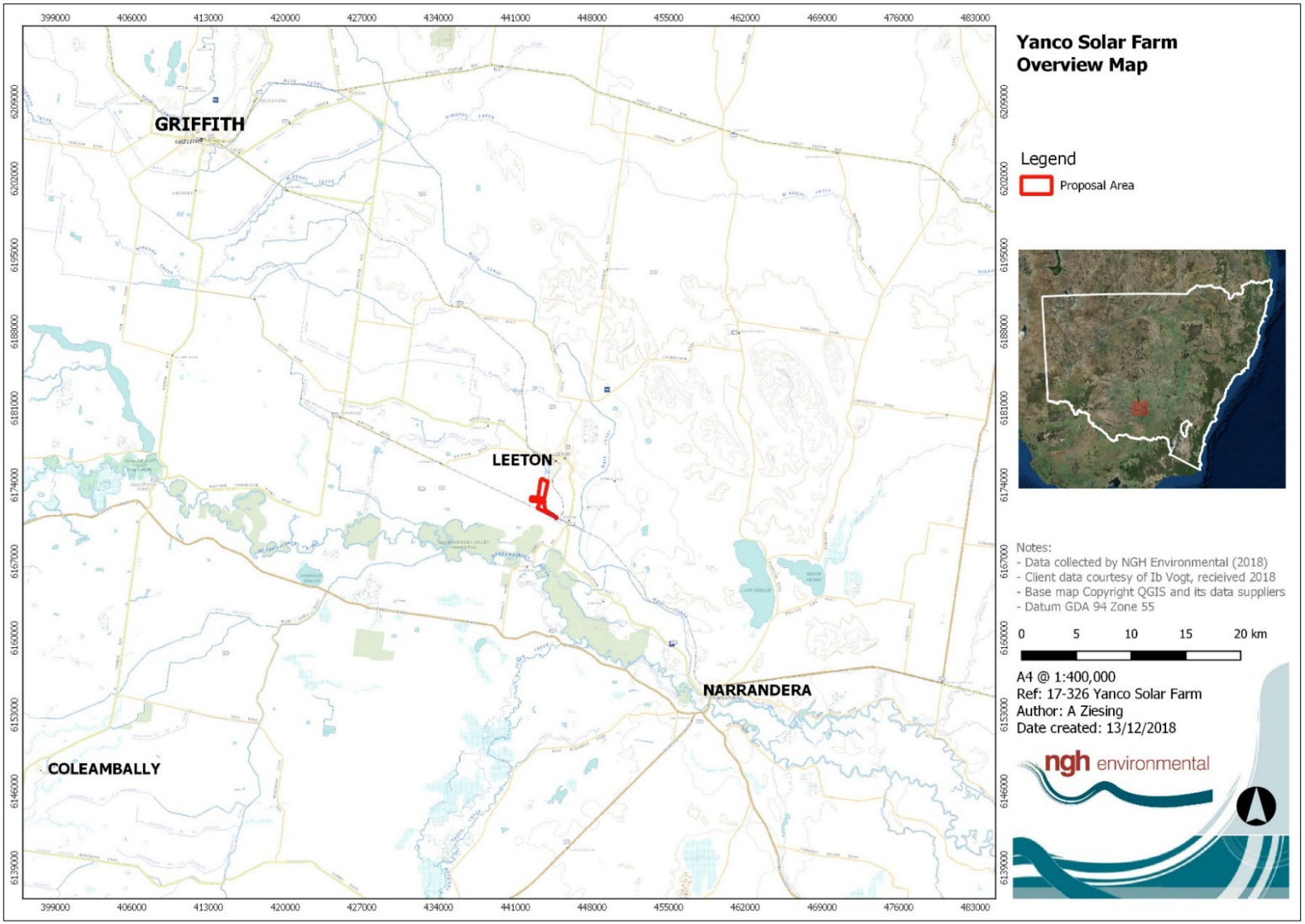

Figure 1. General project area.

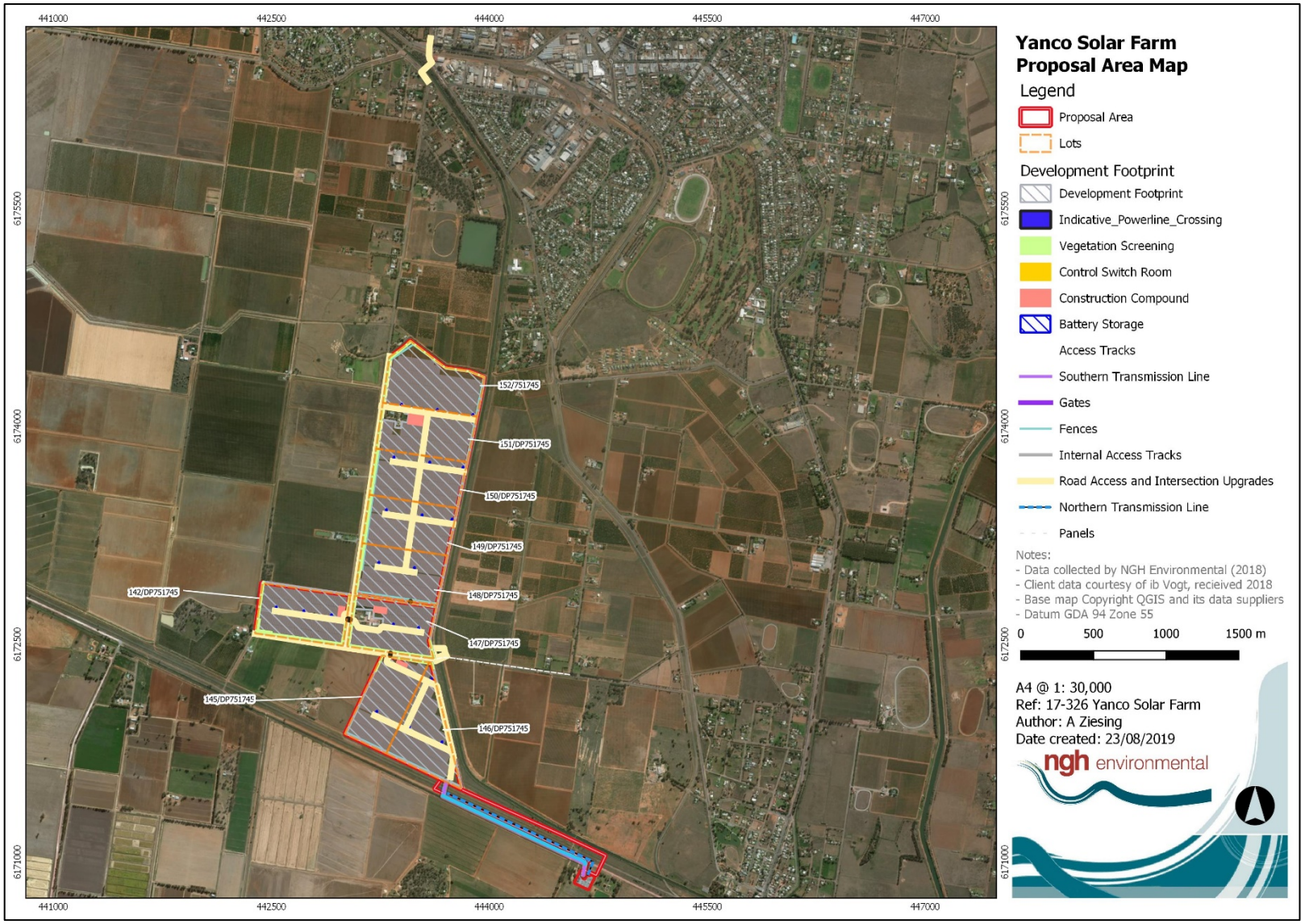

Figure 2. Proposed site layout.

1.4 REPORT FORMAT

For the purposes of this assessment, we have prepared the report in line with the following:

- *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH 2011);
- *Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales* (OEH 2010a), and
- *Aboriginal cultural heritage consultation requirements for proponents 2010* (ACHCRP) (OEH 2010b) produced by the NSW OEH.

The purpose of this ACHA report is therefore to provide an assessment of the Aboriginal cultural values associated with the proposal area and to assess the cultural and scientific significance of any Aboriginal heritage sites. This conforms to the intention of the SEARs.

The objectives of the assessment were to:

- Conduct Aboriginal consultation as specified in clause 80c of the *National Parks and Wildlife Regulation 2009*, using the consultation process outlined in the ACHCRP*;*
- Undertake an assessment of the archaeological and cultural values of the proposal area and any Aboriginal sites therein;
- Assess the cultural and scientific significance of any archaeological material, and
- Provide management recommendations for any objects found.

2 ABORIGINAL CONSULTATION PROCESS

The consultation with Aboriginal stakeholders was undertaken in accordance with clause *80C of the National Parks and Wildlife Amendment (Aboriginal Objects and Aboriginal Places) Regulation 2010* following the consultation steps outlined in the ACHCRP guide provided by OEH. The guide outlines a four-stage process of consultation as follows:

- Stage 1 – Notification of project proposal and registration of interest.
- Stage 2 – Presentation of information about the proposed project.
- Stage 3 – Gathering information about cultural significance.
- Stage 4 – Review of draft cultural heritage assessment report.

The full list of consultation steps, including those groups and individuals that were contacted is provided in a consultation log in Appendix A. A summary of actions carried out in following these stages are as follows.

Stage 1. Letters outlining the development proposal and the need to carry out an ACHA were sent to the Leeton LALC and various statutory authorities including OEH, as identified under the ACHCRP. An advertisement was placed in the local newspapers, the *Leeton Irrigator* on 13 July 2018 seeking registrations of interest from Aboriginal people and organisations. A further series of letters was sent to other organisations identified by OEH in correspondence to NGH. In each instance, the closing date for submission was 14 days from receipt of the letter.

As a result of this process, a single Aboriginal group the Leeton LALC registered their interest in the proposal. No other party registered their interest.

Stage 2. On the 13th of September 2018, an Assessment Methodology document was sent to the Leeton LALC as the only registered party for the project. This document provided details of the background to the proposal, a summary of previous archaeological surveys and the proposed heritage assessment methodology to be employed. The document invited comments and sought any information regarding known Aboriginal cultural significance values associated with the proposal area and/or any Aboriginal objects contained therein. A minimum of 28 days was allowed for a response to the document. No comments were received on the methodology from the Leeton LALC however they expressed an interest in participating in fieldwork.

Stage 3. The *Assessment Methodology* outlined in Stage 2 included a written request to provide any information that may be relevant to the cultural heritage assessment of the proposal area. It was noted that sensitive information would be treated as confidential. No response regarding cultural information was received in response to the methodology.

The fieldwork was organised, and the Leeton LALC were asked to participate. The fieldwork was carried out on the 22nd and 23rd of October 2018 by three archaeologists from NGH with two local Aboriginal representatives from the Leeton LALC.

Representatives who participated in the fieldwork were:

- David Watts (22 -23 October 2018) ; and
- Courtney Davy (22 -23 October 2018).

Stage 4. After the initial fieldwork, ib vogt relocated the proposed transmission line route to the southern side of Houghton Road, resulting in additional survey requirements. This additional area was provided to the Leeton LALC as an addendum email, utilising the same methods outlined in Stage 2.

Stage 5. The subsequent fieldwork was organised, and the registered party were asked to participate in fieldwork. Two members from the Leeton LALC participated in the fieldwork on the 11th of December 2018.

Stage 6. In December 2018 a draft version of this *Aboriginal Cultural Heritage Assessment Report* (this document) was forwarded to the Leeton LALC inviting comment on the results, the significance assessment and the recommendations. A minimum of 28 days was allowed for responses to the document. No comments were received on the draft report.

Stage 7. This ACHA report was finalised in January 2019.

Stage 8. After the report was finalised it was determined that minor extensions would be required inside the existing Yanco substation to allow for the proposed solar farm connection. As these alterations will be within the existing substation concrete pad, no further survey was needed however a letter outlining the additional works was sent to the RAPS for comment and the information added to the final ACHA report.

Stage 9. In August 2019, a further change in the development footprint was proposed, with an additional access point off Research Road to the east of the Gogeldrie Branch Canal crossing. This are was covered during the survey and no additional fieldwork was required. Notification of the additional access point was provided to the RAPs via email on the 6th of August 2019.

2.1 ABORIGINAL COMMUNITY FEEDBACK

During the subsequent transmission line survey, it was requested by the representatives of the Leeton LALC that they be present to monitor any ground disturbance works associated with the Yanco Solar Farm. This included the demolition of orchards and vineyards across the site.

Community consultation occurred throughout the project. The draft report was provided to each of the Registered Aboriginal Parties (RAPs) and feedback was sought on the recommendations, the assessment and any other issues that may have been important.

No comments, recommendations or issues were received on the draft report during the 28 day review period.

No comments were received on the addendum letter outlining the extension works required within the Yanco substation, which was sent to the LALC for review.

No comments were received on the email outlining the additional access point off of Research Road, east of the existing Gogeldrie Branch Canal crossing.

3 BACKGROUND INFORMATION

3.1 REVIEW OF LANDSCAPE CONTEXT

3.1.1 Geology, Topography and Climate

The landscape context assessment is based on a number of classifications that have been made at national and regional level for Australia. The national Interim Biogeographic Regionalisation for Australia (IBRA) system identifies the proposal area as located within the Riverine Plain or Riverina Bioregion of south eastern Australia (DE&E 2016). The Riverina Bioregion forms part of the Murray-Darling basin, which spreads over 1 million square kilometres in area and comprising 14% of Australia, extending from central southern Queensland through much of central New South Wales and into South Australia and northern Victoria.

The Riverina Bioregion (hereafter referred to as the Riverina) covers about 90,000 km^2, extending from just near Ivanhoe in the north to Shepparton in Victoria and from Balranald in the west to Narrandera in the east. The town of Hay is roughly the centre point of the Riverina.

The base geology of the region comprises vast undulating plains with flood deposits of Quaternary alluvium clays and silts with sand which border dune and lake systems.

The Murrumbidgee Scalded Plains Mitchell Landscape covers the entire proposal area (DECC 2002). The Cocoparra Ranges and Footslopes and the Murrumbidgee Channels and Floodplains are located within 2 km of the proposal area. These Mitchell Landscape descriptions are provided in Table 1 below and shown in Figure 3.

Table 1 Description of the Mitchell Landscape relevant to the proposal (DECCW 2002)

Mitchell Landscape
Murrumbidgee Scalded Plains
Quaternary alluvial plains with extensive scalding shown as relic floodplains or terraces. Levees, lunettes and swamps are also present in this landscape. Relief is less than 1 m, but up to 5 m on pans, swamps and lunette formations. Grey, brown and red cracking clays to red-brown soils with scalds. Low shrublands and grasslands of bladder saltbush (*Atriplex vesicaria)* and other annual saltbushes *(Atriplex sp.),* multiple burrs *(Sclerolaena sp.),* cottonbush *(Maireana aphylla),* bush minuria *(Minuria cunninghamii)* white-top grass *(Austrodanthonia caespitosa),* windmill grass *(Chloris truncate)* and hill wallaby grass *(Austrodanthonia eriantha).*

Mitchell Landscape
Cocoparra Ranges and Footslopes
This landscape is comprised of the Cocoparra and the Naradhan land systems. Steep crested ranges, ridges, hills and associated footslopes of Quaternary colluvium with outcrops of upper Devonian sandstone, conglomerate and siltstones. Cliff faces to boulder hill slopes range in relief from 30 to 260 m. Extensive rock outcrop, shallow sandy lithosols with acid, neutral and calcareous red earths on slopes and deep sandy alluvium in creek lines. The ranges comprise scattered white cypress pine (*Callitris glaucophylla*), currawang (*Acacia doratoxylon*), Dwyer's mallee gum (*Eucalyptus dwyeri*) and red ironbark (*Eucalyptus sideroxylon*), locally dense broombush (*Melaleuca uncinata*), hill tea-tree (*Leptospermum divaricatum*), urn heath (*Melichrus urceolatus*), wedge-leaf hopbush (*Dodonaea viscosa*), punty bush (*Senna eremophila*), cough bush (*Cassinia laevis*), sugarwood (*Myoporum platycarpum*), grey box (*Eucalyptus micropcarpa*), wilga (*Geojera parviflora*), and Deane's wattle (*Acacia deanei*), rock fern (*Cheilanthes sieberi*). Understorey of ranges consists of wire grass (Aristida sp.), mulga grass (*Thyridolepis mitchelliana*), short grasses and forbs. On the lower slopes bimble box (*Eucalyptus populnea*), white cypress pine (*Callitris glaucophylla*), mallees (*Eucalyptus sp.*), yarran (*Acacia homalophylla*), wilga (*Geojera parviflora*), emu bush (*Eremophila longifolia*) and various acacias (*Acacia sp*.) with grasses and forbs.
Murrumbidgee channel and floodplains
Quaternary alluvium on seasonally inundated floodplains, active and inactive channels, billabongs, levees and swamps of the Murrumbidgee River and its effluent streams. Relief to 10 m. Includes scalded alluvial flats, broad elevated floodplains and associated relict channels; isolated sandy rises, relief to 5 m. Grey and brown clay with occasional areas of low sandy rise. Open forest of river red gum (*Eucalyptus camaldulensis*), river cooba (*Acacia stenophylla*), cooba (*Acacia salicina*), lignum (*Muehlenbeckia cunninghamii*), nitre goosefoot (*Chenopodium nitrariaceum*) with numerous grasses along the channels and floodplain. Black box (*Eucalyptus largiflorens*) woodland with lignum, nitre goosefoot, thorny saltbush (*Rhagodia spinescens*), old man saltbush (*Atriplex nummularia*) and annual saltbushes (*Atriplex sp*.) on more distal floodplains and back plains. Cumbungi (*Typha orientalis*), common reed (*Phragmites australis*) and nardoo (*Marsilea drummondii*) in flooded depressions.

The proposal area is devoid of naturally occurring bedrock outcrops which might have provided a source of stone material for Aboriginal people. However, outcroppings of sandstone and conglomerate materials are to likely occur in the Cocoparra Ranges and Footslopes landscapes which are located 2 km to the north east of the proposal area.

There is no topographic or discernible variation in the elevation within the land for the proposed solar farm as the majority has been subjected to extensive levelling. It is possible laser levelling may have been used in the past when the land was used to grown rice.

Within the proposal area, the soils are typically a brown or reddish-brown cracking clay with some silt content and very little natural gravels. The soil profile would be expected to be deep with little variation for metres in the heavily aggrading landscape.

While no natural creek lines are evident in the proposal area it is possible and considered likely that the Gogeldrie Branch Canal which boarders the eastern boundary was constructed along a previous creek line that was modified into an irrigation canal. Any natural hydrology of the proposal area has been largely been replaced by irrigation, drainage channels and dams. The proposal area contains six farm dams.

Guises Creek is located approximately 1.8 km to the south and flows into the Murrumbidgee River. The Murrumbidgee River is located approximately 4.3 km south and is a dominant feature within the Riverine landscape. The River is also a key factor in the formation of the landforms in the area. Over many millennia through the Pleistocene, the river systems migrated across the plain forming a complex series of channels, levees, source bordering dunes, lunettes and lakes. Some of these features are visible today, along with more recent Holocene features such as cut off meanders or billabongs, swamps, distributary creeks and anastomosing channels, which altogether form a highly complex landscape of interwoven land units.

The proposed solar farm area has been heavily modified for agricultural production. This has included:

- Extensive clearing of native vegetation;
- Wide spread earth moving to flatten the paddocks (possible laser levelling);
- Construction of Gogeldrie Branch Channel;
- Construction and maintenance of roads and other minor access tracks;
- Construction and maintenance of table drains and irrigation channels;
- Construction for infrastructure such as buried communication cables and overhead powerlines; and
- Ploughing/grading along fence lines for fire breaks.

3.1.2 Vegetation

As stated above, the proposal area is mostly devoid of natural vegetation as the result of clearing. The land is currently used to produce orange orchards and a vineyard and has lost almost all native tree cover and understorey. Introduced species are widespread across the proposal area; however, patches of Yellow Box and River Red Gum woodland surround the area. A patch of planted Eucalypts trees surrounds a house block in the northern part of the proposal area and a windbreak of planted Casuarina species occur along the north-western boundary.

An area of Riverine Plain Grassland occurs along the road side of Houghton Road. Species present within this vegetation community include Curly Windmill Grass (*Enteropogon ramosus*), Speargrass (*Austrostipa spp.*), Red Grass (*Bothriochloa macra*), Wallaby Grass (*Rytidosperma* spp.) and Fuzzweed (*Vittadinia* spp.).

Irrigation channels and dams within the proposal area lack native vegetation and are surrounded by exotic vegetation such as Barley Grass (*Hordeum leporinum*), Prickly Lettuce (*Lactuca serriola*), Mallow (*Malva parviflora*) and Phalaris (*Phalaris aquatica*).

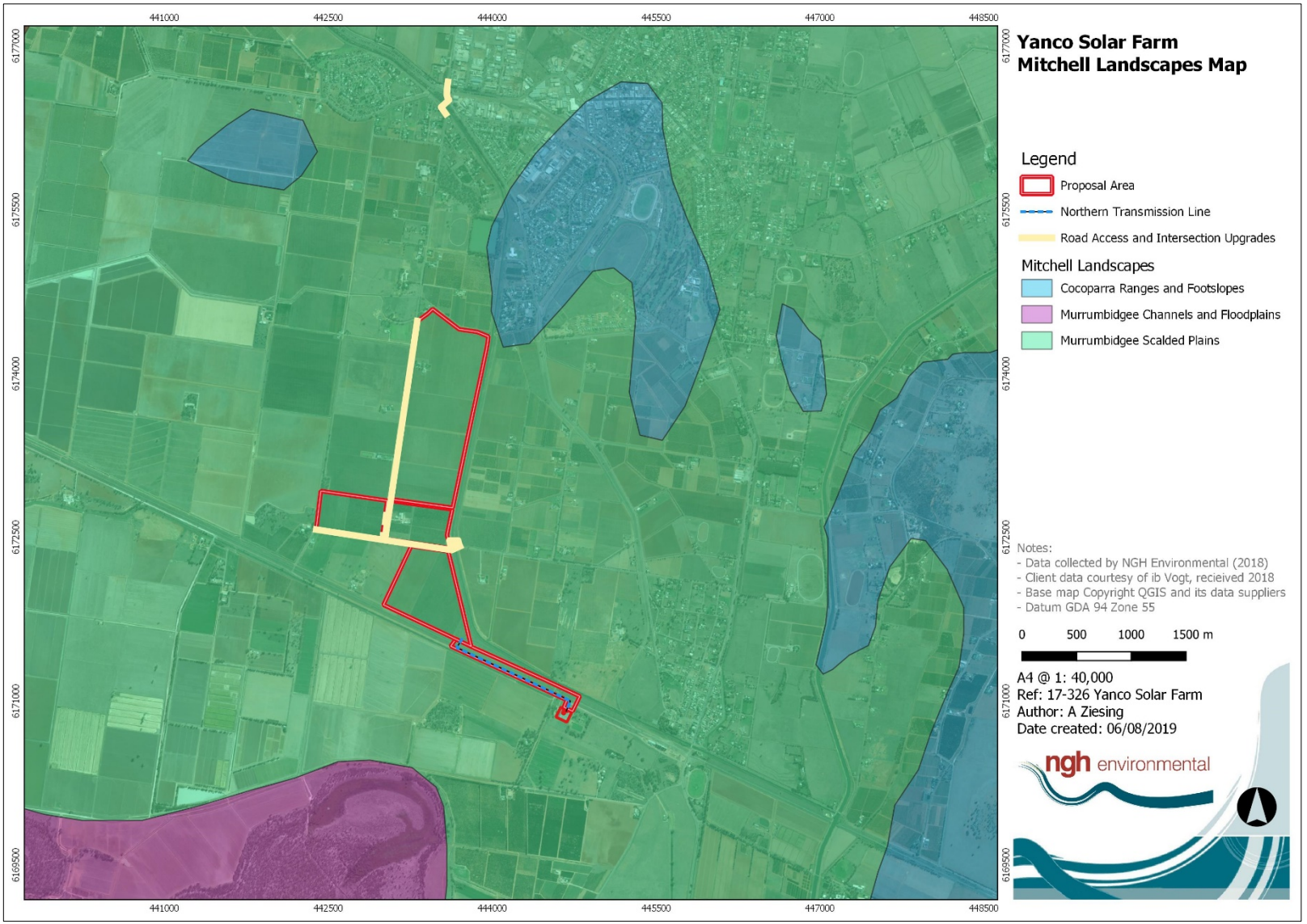

Figure 3. Location of Mitchell landscapes.

3.1.3 Historic Land Use

The township of Yanco, located 5 km south of Leeton, arose when the railway line was extended from Narrandera to Hay in 1881. The railway station was built to service the home of Sir Samuel McCaughey, who is known as 'the father of irrigation.' His farm in North Yanco utilised over 16,000 ha for irrigation with 320 km of channels constructed with steam driven pumps used to create the flow from the river. He began these endeavours in 1899 and by 1906 he had convinced the government of the need for an irrigation scheme over the Riverina region which is known as the Murrumbidgee Irrigation Scheme. The Murrumbidgee Irrigation Scheme was approved by the NSW Government in 1906 and the region saw increased population growth as local towns flourished in support of the Scheme.

The Murrumbidgee Irrigation Area was officially recognised in 1912, with the establishment of dams and weirs to redirect water from the Murrumbidgee River for irrigation purposes. The establishment of the irrigation scheme led to development of the wider region through construction of channels, either by constructing new ones with banks and levees or channelising existing creek lines. The scale of the development required extensive earthworks. It is not known when the proposal area was first cleared and developed but it is assumed it would have been around the time the Murrumbidgee Irrigation Scheme was commenced. The area would have most likely been used as pastoral and/or agricultural farm land prior to the construction of the irrigation system.

The location of the proposed Yanco Solar Farm is within land currently utilised for orange orchards and a vineyard. These practises use drip irrigation systems with water from the Gogeldrie Branch Canal, bordering the eastern boundary of the proposal area. The proposal area has been modified for orcharding and vineyard production for at least 25 years and the land has been intensively used for farming. It is noted that the land was previously intensively irrigated for rice production which is renowned in the Leeton area.

Given the history of the agricultural development of the proposed Yanco Solar Farm area the land has been subject to considerable impacts from farming for many decades. Overall, the proposal area would be categorised as highly disturbed through continual modification for farming and irrigation activities over many decades.

3.1.4 Landscape Context

Most archaeological surveys are conducted in a situation where there is topographic variation, this can lead to differences in the assessment of archaeological potential and site modelling for the location of Aboriginal archaeological sites. As already noted, the proposal area contains no topographic variation which has been furthermore reduced by paddock levelling for cultivation.

There are no differences in the soil types or discernible micro features across the proposal area. The only difference observed within the landscape was the difference in crops which is clearly dived into the orange orchard and the vineyard. Given the lack of topographic or soil variation no areas are identified to have high archaeological potential however stone artefacts as isolated occurrences or low-density scatters may occur across the proposal area. All remnant old growth trees have been removed from the proposal area.

3.2 REVIEW OF ABORIGINAL ARCHAEOLOGICAL CONTEXT

3.2.1 Ethnohistoric Setting

There are several ethnographic recordings of Aboriginal life in the Murrumbidgee region from the 1800s that notably focus on the prevalence of Aboriginal people around waterways in the region. It is however important to consider that the Aboriginal people alive at the time of such observations were survivors of serious epidemics of infectious disease such as smallpox, bought by Europeans, that greatly affected the population sizes and distribution of people within the landscape. Consequently, European records may not necessarily reflect pre-contact population distributions and traditional ways of life (Dowling 1997, Littleton and Allen 2007).

The dispossession from traditional lands and acts of violence against the Aboriginal people caused great social upheaval meaning that access to traditional resource gathering and hunting areas, religious life, marriage links and sacred ceremonial sites were disrupted or destroyed. Despite this Aboriginal people continued to maintain their connections to sites and the landscape in a variety of ways. The Aboriginal people of the region continue to have a strong connection to their land.

Tribal boundaries

Cultural areas are difficult to define and "must encompass an area in which the inhabitants have cultural ties, that is, closely related ways of life as reflected in shared meanings, social practices and interactions" (Egloff et al. 2005, p. 8). Depending on the culture defining criteria chosen - i.e. which cultural traits and the temporal context (historical or contemporary) - the definition of the spatial boundary may vary. In Australia, Aboriginal "marriage networks, ceremonial interaction and language have been central to the constitution of regional cultural groupings" with the distribution of language speakers being the main determinate of groupings larger than a foraging band (Egloff et al. 2005, pp. 8–16).

The Yanco and Leeton area is within an area identified as part of the Wiradjuri language group (Howitt 1904, Tindale 1974, MacDonald 1983, Horton 1994). This is an assemblage of many small clans and bands speaking several similar dialects (Howitt 1996, Tindale 1974, MacDonald 1983, Horton 1994). The Wiradjuri language group was the largest in NSW prior to European settlement. Wiradjuri people believe that "*Wiradjuri was created and come from the Wiradjuri creator. The origins of Wiradjuri…came from Wiradjuri country…from the beginning. We were always here*" (Yalmambirra 2013).

The Wiradjuri borders however were not static, they were most likely fluid, expanding and contracting over time to the movements of smaller family or clan groups. These boundaries ebbed and flowed through contact with neighbours, the seasons and periods of drought and abundance.

Social structures

It was the small family group that was at the core of Aboriginal society and the basis for their hunting and gathering life. The immediate family camped, sourced food, made shelter and performed daily rituals together. The archaeological manifestations of these activities are likely to be small campsites, characterised by small artefact scatters and hearths across the landscape. Places that were visited more frequently would develop into larger site complexes with higher numbers of artefacts and possibly more diverse archaeological evidence.

These small family units were part of a larger band which comprised several families. They moved within an area defined by their particular religious sites (MacDonald 1983). Such groups might come together on special occasions such as pre-ordained times for ceremonies, rituals or simply if their paths happened to

cross. They may also have joined together at particular times of the year and at certain places where resources were known to be abundant. The archaeological legacy of these gatherings would be larger sites rather than small family camps. They may include large hearth or oven complexes, contain several grinding implements and a larger range of stone tools and raw materials.

Identification and differentiation of such sites are difficult in the field. A family group and their antecedents and descendants occupying a particular campsite repeatedly over a long period of time may leave a similar pattern of archaeological signatures as a large group camped over a shorter period of time.

Material culture

Accounts of the material culture of Aboriginal people in the Murray Darling Depression have been detailed extensively by Oxley (1820), Bennet (1834) and later Beveridge (1883) and include descriptions of tools kits, weapons and clothing.

Bennet (1834) detailed the manufacture of possum and kangaroo skin coats using mussel shell scrapers to render the skin pliable. Kangaroo tail sinew made into thread and bone awls were used to stitch the skins into cloaks, many of which had ornamental patterns scratched onto the inner side. The kangaroo sinew was also recorded as used to create head ornaments in the form of hair nets stained with ochre or pipeclay for both men and women (Bennet 1834). Both Oxley (1820) and Bennet (1834) observed that both sexes had the *septum naris* perforated in which a bone, straw or stick was worn. The adult men were also missing an upper incisor attributed to a marker of initiation (Oxley 1820, Bennet 1834) .

A range of tools and weaponry were recorded including spear throwers, parrying shields, broad shields, clubs, shovels, axes and varieties of throwing sticks (Oxley 1820, Bennet 1834, White 1986) as well as trapping nets made from plant fibre cord (Beveridge 1883).

Digging sticks were used by women to collect vegetable foods and 'grub shovels' or small wooden spades were described by Eyre (1845) as being used to dig up grubs, ants and Mallee roots. Skin bags and bark troughs were used to carry water and baskets were made from grasses, rushes and netting (Beveridge 01889, Lawrence 1967). Beverage (1883) describes a wooden trough placed over coals for cooking and 'flints, mussel shells, kangaroo bones and split reeds were used in cutting and skinning foods' (Lawrence 1967, p. 86). Grindstones and pestles were used to pound roots and mill seed and along the Darling River the deliberate cultivation and harvesting of wild millets was recorded (Mitchell 1839, Allen 1974). The bark off trees was also cut and used to carry babies (Creamer 1985, p.4).

In an archaeological context, few of these items would survive, particularly in an open site context. Anything made from bark, timber or animal skins would decay quickly in an open environment. However, other items, those made of stone would survive where they were made, placed or dropped. Shell material may also survive in an archaeological context. Sources of raw materials, such as the extraction of wood or bark would leave scars on the trees that are archaeologically visible, although few trees of sufficient age survive in the modern context.

Food and Resources

There are several ethnographic recordings of Aboriginal life in the Murrumbidgee region from the 1800s. Most notably, the observations of Beveridge (1883) focused on the prevalence of Aboriginal people around water ways in the region. Early settlers and others who wrote about the Wiradjuri people and customs differentiated between the origin of some groups, referring to people as the Lachlan or Murrumbidgee tribes, or the Levels tribe for those between the two major rivers (Woolrych 1890). The Wiradjuri people were known as the people of the three rivers: the Wambool (Macquarie River), the Kalari (Lachlan River) and the Murrumbidjeri (Murrumbidgee River).

The Fivebough and Tuckerbil Wetlands, which are located approximately5 km north east of the proposal area, have always been an integral food resource for the Wiradjuri people (Creamer 1985). The abundance of natural edible plant and animal species present year-round meant that it became a gathering, hunting and fishing place that contributed greatly to the diet of the local tribes. Sustainable practices were employed to ensure that only enough food for the next meal was collected and breeding stocks were left untouched. Many native species still thrive here including ruby saltbush (*Enchylaena tomentosa*), old man saltbush (*Atriplex nummularia*), spiny saltbush (*Rhagodia spinescens*) and Hills Indigo (*Indigofera australis*). The extent of the Wiradjuri group means that there were many different environments that were exploited for natural resources and food. Like everywhere in Australia, Aboriginal people were adept at identifying and utilising resources either on a seasonal basis or all year round.

Historic accounts of Aboriginal people in the Riverine Plains of south eastern Australia reflect a group of people reliant on a range of both aquatic and terrestrial food resources. During certain seasons, fish, shellfish and waterfowl provided a significant part of the flesh diet and corresponds to periods where relatively small areas of land could support large groups of people. In other seasons populations living along the rivers were greatly reduced and the focus on and acquisition of aquatic resources changed. It is during these periods that terrestrial resources became more important and food gathering activities diversified.

During the annual flooding of the rivers, swamps and river flats were inundated and billabongs filled. Under these conditions the netting and trapping of fish by large groups of people became prevalent. The base of a large fibre net would be weighted down with clay heat retainers and at the top of the net reed bundles would be attached as floats. One man would hold one end of the net on the shore while the other would wade into the lagoon gradually dropping the net, once he reached the shore, forming a semi-circle. The two people would start pulling the net back, moving towards one another, hauling the catch of fish towards them. Such activities were recorded to have produced very large volumes of fish (Sturt 1833, p. 92, Beveridge 1883, pp. 28–30). Within major billabongs log traps were also constructed to trap fish within a smaller area, for easier access and often associated with large gatherings of people (Gilmore 1934). Additionally, women were recorded catching crayfish, where two women would trawl a fine gauged net along the lagoon bottom.

The trapping of ducks and other waterfowl in lagoons using large nets has also been observed and Beveridge suggests that over a season hundreds of birds are caught in this manner (Beveridge 1883). Additionally huge numbers of waterbird eggs during breeding season were collected using canoes (Beveridge 1883, p. 18).

Beveridge (1883) observed canoes being manufactured from a single sheet of Red Gum bark that was propped and moulded into the desired shape and left to season in the sun for ten to fifteen days (Beveridge 1883, pp. 24–25). He details pronged fish spears that doubled as a means to pole and paddle the canoes, used to harpoon fish in areas of reedy shallow water (Beveridge 1883, Kabaila 1999). Lawrence (1967) suggests that these spears were probably only used when the reed beds were filled with water and consequently not as important during the remainder of the year.

As the flood waters began to subside, the number of people the land could support began to decline. People began to fish in the broader reaches of the rivers using short, stout spears (Lawrence 1967, p. 76) and women would create weirs made of wooden stakes to trap larger fish in pools as the waters receded (Beveridge 1883, p. 30). Other types of fish traps across rivers have been recorded such as the bridging of a watercourse with a tree trunk with interwoven brush or saplings forming a net beneath the tree preventing larger fish from moving on. As the river flow dwindled and the fish became concentrated in smaller and smaller pools, fish-poisoning could be effectively employed (Lawrence 1967, p. 76).

Collection of river mussels using the toes was recorded by (Sturt 1833) and Balme suggested that mussels were the most common item in the remains of open midden sites along the Darling River and associated lakes in western NSW.

The range of methods employed to exploit aquatic resources were not a matter of random choice, but instead formed part of an annual cycle of fluctuations in river level and flow (Lawrence 1967).

A range of reptiles, other mammals and insects were also a common food type, in particular grubs and ants and ant eggs (Fraser 1892, Pearson 1981). Plant foods were equally as important and mostly consisted of roots and tubers, such as *Typha* or Cumbungi whose tubers were eaten in late summer and shoots in early spring. Other edible plants from the Wiradjuri region include the Yam Daisy or *Murnong*, eaten in summer and autumn, the Kurrajong seeds and roots, Acacia seeds and other rushes (Gott 1982).

3.2.2 AHIMS Search

The Aboriginal Heritage Information Management System (AHIMS) is maintained by OEH and provides a database of previously recorded Aboriginal heritage sites. A search provides basic information about any sites previously identified within a search area. However, a register search is not conclusive evidence of the presence or absence of Aboriginal heritage sites, as it requires that an area has been inspected and details of any sites located have been provided to OEH to add to the register. As a starting point, the search will indicate whether any sites are known within or adjacent to the investigation area.

A search of the AHIMS database was conducted over an area approximately 5 km x 5 km centred on the proposal area extent, on the 2nd of August 2018. The AHIMS Client Service Number was: 361544. An additional search of the AHIMS database was undertaken on the 13 December 2018 to provide a better understanding of the site type modelling in the area. The search was conducted over an area approximately 30 km x 30 km centred on the proposal area. The AHIMS Client Service Number was: 388779. The search area ranged from (Lat, Long) – 34.8091 , 146.1435 to (Lat , Long) - 34.3753 , 146.6039 . There were an additional 106 Aboriginal sites and one declared Aboriginal Place recorded in the search area. Figures 4 and 5 shows the locations of the AHIMS sites in relation to the proposal area and Table 2 shows a breakdown the of the site types.

Table 2 Breakdown of previously recorded sites with 30km of the proposal area.

Site Type	Number
Artefact (1 or more)	49
Modified Tree (Carved or Scarred)	49
Massacre	1
Stone Quarry	2
Aboriginal Resource and Gathering	2
Earth Mound/PAD	1
Earth Mound, Hearth (oven)	2
Artefact Scatter, Stone Quarry	1
Shell Midden	1
Restricted Site	1
TOTAL	**112**

None of the registered AHIMS sites are located within the proposal area. The closest sites are three scarred trees located approximately 1 km to the north. There is a dominance of scarred trees in the wider area especially where remnant stands of native trees exist.

One of these scarred tree sites (AHIMS# 49-6-001) is listed as destroyed. Email correspondence with OEH confirmed that the Restricted Site (AHIMS# 49-6-0036) does not fall within the proposed Yanco Solar Farm area, but is closer to Narrandera (*per email* OEH, Eva Day 14/12/18).

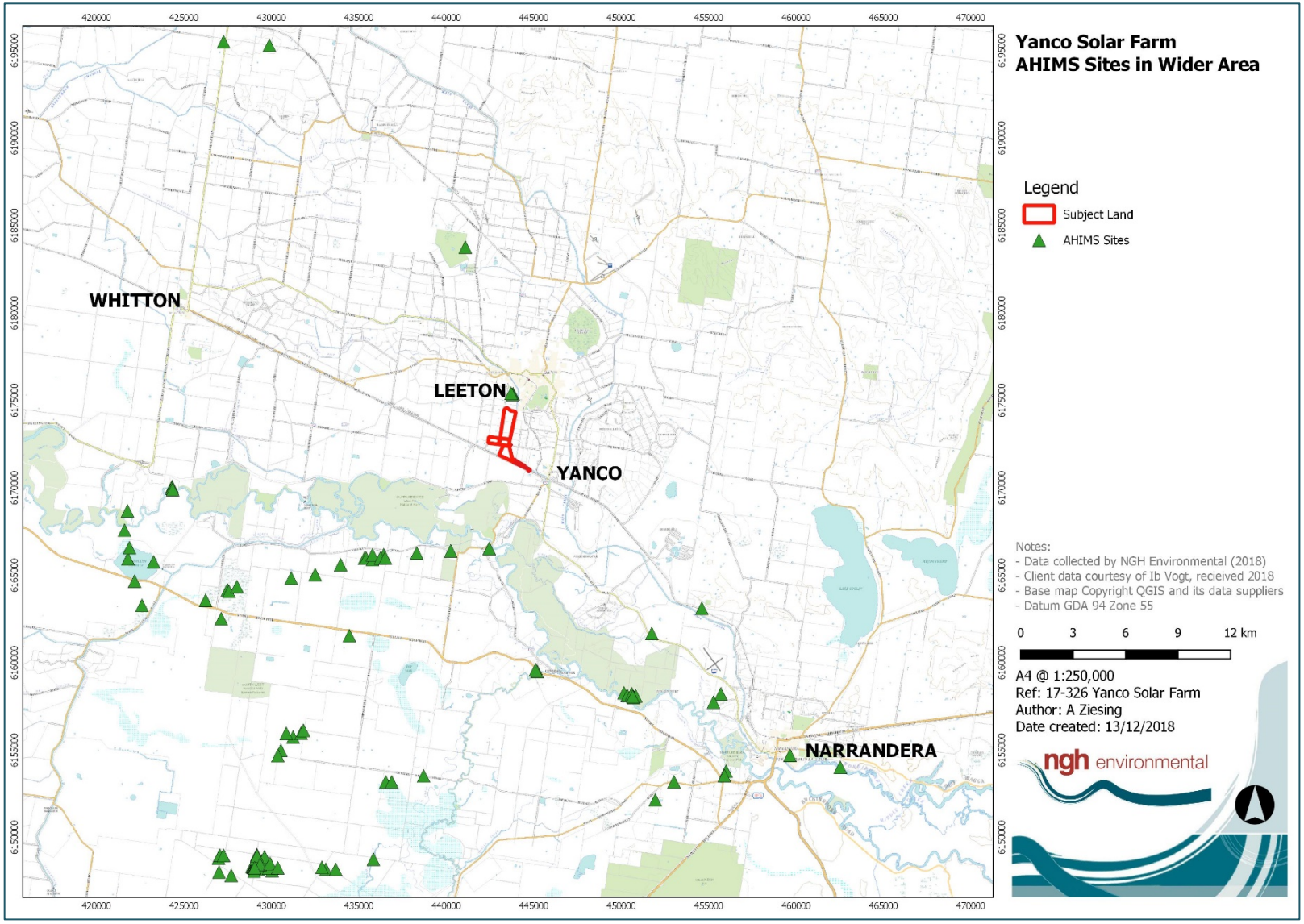

Figure 4 AHIMS Sites within a 30 km radius of the proposed Yanco Solar Farm.

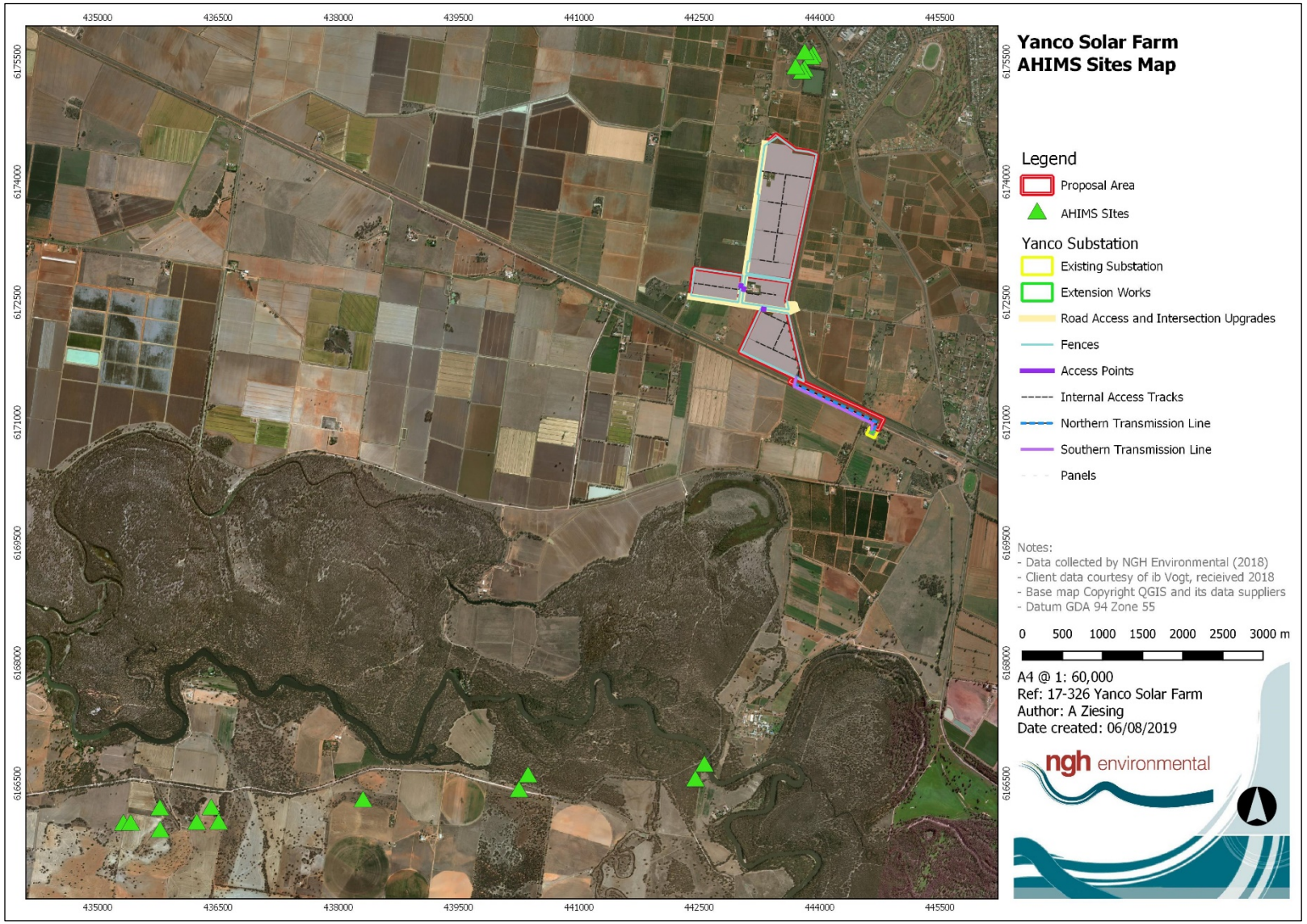

Figure 5. AHIMS Sites recorded within 5km of the Yanco Solar Farm, in the wider Leeton area.

3.2.3 Historic Heritage

Australian Heritage Database

A search of the Australian Heritage Database was completed on 13 December 2018. The following were found near the proposal area:

Table 3 Australian Heritage Database Search Results.

Scheme	Heritage Item	Status	Impact
Yanco Solar Farm	Dry Lagoon Area, Narrandera	Indicative Place	None
	Indigenous Place, Leeton	Registered	None

State and local heritage

Searches of the State Heritage Register were completed on 13 December 2018, which found 12 items of identified state significance was located near the proposal area.

Table 4 NSW State Heritage and S.170 NSW State Agency Heritage Registers Database Search Results.

Scheme	Heritage Item	Status	Impact
Yanco Solar Farm	Yanco Weir and site	Registered (#00969) – State Heritage Register	None
	Yanco Police Station and Official Residence	Registered – s.170 NSW State agency heritage register	None
	Gogeldrie Weir	Registered – s.170 NSW State agency heritage register	None
	Driveway Palm Trees	Registered – s.170 NSW State agency heritage register	None
	Gaol and Solitary Confinement Cell	Registered – s.170 NSW State agency heritage register	None
	Olive Trees	Registered – s.170 NSW State agency heritage register	None
	Rice Seed Germplasm Collection	Registered – s.170 NSW State agency heritage register	None
	Takasuka Monument	Registered – s.170 NSW State agency heritage register	None
	Yanco Agricultural Institute	Registered – s.170 NSW State agency heritage register	None
	Yanco Old Weir	Registered – s.170 NSW State agency heritage register	None

A search of the Leeton Local Environmental Plan 2014 was completed on 13 December 2018, which found 21 items of identified local significance within the proposal area.

Table 5 Local Environmental Plan Listings

Scheme	Heritage Item	Status	Impact
Yanco Solar Farm	Yanco Public Hall	Registered - Local	None
	Blue Gate Dam and Cudgel Escape, McCaughey Irrigation Works	Registered - Local	None
	Yanco Powerhouse Museum	Registered - Local	None
	Yanco Water Tower	Registered - Local	None
	Yanco Public School	Registered - Local	None

	Palm Tree row	Registered - Local	None
	Tatsuka Monument	Registered - Local	None
	Yanco Agricultural Institute, gaol and solitary confinement cell	Registered - Local	None
	Yanco Agricultural Institute, main buildings	Registered - Local	None
	Yanco Agricultural Institute, olive trees	Registered - Local	None
	Yanco Agricultural Institute, Rice seed germplasm collection	Registered - Local	None
	Water trough	Registered - Local	None
	Hotel Yanco	Registered - Local	None
	Yanco School of Arts (former)	Registered - Local	None
	Yanco Post Office (former)	Registered - Local	None
	St Mary's Anglican Church (former)	Registered - Local	None
	Yanco Police Station and lock up (former)	Registered - Local	None
	Catholic Convent	Registered - Local	None
	St Patrick's Catholic Church	Registered - Local	None
	Yanco Agricultural High School (former Samuel McCaughey's Homestead)	Registered - Local	None
	Yanco Conservation Area	Registered - Local	None

None of these items of historic heritage significance will be impacted by proposed Yanco Solar Farm. The closest site is over 750 m east from the proposal area.

All these historic heritage places are shown in Figure 6 below.

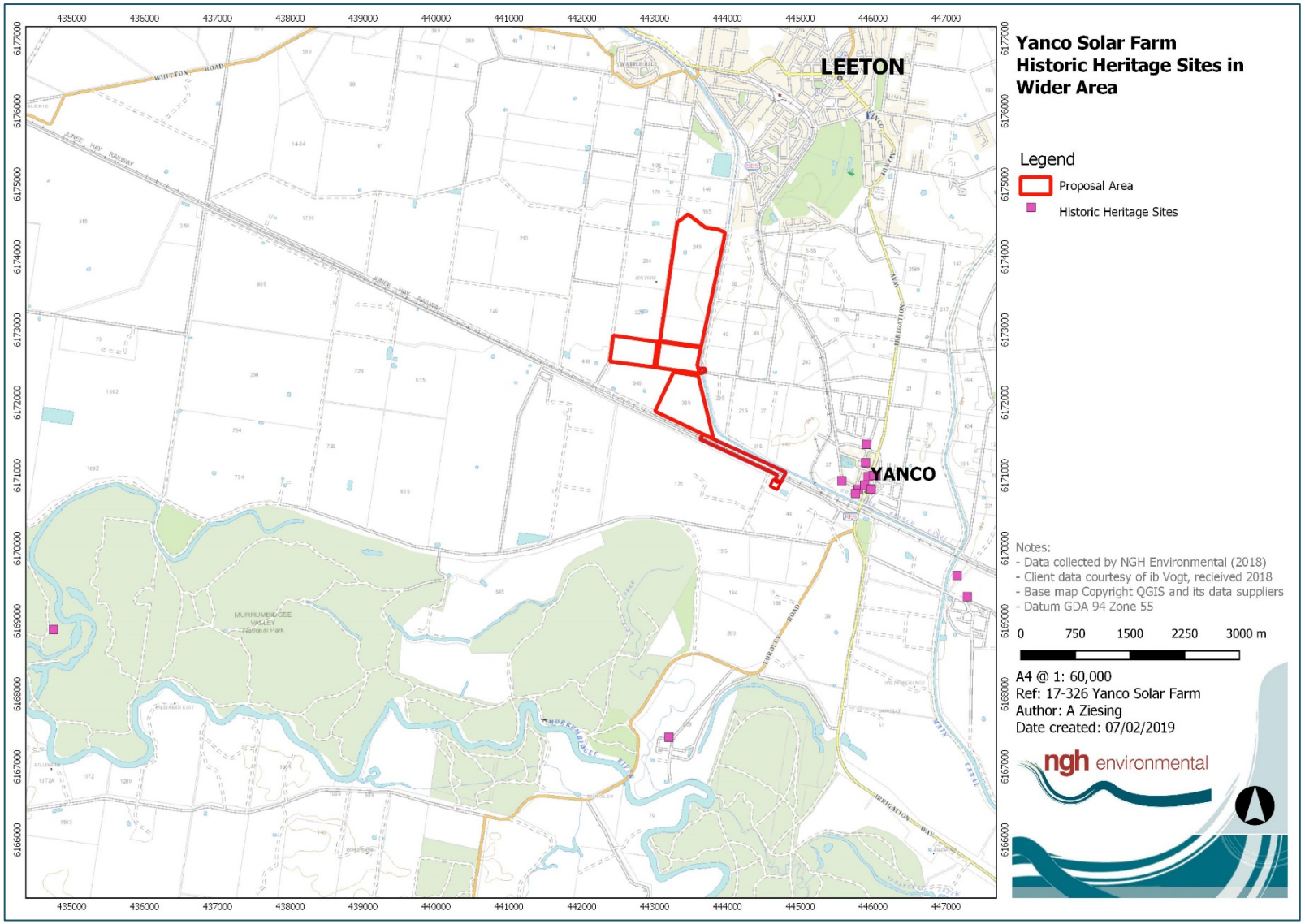

Figure 6 Historic Heritage Sites within the wider Yanco Area.

3.2.4 Archaeological Setting

Aboriginal people have occupied what we now know as the Australian continent for at least 40,000 years and perhaps 60,000 years and beyond (Mulvaney and Kamminga 1999, Hiscock 2007). Archaeological evidence from Lake Mungo, 160 km to the west of the proposal area provides ample evidence of Aboriginal occupation dating back 40,000 years (Bowler et al. 2003). No regional synthesis of the archaeology has been completed for the Yanco area however some archaeological investigations have been conducted relatively close to the study area. A summary of those surveys is provided below.

In 1977 McIntyre conducted an archaeological survey of the Tombullen Swamp, approximately 33 km south west of the proposal area. The swamp is an abandoned meander channel of the Murrumbidgee River near the entrance to the Tubbo Homestead. Source-bordering dunes area situated to the north and south west of the swamp. 18 archaeological sites were located, including 15 scarred trees and three artefact sites. Most of the tree sites were suspected of being used as bark canoes, with three of possible Aboriginal origin. The artefact sites contained low density finds of flakeable or ground material. Ground surface visibility was low surrounding the swamp, which prevented the identification of further sites of Aboriginal cultural heritage. No large artefact scatters, hearths or shell middens were identified. Areas of archaeological potential for burials were noted in the sand hills and a stop works procedure recommended for any works in this area.

In 1978 Kelly and Morris surveyed the Aboriginal sites at the Warrangesda Aboriginal Mission at Darlington Point approximately 53 km west of the proposal area. The report details the history of the Mission and discusses the two burial sites and access to these areas. Detailed accounts of the construction of the buildings by Aboriginal people living on the Mission is also provided. There are also registered sites cards for scarred trees in the area (AHIMS # 49-5-46 and 49-5-21).

In 1982 Gollan carried out a survey for the proposed 132 Kv transmission line from Darlington Point to Griffith. The survey route is approximately 19 km west of the proposal area. This survey identified artefact scatters, a stone quarry and scarred trees. Several scarred River Red Gum trees were recorded on the southern bank of the Murrumbidgee River and an artefact scatter was recorded that extended across both sides of Mirrool Creek. This survey identified an Aboriginal stone quarry on Whitton Road, where stone material was extracted for flaking. Gollan identified that the stone source as the pebbles from the pebbly sandstone and conglomerate beds, over a 40 m x 50 m area. Although the location was heavily disturbed from recent quarrying and machine extraction, Gollan (1982) found numerous cores, flakes and hammerstones confirming the Aboriginal use of the outcrop. Raw materials recorded included quartz, quartzite, chert, greenstone and basalt. The site also exhibited signs of excavation or quarrying to obtain better materials (Gollan 1982).

In 1982 Thompson undertook a survey from Darlington Point to Yanco for a proposed transmission line. The route from Darlington Point passed though mainly grazing country, away from the Murrumbidgee River before crossing over the river near Euroley Bridge and continuing through farmed land to the substation in Yanco. During the survey Thompson recorded several Aboriginal sites. The most common site type recorded was scarred trees, with scars present on several different tree species. Larger scars, attributed to extraction for possible canoes, were located away from the river, and were noted to most likely be extracted during flooding events when the water was higher. Several smaller scars were also identified on Black Box trees. The survey also identified several potential oven sites however they were unable to unequivocally determined to be Aboriginal in origin. One surface camp site was identified, and four isolated stone artefacts were also recorded. As stone is not a naturally occurring resource in the area, it was concluded by Thompson that these tools would have been brought to the area from outside resource areas.

In 1983 Witter completed an archaeological survey of the Yanco to Darlington Point Transmission Line for NPWS and ELCOM. The purpose of this report was to inspect the effect of development on the previously recorded sites (Thompson 1982) and to survey a 10 km deviation of the proposed route. All previously recorded sites were assessed including possible oven mounds, 32 scarred trees, grindstone and axe fragments and three historic sites. Four additional Aboriginal sites were identified, including two occupation sites and two scarred trees. The artefact and hearth sites were in plains, one in a ploughed field and the other in an exposure, within 100 m of a Black Box flood channel.

In 1985 Creamer completed a report on the cultural significance of the Koonadan – Tuckerbil Area to the Aboriginal people of the Leeton District. The investigations were conducted over a two-year period with members of the Leeton Aboriginal community, including three prominent Elders and younger individuals. It details the location, past uses of the area by Aboriginal people and the associated significance of the area, including historic links to the nearby Warangesda mission. The site contains skeletal remains within the sand hill, open campsites, hearths, scarred trees, Burbung grounds and resource places. Unfortunately, the scarred trees and Burbung (ceremonial) grounds have been removed through land clearance and cropping. The report also provides an overview of management procedures and future recommendations. These including the gazettal of portion 302 as an Aboriginal Place in 1983, which ceased sand mining in the area and saw the erection of fencing, signage and valuation of the land. Monitoring of the sites for erosion by the Leeton LALC is an ongoing procedure. Creamer subsequently recommends that management plans for Koonadan and neighbouring Tuckerbil Swamp are produced to provide regulatory protection of both sites.

In 1985 McIntyre carried out a survey for a 167 km transmission line between Darlington Point and Deniliquin. A total of 27 Aboriginal archaeological sites were recorded with one associated with historic features. The site types recorded were primarily scarred trees with artefact scatters, hearths and mounds also recorded. Artefacts were manufactured from silcrete, quartz, basalt, siltstone, chert and siliceous rock. All scarred trees recorded during the survey were Grey Box trees. McIntyre noted that most of the sites recorded were clustered around existing water courses. It was suggested that such areas were favoured by Aboriginal people as they provided several resources such as food, water and shade.

Work undertaken by Edmonds (Edmonds 1990, 1992, 1995, 1996) in the Benerembah Irrigation District (BID), a 44,000 hectare area 70 km west of the proposal area has established a model of site location for the region. The 1990 and 1992 surveys carried out by Edmonds within the BID recorded 13 scarred trees, 3 artefact scatters, 4 hearths, 2 of which were in association with artefacts and an open campsite (Edmonds 1996, p. 11). Edmonds differentiates a campsite from an artefact scatter by the presence of hearths and implements such as grindstones (Edmonds 1995, 1996). Six physiographic land units were identified in the BID, which were representative of the broader riverine plains. They included Prior Stream Formations, Elevated Lands, Alluvial Plains, Linear Depressions, Alluvial Floodplain and Occluded Depressions. It was concluded that two of these landforms were archaeologically sensitive, linear depressions and prior stream formations (Edmonds 1996, p. 11).

In 1993 Holmes completed a report on the conservation works of Warangesda Aboriginal Mission in Darlington Point, approximately 53 km west of the proposed solar farm area. While the theme of this report focuses on the historic heritage component, it has been included in this summary for its association with many of the Aboriginal community members of the Leeton area. The conservation of the site also included the preservation of artefact scatters, mounds and small hollows with adequate fencing. The Mission operated from 1879-1924 with food resources being subsidised by traditional fishing and hunting throughout the local region.

In 1995 Hamm carried out a survey for a 117 km optical fibre cable to link telephone exchange networks from Darlington Point, Coleambally, Finley and Jerilderie, between 50-150 km west of the proposed solar farm. A

total of 20 sites were recorded during the survey with three scarred trees located between Darlington Point and Coleambally and 17 scarred trees recorded between Finley and Jerilderie. All scars were on Yellow Box trees.

In 1997 Australian Archaeological Survey Consultants (AASC) assessed several unused gravel pits at Hull's Quarry located between Wagga Wagga and Narrandera that were identified for further extraction approximately 72 km south east of the current assessment area. The study area was 5 km north of Old Man Creek and 5 km south of the Murrumbidgee River. No sites were recorded, and it was noted that this may be due the distance from a reliable water source. It was also suggested that the absence of sites may be the result of prior disturbances in the area.

In 1998 Central West Archaeological and Heritage Services (CWAHS) surveyed the 40 km proposed optic fibre cable route between Morundah and Dundure that followed the Newell Highway (CWAHS 1998a). This survey route is approximately 54 km north of the current assessment area. A total of five sites were recorded during the survey. The sites were three mounds, a scarred tree and a mound/open campsite with an artefact scatter. The mounds were all located near watercourses (Yanco Creek). Five additional areas of potential archaeological sensitivity were also identified at sandhill and/or dune deposits along the proposed route for a total of 2.6 km. It was recommended that due to the sensitivity of these landforms that works should be monitored in these locations by a LALC representative or an archaeologist. It was noted that the potential for sites over most of the survey was low given that presence of black soils and the generally high level of surface disturbance.

In 1998 CWAHS (1998b) also surveyed the 22 km proposed optic fibre cable route between Narrandera and Euroley (CWS 1998b). No sites were recorded during the survey however two archaeologically sensitive sand hills were located along the Sturt Highway approximately 9.5 km and 16 km west of Narrandera. It was recommended that due to the sensitivity of the sand hill landforms that works should be monitored in these locations by a LALC representative or an archaeologist. It was noted that the potential for sites over most of the survey area was low.

In 1999 CWAHS surveyed the proposed widening of the Colombo Creek Bridge and the Colombo Creek Floodway Channel Bridge approximately 57 km south west of the current proposal area. A single quartz flake and an associated area of potential archaeological deposit (PAD) were recorded. It was noted that the PAD was a raised dune above the floodplain that had potential for burials and artefacts. It was recommended that works should be monitored and that the widening of the bridges and the approached occur on the western side of the road to avoid the archaeologically sensitive area.

In 2000 Barber completed subsurface investigations at Lake Wyangan in Griffith for the Local Aboriginal Land Council, approximately 72 km north west of the proposed solar farm. Surface artefacts were identified at four locations, including a lunette formation on the eastern side of Lake Wyangan (Area A). The ridge running north to south through the property was also identified as being archaeologically sensitive despite no surface artefact being identified (Area B). The sensitivity of the ridgeline pertained to its elevated nature and proximity to a creek line. 70 test pits were predicted for Area A and a further 40 test pits for Area B; however, this number was reduced during the fieldwork as some of the digging was undertaken with a mini excavator, resulting in the same volume of soil material being removed but over less surface area (Area A=12, Area B=13). A total of 35 artefacts, including one flaked glass artefact, were identified across Area A, with most of the finds coming from the top spit (0-10cm), but small numbers still occurring at 40-70cm depth. The lower depth find suggests that these sites may reflect very old Aboriginal archaeological material. The artefacts were spread across the lunette formation, with concentrations in the north, central and southern portions, but some test pits contained no artefactual material. Area B also contained artefacts, but within very low numbers, suggesting the area was not preferred for camping by Aboriginal people.

In 2001 Edmonds undertook a survey of the area surrounding the Euroley Bridge over the Murrumbidgee River on the Yanco-Sturt Highway Local Road, 3 km south of Yanco. The proposed works featured the replacement of the old Dare truss timber and iron bridge with a concrete two-lane bridge. A single Aboriginal site, a scarred tree, was recorded during the survey. The scarred tree was located on the southern bank of the Murrumbidgee River 19 metres east of the abutment of the original dare truss bridge. Edmonds noted that the lack of other identified sites within the project area was the result of the lack of archaeologically sensitive landforms in the area.

In 2009 OzArk completed an Aboriginal heritage assessment of the proposed water saving works at Coonancoocabil Lagoon near Yanco which is located approximately 9 km west of the proposal area. No Aboriginal sites or areas of potential subsurface deposit were recorded during this study.

In 2011 OzArk completed an Aboriginal heritage assessment for the McWilliams Hanwood Proposed Winery Expansion Project. This area is located approximately 56 km north west of the proposed solar farm and 4.8 km south of Griffith. Three Aboriginal sites were identified, including two isolated finds (1x silcrete flake, 1x silcrete core) and one artefact scatter (3x broken silcrete flakes), all in highly disturbed contexts. The former had been subject to extensive ploughing and the latter was found in a graded table drain of John Condon Road which was proposed as the area for installation of a water pipeline trench. The likelihood of locating occupation sites was deemed to be low, due to the distance of the survey site from permanent or ephemeral water sources. The identified finds were not expected and suggest that the area may have formed occupation centred around shallow depressions that retained water after inundation (OzArk 2011, p.24).

In 2015 OzArk completed an ACHA for the Euroley Poultry Production Complex 30 km west of Narrandera and approximately 14 km south west of the proposed Yanco Solar Farm. Two scarred trees and one hearth were identified during the survey, but no areas of potential subsurface deposit were found. The scarred trees (EPPC-ST1 and EPPC-ST2) were identified on Black Box species situated on a farm access track in predominantly cleared land 6-7km south of the Sturt Highway. The hearth site (EPPC-H1) consisted of fired clay and was located around 40m to the north west of an ephemeral floodway in an exposure on the edge of a cleared, ploughed paddock. The hearth was relatively intact and had not been damaged by the ploughing. No artefacts were associated with this site (OzArk 2015, p. 21). Overall, it was determined that the survey area only retained marginal potential for the identification of Aboriginal sites and no potential for subsurface archaeological material.

In 2016 NGH Environmental (2016a) conducted an assessment of the proposed Coleambally Solar Farm, approximately 71 km south west of the current assessment area. Despite the variable visibility encountered during the survey, no Aboriginal cultural material or objects were recorded. However, three European survey or blaze marker trees were identified. Given that much of the project area has been laser levelled and subject to extensive modification from laser levelling the lack of Aboriginal sites was not unexpected. Unfortunately, due to the extensive modifications of the drainage patterns, the construction of channels and continual cultivation of the project area the pre-European landscape of the area was unable established.

In 2016 NGH Environmental assessed the proposed Griffith Solar Farm, approximately 63 km north west of the current assessment area. Pedestrian survey was undertaken, and eleven artefacts were recorded however, they concluded that the potential for the presence of subsurface archaeological deposits would be low due to the sites land use history. NGH suggested that the models of site location in the Griffith area should be amended to reflect the fact that artefact scatters or campsites can occur at least 600m away from water sources within the broader floodplain environment, despite intensive agricultural practices (NGH Environmental 2016b, p. 20).

In 2016 OzArk conducted a Due Diligence Assessment of The Ranch Farm 4 and 5, approximately 89 km north west of the current proposal area. Desktop and pedestrian survey were undertaken however, no Aboriginal

sites or landforms were identified (OzArk 2016). The lack of Aboriginal heritage sites or objects within these three project areas was attributed to high levels of European disturbance, relatively long distances from water sources and lack of landforms identified to have high archaeological potential.

In 2018 Australian Cultural Heritage Management (ACHM) surveyed an area of approximately 600 ha for the proposed Sandigo Solar Farm, approximately 22 km south west of Narrandera, NSW. Six archaeological sites were located including two grindstones and four artefact scatters.

In 2017 and 2018 NGH Environmental conducted an Aboriginal Cultural Heritage Assessment of the proposed Avonlie Solar Farm, approximately 42 km south east of the current assessment area. Pedestrian survey was undertaken over 570 ha of land, and four artefact scatters, a scarred tree and 64 isolated artefacts were recorded however, they concluded that the potential for the presence of subsurface archaeological deposits would be low due to the sites land use history. An addendum to this assessment is underway, including an additional survey area for the powerlines. Two isolated artefacts and no areas of subsurface archaeological potential were identified during this fieldwork. The high number of grinding stones recorded suggested that this area was utilised for food processing. The dominant raw material type was quartz with lesser numbers of silcrete, sandstone, volcanic and quartzite material.

In 2018 OzArk conducted a survey of the proposed Yarrabee Solar Farm near Narrandera, approximately 26 km south east of the current proposal area. A total of 25 Aboriginal sites were identified, including nine isolated finds, 13 artefact scatters, one earthen mound and two scarred trees. The earthen mound and a dune landform within the proposal area were identified as having high archaeological potential.

There have also been several archaeological surveys conducted in the wider Murrumbidgee Province that contribute to an understanding of the nature of Aboriginal occupation.

In 1997 Bonhomme inspected several sites recorded on the NPWS Site register within the wider Riverine Plain as part of an examination of sand mining. From this research, it was suggested that burials within sand bodies are extremely common within the Riverine Plain however, burial location in sand bodies is highly variable across the plain. There is a strong correlation between burial sites and water sources, though this study could not determine whether this reflected Aboriginal occupation patterns or was due to the naturally close relationship between sand bodies and water sources on the Riverine Plain.

Sample surveys undertaken by Pardoe and Martin in 2001 within the Murrumbidgee Province covered an area of approximately 30,000 square kilometres, extending from Balranald to Narrandera and Booligal to Jerilderie. Using an analysis of landforms and identifying gaps in the archaeological knowledge based on the sites recorded in the AHIMS database, they found that there was a bias in the distribution of sites along major waterways and some landforms such as lunettes but there were also large gaps where no sites had been recorded. Pardoe and Martin surveyed 61 sample areas or quadrants from 22 Stations or locations across their project area. This resulted in 347 new sites being recorded. The major site types were scarred trees (26.2%), mounds (24.2%), open sites (14.4%), ovens (12.4%), burials (7.8%) and hearths (6.1%) as shown in Table 6.

Pardoe and Martin analysed their results to develop a predictive model for site distribution across the Murrumbidgee Province. They found that mounds varied in size, from 4 m-140 m in diameter and height also varied from 2 cm to 2 m. Mounds were most commonly found along floodplain creeks within River Red Gum and Black Box vegetation communities. They found that as well as being situated along the major rivers, they were also located on the plains to the north and south of the Murrumbidgee, such as around the edge of depressions such as lakes and swamps and on palaeochannel features. Mounds were often characterised as being situated on elevated ground such as lunettes, levees and dunes where silty sandy soil was prevalent (Pardoe and Martin 2001, pp. 82–87).

Table 6. Sites recorded in Murrumbidgee Province survey (Pardoe and Martin 2001: Table 5.4)

Site Type	Number	%
Modified trees	91	26.2
Mound	84	24.2
Open Site	50	14.4
Oven	43	12.4
Burial	27	7.8
Hearth	21	6.1
Midden	9	2.6
Isolated artefact	6	1.7
Dinner camp	5	1.4
Shell midden	3	0.9
Historic	3	0.9
Soak	1	0.3
Myth	1	0.3
Historic burial	1	0.3
Bora ring	1	0.3
Artefact scatter	1	0.3
Total	347	100.0

Burials occurred mostly as individuals within mounds but there were six locations where more than one burial were recorded. Most of the burials were observed as highly fragmented bone disturbed by rabbit activity. Scarred trees were found to be quite variable in the size of the scar with the largest scars being on River Red Gums. Scars were classified into three groups, ceremonial- which were associated with a known burial, extraction- used in extracting food such as honey or grubs, and functional- all other types. The latter varied in size from 0.18 m to 3.6 m in length and width from 0.09 m to 0.55 m with an average of 0.38 m.

Pardoe and Martin (2001) developed a predictive model of site distribution based on their results and an analysis of variables through the use of GIS mapping. They examined proximity to water and found that no sites were more than 12 km from a major river channel (in this case the Murrumbidgee River, and the Yanco, Box and Mirrool Creeks). They also found that 75% of sites were within 3.3 km of such water courses. An assessment of proximity to minor stream was made difficult by the presence of irrigation channels in their GIS layer but nevertheless, they also found that the average distance from a minor stream was 1.8 km and 75% of sites were within 2.2 km (Pardoe and Martin 2001, p. 106).

The conclusion regarding Aboriginal site modelling for the region to date suggests that the most archaeologically sensitive areas occur in association with major water sources, including anabranches and ephemeral and relict lake systems and relatively intact tracts of riverine red gum forest along the floodplains of the major active rivers and creeks, and Black Box fringed depressions. The archaeological sensitivity of source bordering dunes and lunettes to water sources, prior streams and sand bodies, including scalded environments is also noted.

3.2.5 Summary of Aboriginal land use

Previous archaeological surveys and excavations within the region demonstrate that there is a strong, complex and varied pattern of human use and movement through the landscape. This behaviour is recorded as a range of artefact and site types distributed and concentrated in specific landforms. Unsurprisingly there appears to be a strong association between the presence of potential resources for Aboriginal use and the presence of archaeological sites. Areas directly associated with water and or elevated ground appear to have the greatest potential for identification of Aboriginal cultural material. There are exceptions to this however and it is also reasonable to expect that Aboriginal people ventured away from these resources to utilise the broader relatively low-lying floodplain areas.

The identification of scarred trees where remnant old growth trees remain provides direct evidence of Aboriginal subsistence strategies. Scarred trees have been consistently identified on Black or Grey Box and River Red Gum within depressions, on riverbanks, lagoon margins and creek lines. The dominance of modified trees in the region can be attributed to more conspicuous nature of scarred trees as opposed to other artefacts, particularly when levels of visibility are low or significant land disturbance has occurred.

Mounds and hearths have been recorded in large numbers throughout the region most often located on elevated areas associated with creek banks, sand bodies, lunettes, river levees, lagoons, floodplain margins and minor distributaries.

The close association between mound sites and elevated areas associated with water has been noted. Excavation of several mounded sites demonstrates the long term and repetitive use of these areas, particularly following seasonal flooding (Klaver 1998). It is important to note that after occupation many mounded sites were used as Aboriginal burial sites.

Isolated artefacts and artefact scatters are routinely identified in association with the above site types and landforms. It is important to note however, that these sites have also been identified within the broader floodplain environment at least 600 m away from a water source.

Based on the previous archaeological investigations in the Yanco region and knowledge of Wiradjuri cultural practices and traditional activities the Yanco Solar Farm proposal area has a possibility of containing archaeological sites, given that Aboriginal people have lived in the region for tens of thousands of years. This would most likely be in the form of stone artefacts and scarred trees in areas of remnant vegetation.

3.2.6 Archaeological Site Location Model

Based on the results of the previous archaeological investigations in the general Yanco area, and through the extrapolation of sites from other areas of the Murrumbidgee plain, it is possible to provide the following model of site location in relation to the proposed Yanco Solar Farm.

Stone artefact scatters – representing camp sites artefact scatters can occur across the landscape, usually in association with some form of resource or landscape. Water bodies, such as rivers, ephemeral creeks or clay pans can also be a focus of Aboriginal occupation. These features are not present in the Yanco Solar Farm

proposal area but have been recorded in previous surveys in the Yanco region. These features are therefore possible to occur within the proposal area.

Hearths/Ovens – are identified by burnt clay used for heat retainers. Mounds are recorded in the region in association with resource locations. However, they could occur either independently or in association with other Aboriginal cultural features such as artefact scatters. Hearths are generally considered to be limited, one-off use or reused but few times and are smaller concentrations. Ovens are considered to represent larger features, often extending over a larger area and can include other material such as bone. This feature is unlikely to occur within the proposal area.

Mounds- are accumulations of heat retainer ovens that have built up over time. They are typically round or oval and range in length from just a few metres to over 100 m and range in height from 0.1 m to 2 m. They are identified by the presence of baked clay heat retainers, which have usually been brought to the location from a nearby source of natural clay such as a lake bed, swamp or drainage line. Mounds are generally found in proximity to wetland areas such as lakes, swamps and creeks, often elevated above these areas by being situated on sandy rises, lunettes, source bordering dunes and palaeochannels. Mounds are likely to contain a range of other archaeological features such as bone, shell, stone artefacts and burials. This feature has not been recorded in the Yanco or wider Leeton region. It is unlikely that this feature will occur within the proposal area.

Burials – are generally found within mound sites, in elevated sandy contexts or in association with rivers and major creeks. These features are not present within the Yanco Solar Farm proposal area; however, previous burial sites have also been recorded in the wider Leeton region. The lack of elevated sandy areas within the proposal area suggests that this feature is unlikely to occur within the proposal area.

Scarred Trees – these require the presence of old growth trees and are likely to be concentrated along major waterways and around swamp areas. There are no mature trees remaining in the proposal area and this feature is therefore unlikely to occur.

Stone resources – are areas where people used natural stone resources as a source material for flaking. This requires geologically suitable material outcropping to be accessible. The proposal area contains no natural outcropping stone of suitable material.

Shell Middens – are the agglomeration of shell material disposed of after consumption. Such places are found along the edges of significant waterways, swamps and billabongs. The proposal area contains no significant waterways, swamps and billabongs and this feature is therefore unlikely to occur.

Isolated Artefacts – are present across the entire landscape, in varying densities. As Aboriginal people traversed the entire landscape for thousands of years, such finds can occur anywhere and indicate the presence of isolated activity, dropped or discarded artefacts from hunting or gathering expeditions or the ephemeral presence of short-term camps.

In summary, the lack of topographic or landscape features and the highly modified and disturbed context of the proposal area means that there are few loci that could contain *in situ* archaeological traces. Nonetheless, given that Aboriginal people have lived in the region for tens of thousands of years, there is some potential for archaeological evidence to occur. This is most likely to be in the form of stone artefacts.

4 ARCHAEOLOGICAL INVESTIGATION RESULTS

4.1 SURVEY STRATEGY

The survey strategy was to cover as much of the ground surface as possible within the proposal area. Although the actual ground impact from the construction method for the proposed solar farm is likely to be low, the placement of solar arrays across the landscape has the potential to cover any cultural heritage sites.

The strategy therefore was to walk a series of transects across the proposed solar farm landscape to achieve maximum coverage. Because the proposed solar farm area was arranged in plantings of north-south and/or east-west orange trees and vineyards in evenly spaced rows, transects were spaced evenly between the rows of plantings with the survey team spread apart at 15 to 25 m intervals, walking in parallel lines. The evenly spaced nature of the orange trees and vineyards made this an ideal survey strategy. The team were able to walk in parallel lines, at a similar pace, allowing for maximum survey coverage and maximum opportunity to identify any heritage features.

The survey team consisted of between three and five people which allowed for approximately 45-125 m wide tract of the proposal area to be surveyed with each transect depending on the number of survey participants and the spacing of individuals. At the end of each transect, the team would reposition along a new transect line at the same spacing and walk back on the same compass bearing between the orange trees and vineyards. Two people surveyed the proposed transmission line, the widening access routes along Research Road and Toorak Road and intersection upgrades at Toorak Road and Canal Street, Irrigation Way and Canal Street, Toorak Road and Research Road and all associated access points and channel crossings into the proposed solar farm.

While no mature trees remained within the proposed solar panel area the remaining trees along the transmission line route and the Gogeldrie Branch Canal south of Research Road were inspected for Aboriginal modification (cf. Long 2005).

We believe that the survey strategy was comprehensive and the most effective way to identify the presence of Aboriginal heritage sites. Discussions were held in the field between the archaeologists and Aboriginal community representatives to ensure all were satisfied and agreed with the spacing, coverage and methodology.

The proposal area was divided into three sections as listed below and shown in Figure 7.

- Orange orchards;
- Vineyard; and
- Disturbed areas including ploughed paddocks, transmission lines and roads.

The initial survey was undertaken on the 22nd and 23rd of October 2018 by three archaeologists from NGH with two representatives from the Aboriginal community.

After the initial survey the area for the proposed transmission line was altered to the southern side of Houghton Road, making it necessary to undertake subsequent fieldwork on 11th December 2018. The same survey method was continued from the initial survey.

Notes were made about visibility, photos taken, and any possible Aboriginal features identified were inspected.

4.2 SURVEY COVERAGE

The survey was impeded by poor visibility in the orange orchard however the visibility in the vineyard was quite high, particularly in the field which had recently had the vineyard crop cleared and the paddock ploughed.

The visibility in the orange orchard ranged from less than 5% to 25% with an averaged visibility of 5%. The visibility in the vineyard ranged from 10% to 100% in the recently cleared and ploughed flied, with an average of 40%. Bare ground along vehicle tracks were inspected and all contributed to the effectiveness of the visibility and the survey coverage. The visibility of the disturbed areas along proposed transmission line, road widening, and intersection upgrade areas ranged from less than 5% to 40% with an averaged visibility of 15%.

Table 7 below shows the calculations of effective survey coverage and Plates 1-8 show examples of the transects landforms and visibility for the Yanco Solar Farm area.

Over the course of the field survey, approximately 25 km of transects were walked across the proposal area by each participant. Allowing for an effective view width of 5m each person, this equates to a total surface area examined of 52 ha. However, allowing for the visibility restrictions, the effective survey coverage for the orange orchards is reduced to 1.2 ha, or 1.8% and the effective survey coverage for the vineyard reduced to 9.6 ha, or 8%.

Overall, it is considered that the surface survey of the Yanco Solar Farm proposal area had sufficient and effective survey coverage. The results identified are considered a true reflection of the nature of the Aboriginal archaeological record present within the proposal area.

Plate 1 View north of tracks around the orange orchard.

Plate 2 View east of the orange orchards.

	
Plate 3 View east of vineyards .	Plate 4 View north of tracks around the vineyard.
	
Plate 5 View west showing ploughed vineyard field.	Plate 6 View south east of Irrigation Way and Canal Street intersection.
	
Plate 7 View south east showing the intersection of Research Road and Amato Road east of the Gogeldrie Branch Canal.	Plate 8 View west of proposed transmission line route, following exiting powerlines.

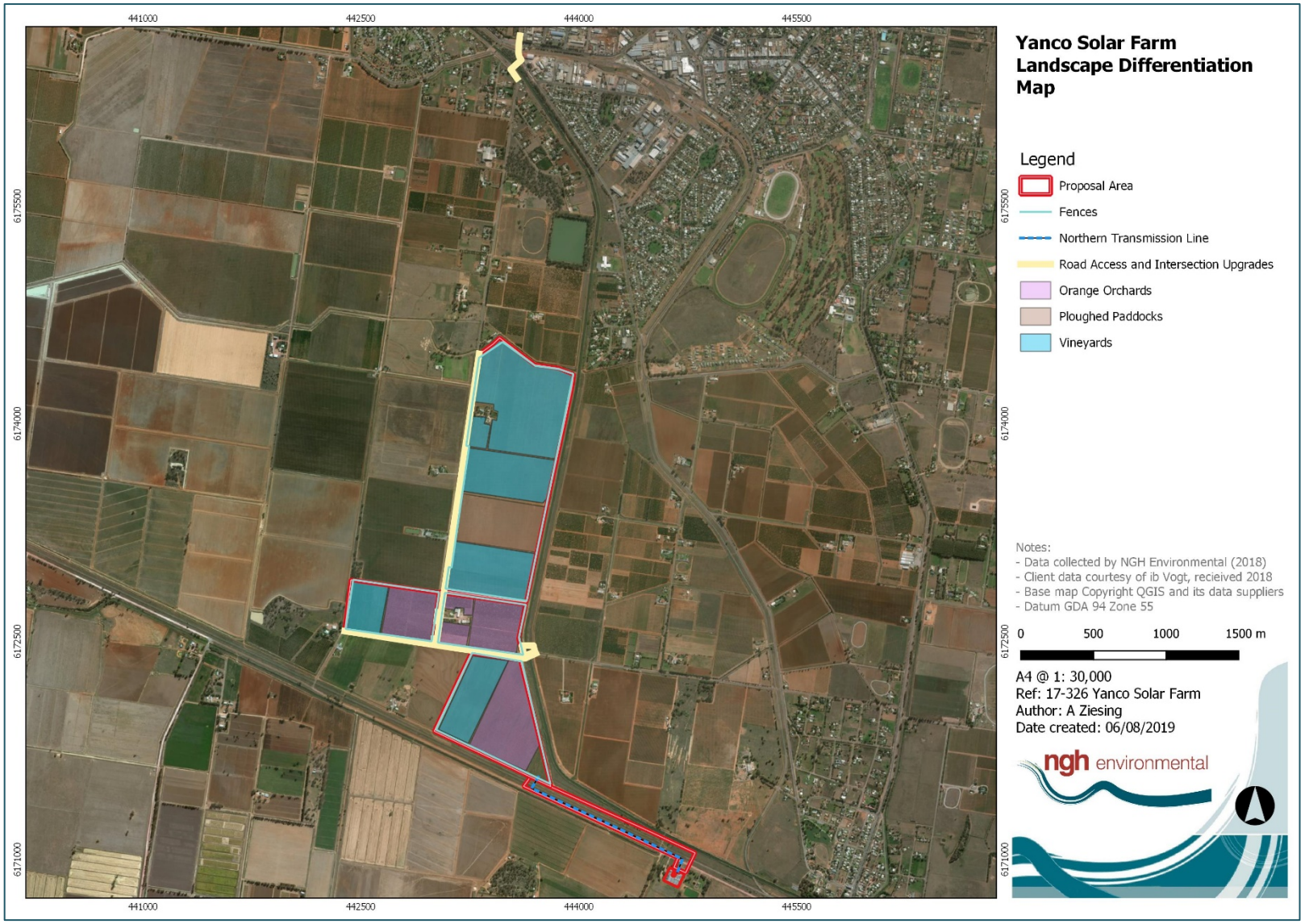

Figure 7 Landscape Differentiation across the Yanco Solar Farm proposal area.

Table 7. Transect information.

Survey Unit	Number of Survey Transects	Exposure type	Proposal Area ha	Surveyed area (length m x width m)	Survey Area m2	Visibility	Effective coverage (area x visibility) m2	Proposal Area surveyed (ha)	Percentage of Proposal area effectively surveyed	Archaeological Result
Orange Orchards	18	Bare ground and vehicle tracks.	66	3,000 x 25 6,500 x 25	237,500	5%	11,875	1.2	1.8	Nil
Vineyards	16	Bare ground, ploughed and cleared fields and vehicle tracks.	120	6,300 x 25 5,500 x 15	240,000	40%	96,000	9.6	8	Nil
Disturbed areas of ploughed paddock, transmission lines and roads	6	Bare ground, and vehicle tracks	14	4,000 x 10	40,000	15%	6,000	0.6	4.3	Nil

4.3 SURVEY RESULTS

Despite the variable visibility encountered during the survey, no Aboriginal cultural material or objects were found in the initial ACHA survey (Figure 8).

During the subsequent survey for the southern transmission line route, one new isolated artefact (YSF_IF_001) was identified between the south side of Houghton Road and the channel bank. This site consists of a single fine-grained red silcrete core located in a red cracking clay exposure south of Houghton Road and 2 m north of the channel bank. The core has three negative flake scars from two platforms with a secondary reduction stage and 15% pebble cortex. The site is heavily disturbed from channel silt dumping and the ground surface visibility is low (30%) due to the low-lying vegetation and surrounding road base gravels.

4.3.1 Consideration of Potential for Subsurface material

Discussions were held in the field with the representatives present to assess the potential for subsurface deposits across the proposal area. Based on the land use history, an appraisal of the landscape, soil, level of disturbance and the results from the field survey it was concluded that there was negligible potential for the presence of intact subsurface deposits with high densities of cultural material within the proposal area. It was determined by the archaeologists and representatives from the Aboriginal community present during the survey that subsurface testing was not warranted for this project.

4.4 DISCUSSION

The predictions based on the modelling for the proposal area was that stone artefacts were the most likely manifestation of Aboriginal occupation of the area, despite the high level of disturbance. However, the survey identified only one Aboriginal object within the proposal area, suggesting that the level of disturbance was even higher than originally assumed.

Given that most of the proposal area has been levelled and subject to extensive modification the lack of Aboriginal sites was not unexpected.

The absence of Aboriginal scarred trees in the proposal area was expected and corresponds directly with the lack of remnant old growth trees within and adjacent to the immediate proposal area. For a tree to have been a mature specimen suitable for bark extraction at the time Aboriginal people were last practicing tradition ways, the tree would have to be over 100 years old. The trees along the transmission line route and the Gogeldrie Branch Canal south of Research Road were young and did not conform to the standard scarring morphology accepted for Aboriginal modification (cf. Long 2005).

It is also possible that the Aboriginal occupation of the area focused on larger permanent sources of water and resources, such as the Murrumbidgee River and Yarangery Creek to the south of the proposal area. Unfortunately, due to the extensive modifications seen across the proposal area, the construction of channels and prolonged cultivation the pre-European landscape of the area is unable to be established and has been almost entirely disturbed.

In terms of the current proposal therefore, extrapolating from the results of this survey, it is unlikely that *in situ* stone artefacts could occur within the proposed development footprint. Based on the land use history of the proposal area, and an appraisal of the results from the field survey, there is negligible potential for the presence of intact subsurface deposits with high densities of objects or cultural material within the Yanco Solar Farm project area.

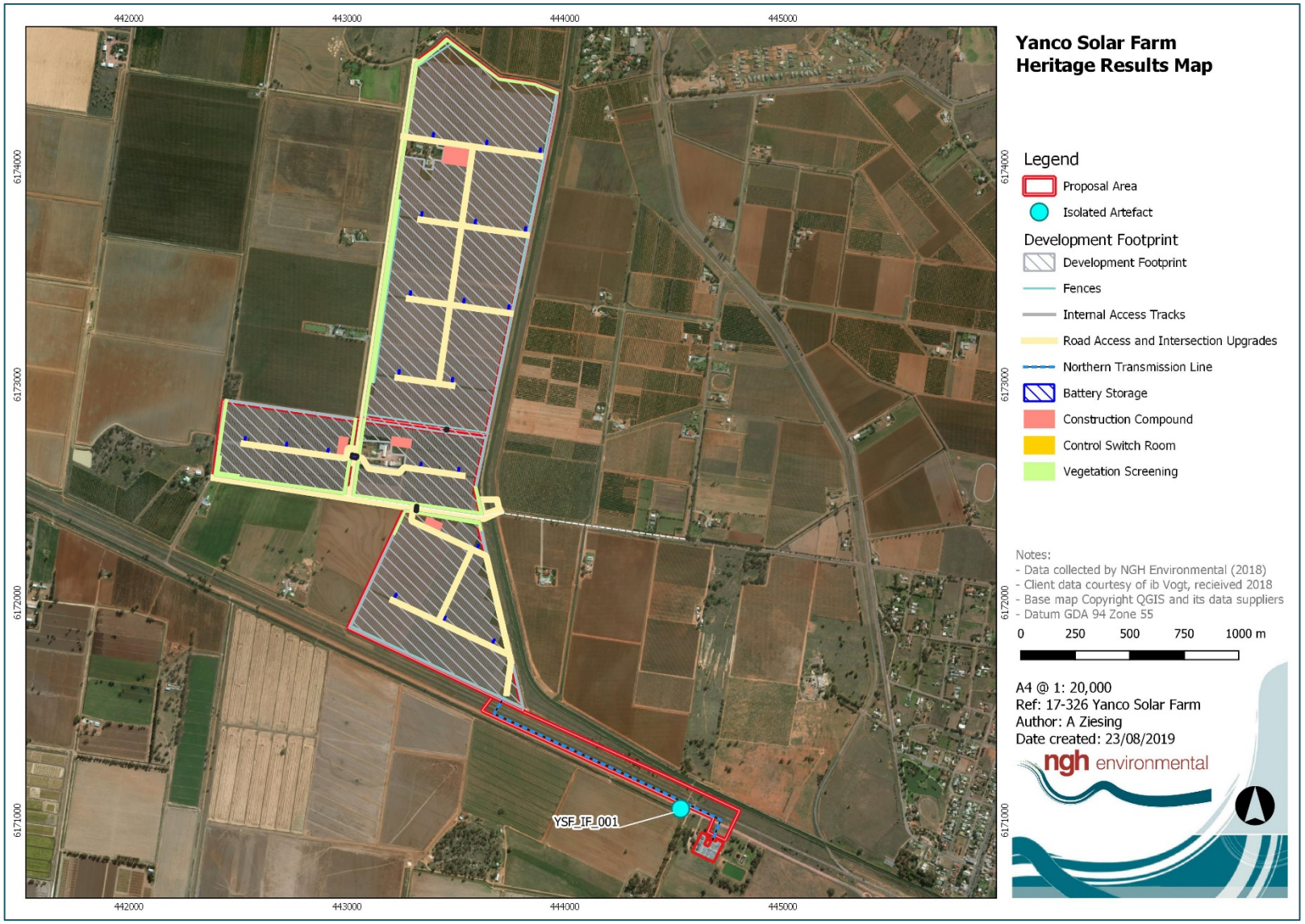

Figure 8 Heritage Results Map within the Yanco Solar Farm proposal area.

5 CULTURAL HERITAGE VALUES AND STATEMENT OF SIGNIFICANCE

The assessment of the significance of Aboriginal archaeological sites is currently undertaken largely with reference to criteria outlined in the ICOMOS Burra Charter (Marquis-Kyle and Walker 1994). Criteria used for assessment are:

- *Social or Cultural Value*: In the context of an Aboriginal heritage assessment, this value refers to the significance placed on a site or place by the local Aboriginal community – either in a contemporary or traditional setting.
- *Scientific Value*: Scientific value is the term employed to describe the potential of a site or place to answer research questions. In assessing scientific value issues such as representativeness, rarity and integrity are addressed. All archaeological places possess a degree of scientific value in that they contribute to understanding the distribution of evidence of past activities of people in the landscape. In the case of flaked stone artefact scatters, larger sites or those with more complex assemblages are more likely to be able to address questions about past economy and technology, giving them greater significance than smaller, less complex sites. Sites with stratified and potentially in situ sub-surface deposits, such as those found within rock shelters or depositional open environments, could address questions about the sequence and timing of past Aboriginal activity, and will be more significant than disturbed or deflated sites. Groups or complexes of sites that can be related to each other spatially or through time are generally of higher value than single sites.
- *Aesthetic Value*: Aesthetic values include those related to sensory perception and are not commonly identified as a principal value contributing to management priorities for Aboriginal archaeological sites, except for art sites.
- *Historic Value*: Historic value refers to a site or place's ability to contribute information on an important historic event, phase or person.
- *Other Values*: The Burra Charter makes allowance for the incorporation of other values into an assessment where such values are not covered by those listed above. Such values might include Educational Value.

All sites or places have some degree of value, but of course, some have more than others. In addition, where a site is deemed to be significant, it may be so on different levels or contexts ranging from local to regional to national, or in very rare cases, international. Further, sites may either be assessed individually, or where they occur in association with other sites the value of the complex should be considered.

Social or cultural value

While the true cultural and social value of Aboriginal sites can only be determined by local Aboriginal people, as a general concept, all sites hold cultural value to the local Aboriginal community.

Only one Aboriginal site was identified during the survey for the Yanco Solar Farm and no known cultural sites or places of value within the proposal area have been identified during the consultation process for this assessment.

Scientific (archaeological) value.

The isolated find is attributed a low scientific value due to the highly disturbed nature of the channel bank and road reserve in which it was located. There is no subsurface potential at this site. The artefact itself is intrinsically interesting in terms of its base technical information however, the lack of contextual and comparative archaeological material makes detailed conclusions about Aboriginal land use unachievable. In this instance, the isolated artefact cannot be used to assist in the development of site modelling for the region and has little scientific value for further research. Isolated finds are very common throughout the wider region and have a high site representation.

Aesthetic value

The modified and heavily disturbed landscape within the solar farm development area detracts from any aesthetic setting. There are no aesthetic values associated with the archaeological sites per se, apart from the presence of European survey marker trees in the landscape.

Historic value

There are no know historic vales associated with the proposal site or links to known people. The site does have some historic links to the occupation of the region by Aboriginal people. The closest site of historic value is located over 750 m east of the proposal area.

Other Values

There are no other known heritage values associated with the proposal area.

6 PROPOSED ACTIVITY

6.1 HISTORY AND LANDUSE

It has been noted above that historically the solar farm proposal area has been impacted through land use practices, levelling, clearing, ploughing and the construction of roads and irrigation canals.

The implications for this activity are that the archaeological record has been compromised in terms of the potential for scarred trees to remain within the proposal area. The scale of the earthworks for levelling, clearing and ploughing means that any stone artefacts that may have been present are now likely to have been removed or displaced.

Despite these localised impacts, Aboriginal artefacts and cultural material remain in the broader area with 112 Aboriginal sites previously recorded within a 30 km radius of the proposal area, indicating the presence of past Aboriginal people and providing indications of their use of this landscape.

PROPOSED DEVELOPMENT ACTIVITY

As noted above in Section 1.2, the proposal involves the construction of a solar farm and includes connection to the nearby substation via a transmission line. Minor extension works will be required at the Yanco substation to allow for the proposed solar farm connection however, these alterations will be contained within the boundaries of the substation and do not require ground disturbance. Some access roads require widening and intersection upgraded. The development will result in disturbance of approximately 204 ha encompassing Lots 142 and 145 – 152 DP 751745 and Lot 6650 DP1197165.

Disturbances will largely be in the preparation of the ground for the solar farm. Piles would be driven or screwed into the ground to support the solar array's mounting system, which reduces the potential overall level of ground disturbance.

- Flat plate PV modules would be installed on a pile-driven steel post and framing system across the site. Each of them would be linked to an inverter and a transformer.
- Trenches would be dug for the installation of a series of underground cables linking the arrays across the proposal site.
- Some internal access tracks would also be required, and typically these would comprise of a compacted layer of gravel laid on stripped bare natural ground.
- Some ancillary facilities would also be required including parking facilities, staff amenities and offices.
- A perimeter fence and a vegetation buffer would also be constructed around the solar farm.
- A power line would be installed to connect the solar farm the existing Yanco substation.

The proposal is expected to operate for around 30 years. The construction phase of the proposal is expected to take 10 months. After the initial operating period, the solar farm would either be decommissioned, removing all above ground infrastructure and returning the site to its existing land capability, or upgraded with new PV equipment.

The development activity will therefore involve disturbance of the ground during the construction of the solar farm and transmission line to the existing substation and the extension of the substation. Once established however, there would be minimal ongoing disturbance of the ground surface. The installation of the transmission line would provide the highest degree of ground disturbance if the underground construction method is used. Discussions with ib vogt during the production of this assessment determined that the northern transmission line route was too be used for the location of the proposed line, avoiding any impact to isolated find (YSF_IF_001). Therefore, no impacts will occur as a result of the proposed Yanco Solar Farm.

The final details and timing of the proposed construction activity have yet to be finalised, but it is anticipated that construction could commence in 2019.

6.2 ASSESSMENT OF HARM

As described in this report, only one isolated find (YSF_IF_001) was identified within the project area. ib vogt can avoid this site by utilising the proposed northern transmission line route. Therefore, the assessment of harm for the project is nil.

6.3 IMPACTS TO VALUES

The values potentially impacted by the development are any social and cultural values attributed to the project area by the local Aboriginal community. As described in this report, only one isolated find (YSF_IF_001) was identified within the project area, which will be avoided by utilising the northern proposed transmission line route. Therefore, the impact to values for the project is nil.

7 AVOIDING OR MITIGATING HARM

7.1 CONSIDERATION OF ESD PRINCIPLES

The consideration of the principles of Ecologically Sustainable Development (ESD) and the use of the precautionary principle was not required to be undertaken when assessing the harm to the isolated find site and the potential for mitigating impacts on Aboriginal heritage within the Yanco Solar Farm proposal area given that only one site of low scientific value and high site representativeness was identified. As this site will be avoided by the proposed solar farm works, the ESD principles do not apply to this assessment.

We therefore argue that the overall cumulative impact on the archaeological record for the region is nil given that only one site that is common in the surrounding region with no known cultural values was identified and will be avoided.

7.2 CONSIDERATION OF HARM

As described in this report, only one Aboriginal archaeological site was located within the project area and no cultural values within the project area have been identified by local Aboriginal community. Given the low number of Aboriginal archaeological sites and cultural values within the proposed Yanco Solar farm project area avoidance of this site is recommended and will be achieved.

7.3 AVOIDING OR MITIGATING HARM

Mitigation of harm to cultural heritage sites generally involves some level of detailed recording to preserve the information contained within the site or setting aside areas as representative samples of the landform to preserve a portion of the site. Mitigation can be in the form of minimising harm, through slight changes in the development plan or through direct management measures of the artefact. This has been achieved by selecting the northern transmission line route over the southern route and avoiding impacts to any newly identified Aboriginal cultural heritage.

If in the future the location is altered to the southern transmission line route, then salvage of isolated find (YSF_IF_001) is recommended in conjunction with the Leeton & District LALC to prevent impact to this site.

Installation of visible barrier fencing, including a 5 m buffer zone, around isolated artefact (YSF_IF_001) to prevent any inadvertent harm during the construction works.

ib vogt should prepare a Cultural Heritage Management Plan (CHMP) in consultation with Registered Aboriginal Parties (RAPs) and OEH which will include a heritage site induction for all contractors and works crews. The CHMP should include the UFP, heritage site induction information and mitigation strategy listed in Recommendation 2 to ensure that YSF_IF_001 is not harmed during the construction works.

It is noted that the Leeton & District LALC have requested to monitor any ground disturbance as a mitigation strategy for the proposed Yanco Solar Farm (Section 2.1). NGH do not believe that monitoring is warranted, in this instance, based on the archaeological survey results and the degree of previous disturbance across the proposal area. Any potential agreement between ib vogt and the RAPs to undertake monitoring falls outside of the legislative requirements covered by this assessment.

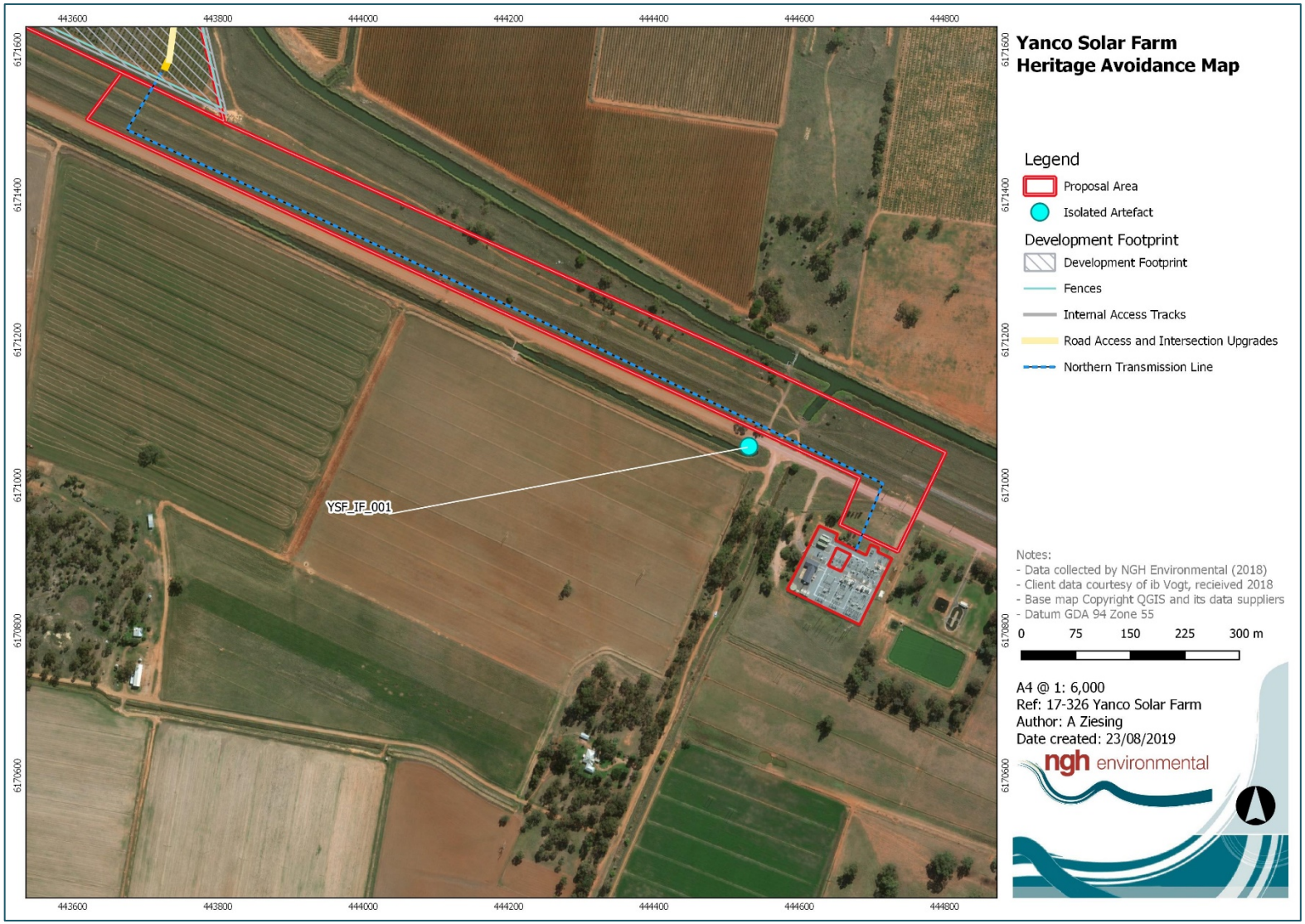

Figure 9 Avoidance map showing how isolated find (YSF_IF_001) will not be impacted.

8 LEGISLATIVE CONTEXT

Aboriginal heritage is primarily protected under the NPW Act and as subsequently amended in 2010 with the introduction of the *National Parks and Wildlife Amendment (Aboriginal Objects and Places) Regulation 2010*. The aim of the NPW Act includes:

> The conservation of objects, places or features (including biological diversity) of cultural value within the landscape, including but not limited to: places, objects and features of significance to Aboriginal people.

An Aboriginal object is defined as:

> Any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with the occupation of that area by persons on non-Aboriginal extraction and includes Aboriginal remains.

Part 6 of the NPW Act concerns Aboriginal objects and places and various sections describe the offences, defences and requirements to harm an Aboriginal object or place. The main offences under section 86 of the NPW Act are:

- A person must not harm or desecrate an object that the person knows is an Aboriginal object.
- A person must not harm an Aboriginal object.
- For the purposes of this section, "circumstances of aggravation" are:
    - that the offence was committed in the course of carrying out a commercial activity, or
    - that the offence was the second or subsequent occasion on which the offender was convicted of an offence under this section.
- A person must not harm or desecrate an Aboriginal place.

Under section 87 of the NPW Act, there are specified defences to prosecution including authorisation through an Aboriginal Heritage Impact Permit (AHIP) or through exercising due diligence or compliance through the regulation.

Section 89A of the Act also requires that a person who is aware of an Aboriginal object, must notify the Director-General in a prescribed manner. In effect, this section requires the completion of OEH AHIMS site cards for all sites located during heritage surveys.

Section 90 of the NPW Act deal with the issuing of an AHIP, including that the permit may be subject to certain conditions. This does not apply in this instance as the development is listed as a State Significant Development (SSD) and will be determined by the Department of Planning.

The EP&A Act is legislation for the management of development in NSW. It sets up a planning structure that requires developers (individuals or companies) to consider the environmental impacts of new projects. Under this Act, cultural heritage is considered to be a part of the environment. This Act requires that Aboriginal cultural heritage and the possible impacts to Aboriginal heritage that development may have are formally considered in land-use planning and development approval processes.

Proposals classified as State Significant Development or State Significant Infrastructure under the EP&A Act have a different assessment regime. As part of this process, Section 90 harm provisions under the NPW Act are not required, that is, an AHIP is not required to impact Aboriginal objects. However, the Department of Planning and Environment is required to ensure that Aboriginal heritage is considered in the

environmental impact assessment process. The Department of Planning and Environment will consult with other departments, including OEH prior to development consent being approved.

The Yanco Solar Farm proposal is a State Significant Development and will therefore be assessed via this pathway, which does not negate the need to carry out an appropriate level of Aboriginal heritage assessment or the need to conduct Aboriginal consultation in line with the requirements outlined by the OEH *Aboriginal cultural heritage consultation requirements for proponents 2010* (OEH 2010b).

9 RECOMMENDATIONS

The recommendations are based on the following information and considerations:

- Results of the archaeological survey;
- Consideration of results from other local archaeological studies;
- Results of consultation with the registered Aboriginal parties;
- The assessed significance of the sites;
- Appraisal of the proposed development, and
- Legislative context for the development proposal.

It is recommended that:

1. Avoidance of isolated artefact (YSF_IF_001) be achieved by utilising the proposed northern transmission line route (Figure 9).
2. Installation of visible barrier fencing, including a 5 m buffer zone, around isolated artefact (YSF_IF_001) to prevent any inadvertent harm during the construction works.
3. If the route is altered to the southern transmission line option in the future, then this site should be salvaged and reburied outside of the impact corridor in consultation with the Leeton & District LALC.
4. NGH does not believe it is warranted to undertake monitoring for ground disturbance associated with the proposed Yanco Solar Farm, based on the results of the surveys and level of previous disturbance across the site.
5. ib vogt should prepare an Unexpected Finds Protocol (UFP) to deal with construction activity and the inadvertent discovery of Aboriginal objects. An example UFP has been provided in Appendix D in case of finds.
6. ib vogt should prepare a Cultural Heritage Management Plan (CHMP) in consultation with Registered Aboriginal Parties (RAPs) and OEH which will include a heritage site induction for all contractors and works crews. The CHMP should include the UFP, heritage site induction information and mitigation strategy listed in Recommendation 2 to ensure that YSF_IF_001 is not harmed during the construction works.
7. In the unlikely event that human remains are discovered during the construction, all work must cease in the immediate vicinity. OEH and the local police should be notified immediately. Further assessment would be undertaken to determine if the remains were Aboriginal or non-Aboriginal. If the remains are determined to be Aboriginal in origin, then the Registered Aboriginal Parties (RAPs) and local Aboriginal community should be informed of the find.
8. Further archaeological assessment would be required if the proposal activity extends beyond the area of the current investigation. This would include consultation with the registered Aboriginal party and may include further field survey.

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APPENDIX A ABORIGINAL CONSULTATION

Organisation	Contact	Action	Date Sent	Reply Date	Replied by	Response
OEH	Andrew Fisher	Letter sent via email	2/08/2018	10/08/2018	Letter via email	Recommended contacting Leeton & District Shire LALC and Griffith LALC
NTScorp		Letter sent via email	2/08/2018	N/A	No response	No response
National Native Title Tribunal		Online search	2/08/2018			
Office of Registrar ***Aboriginal Land Rights Act***	Jodie Rikiti	Letter sent via email	2/08/20108	3/08/2018	Letter via email	Recommended contacting Karen Davy from Leeton & District LALC
Riverina Local Land Services	Julie Heath	Letter sent via email	2/08/2018	6/08/2018	Letter via email	Recommended contacting Karen Davy from Leeton & District LALC
Leeton Shire Council		Letter sent via email	2/08/2018	N/A	No response	
Leeton & District LALC	Karen Davy	Letter sent via email	2/08/2018	2/08/2018	Email	Registered interest in the project
Newspaper advertisement	Leeton Irrigator	Advertisement sent via email	12/07/2018			
OEH list of stakeholders						
Leeton & District LALC	Karen Davy	Already contacted	2/08/2018	2/08/2018	Email	Registered interest in the project
Griffith LALC	Robert Carroll	Letter sent via email	2/08/2018	N/A	No response	No response
Methodology						
Leeton & District LALC	Karen Davy	NGH sent methodology	13/09/2018	N/A	No comment or response	close date 11/10/18

Initial Fieldwork						
Leeton & District LALC	Karen Davy	2 representatives from 22-23 October 2018	27/09/18	15/10/2018	Email and phone	Confirmed 15/10/18
Addendum to Methodology sent to RAPs						
Leeton & District LALC	Karen Davy and Courtney Davy	Sent addendum to methodology to RAPs via email	22/11/2018	28/11/2018	Email	Confirmed availability for 11/12/2018
Subsequent Fieldwork						
Leeton & District LALC	Courtney Davy and David Watts	Reminder sent to 2 representatives for 11 December 2018 (phone)	10/12/2018	10/12/2018	Phone	Confirmed they would be present at 9:00am
Draft Report						**Comments due 17/01/2019**
Leeton & District LALC	Karen Davy	Sent draft report for comment	20/12/2018	11/01/2019	Email and phone	No issues with draft report
Final Report	Karen Davy	Sent final report via email	17/01/2019			
Addendum Letter						
Leeton & District LALC	Karen Davy	Sent addendum letter for substation extensions works for comment	01/02/2019			
Additional Access Point						
Leeton & District LALC	Karen Davy	Sent addendum email for additional access point off Research Road for comment	06/08/2019			

Correspondence received from Leeton & District LALC on the 2nd of August 2018 for registration.

From: L&DLALC Admin <admin@ldlalc.com.au>
Sent: Thursday, August 2, 2018 2:59:18 PM
To: Amy Ziesing
Cc: Karen Jamieson
Subject: Propose Solar Farm at Yanco

Hi Amy,

Our organisation would like to register our interest in the development as per the correspondence forwarded today by Karen Jamieson today.

Kind regards,

Karen Davy | Chief Executive Officer

Leeton & District Local Aboriginal Land Council

[redacted]

W: www.ldlalc.com.au

F: http://www.facebook.com/pages/Leeton-and-District-Local-Aboriginal-Land-Council/144759648990832

"Always Was, Always Will be Aboriginal Land"

Public Notice placed in the Irrigator on the 13th of July 2018.

Public Notices

Notification for registration of interest for Aboriginal stakeholders

NGH Environmental has been contracted by ib vogt GmbH to undetake an Aboriginal Cultural Heritage Assessment (ACHA) for a proposed solar farm comprising Lots 142, 145-152, 287 and 572 in DP751745, Lots 1 and 2 in DP1198789, Lot 182 in DP1198085, Lot 6650 in DP1197165 and Lot 1700 in DP1188161, approximately 5km south-east of Leeton in the Leeton Local Government Area.

The purpose of the consultation with Aboriginal people is to assist the proponent in the preparation of the ACHA and to be involved in consultation as part of possible lodgement of an Aboriginal Heritage Impact Permit application.

In order to fulfil the requirements set out in the OEH *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*, NGH Environmental is seeking interested Aboriginal parties who hold cultural knowledge of the assessment area to register their interest in the consultation process for the project and to assist in the determination of cultural significance of any Aboriginal objects or places located there.

Registrations should be provided in writing to:

NGH Environmental Pty Ltd

PO Box 5464

WAGGA WAGGA NSW 2650

Or via email to:

ngh@nghenvironmental.com.au

Closing date for registration is **27 July 2018.**
Those registering an interest will be contacted to discuss the project further. Those who do register are advised that their details will be provided to OEH and the Local Aboriginal Land Council, unless they specifically advise in writing that their details are not to be forwarded.

EUCHRE TOURNAMENT EVERY MONDAY
at the Leeton Men's Shed
Open to all men over 18 years
Starting Monday 30th July
$2.00 entry fee
1.00pm start and end about 3.30pm
Contacts Garry 0499 552 922
Ron 0427 800 426

OPEN HOME
110 WADE AVENUE
Saturday 21st July 10am - 11am
Ph: 0427 922 461

Positions Vacant

Murrumbidgee Irrigation

FIELD OPERATORS

Griffith and Leeton, NSW

We are seeking two highly motivated individuals to participate in the maintenance activities associated with MI's irrigation supply and drainage system. These full-time positions have an initial 12 month term.

The successful applicants will have: relevant industry experience; General Construction Induction certificate (White Card); and a 'HR' driver licence. Experience with mobile and heavy plant and machinery, including associated licences, would be highly desirable.

Applications should include a Murrumbidgee Irrigation application form and current resume, with a cover letter addressing ability to meet the following criteria.

- Ability to operate and maintain a range of vehicles, plant and equipment.
- Ability to assist in maintenance and construction activities according to Safe Work Method Statements and/or in accordance with verbal/written instructions.
- Ability to identify, analyse and report faults to plant and equipment.
- Experience in using technology to organise and document work activities.
- Experience in following WHS policies, procedures and regulatory requirements.

To obtain an application package, please visit www.mirrigation.com.au/Careers, or ring Karen Robertson on 02 6962 0200. For specific position enquiries, contact Simon Jackson (Civil Maintenance Facilitator) or Nev Gras (Supply Channels Program Leader) on 02 6962 0200.

Applications close: Friday 27 July 2018

Please mark your application 'CONFIDENTIAL' and forward to:

Human Resources, Murrumbidgee Irrigation, Locked Bag 6010, GRIFFITH NSW 2680

Or by email to:
karen.robertson@mirrigation.com.au

Positions Vacant

Narrandera Shire Council

POSITION VACANT

Truck Driver - HR Grade 6
$933.59 to $1045.62/week

Technical Officer Grade 13
$1152.64 to $1290.96/week

Closing Date 26 July 2018

For further information visit **www.narrandera.nsw.gov.au** or contact Council's Human Resources Department on **02 6959 5510**

Narrandera Shire Council

POSITION VACANT

Work Health Safety and Risk Officer Grade 16
$1339.50 to $1500.24/week

Closing Date 20 July 2018

For further information visit **www.narrandera.nsw.gov.au** or contact Council's Human Resources Department on **02 6959 5510**

Trade Services

Positions Vacant

Addendum letter outlining minor extension works to Yanco Substation sent to RAPS on 31st of January 2019.

ngh environmental

1 February 2019

Karen Davy
CEO
Leeton Local Aboriginal Land Council

admin@ldlalc.com.au

canberra
unit 8, 27 yallourn st
(po box 62)
fyshwick act 2609
t 02 6280 5053

bega
89-91 auckland st
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bega nsw 2550
t 02 6492 8333

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t 07 3129 7633

newcastle
2/54 hudson st
hamilton nsw 2303
t 02 4929 2301

sydney
unit 18, level 3
21 mary st
surry hills nsw 2010
t 02 8202 8333

wagga wagga
suite 1, 39 fitzmaurice st
(po box 5464)
wagga wagga nsw 2650
t 02 6971 9696
f 02 6971 9693

ngh@nghenvironmental.com.au
www.nghenvironmental.com.au

Dear Karen,

RE – Yanco Solar Farm Notice of Extension Works within Yanco Substation

Recently NGH Environmental was informed that ib vogt GmbH have updated the Yanco Solar Farm development footprint to include an area within the existing Yanco Substation. The area requiring extension works to allow for the solar farm connection lies within the current concrete pad of the substation and therefore does not need further heritage survey see Figure 1. This extension in the overall size of the development footprint will not impact upon the nearest isolated artefact (YSF_IF_001).

As a result of the change, NGH has updated the report, see attached, to reflect the new information. We would like to inform you that the internal substation extension has resulted in some minor changes to the Introduction (Section 1), Project Proposal (Section 1.2), Aboriginal Consultation Process (Section 2), maps and Appendix D in the ACHA. These minor updates in no way alter or affect any of the recommendations provided to you for review in the draft report.

Given that this update is only a minor change to the development footprint not needing any ground disturbance, there is no requirement to change the report conclusions or recommendations.

If you have any questions or concerns about this change in the development footprint, please do not hesitate to contact me on 6923 1548.

Yours Sincerely,

Amy Ziesing
Heritage Consultant
NGH Environmental

NGH Environmental Pty Ltd (ACN: 124 444 622. ABN: 31 124 444 622) ABN: 62 603 938 549)

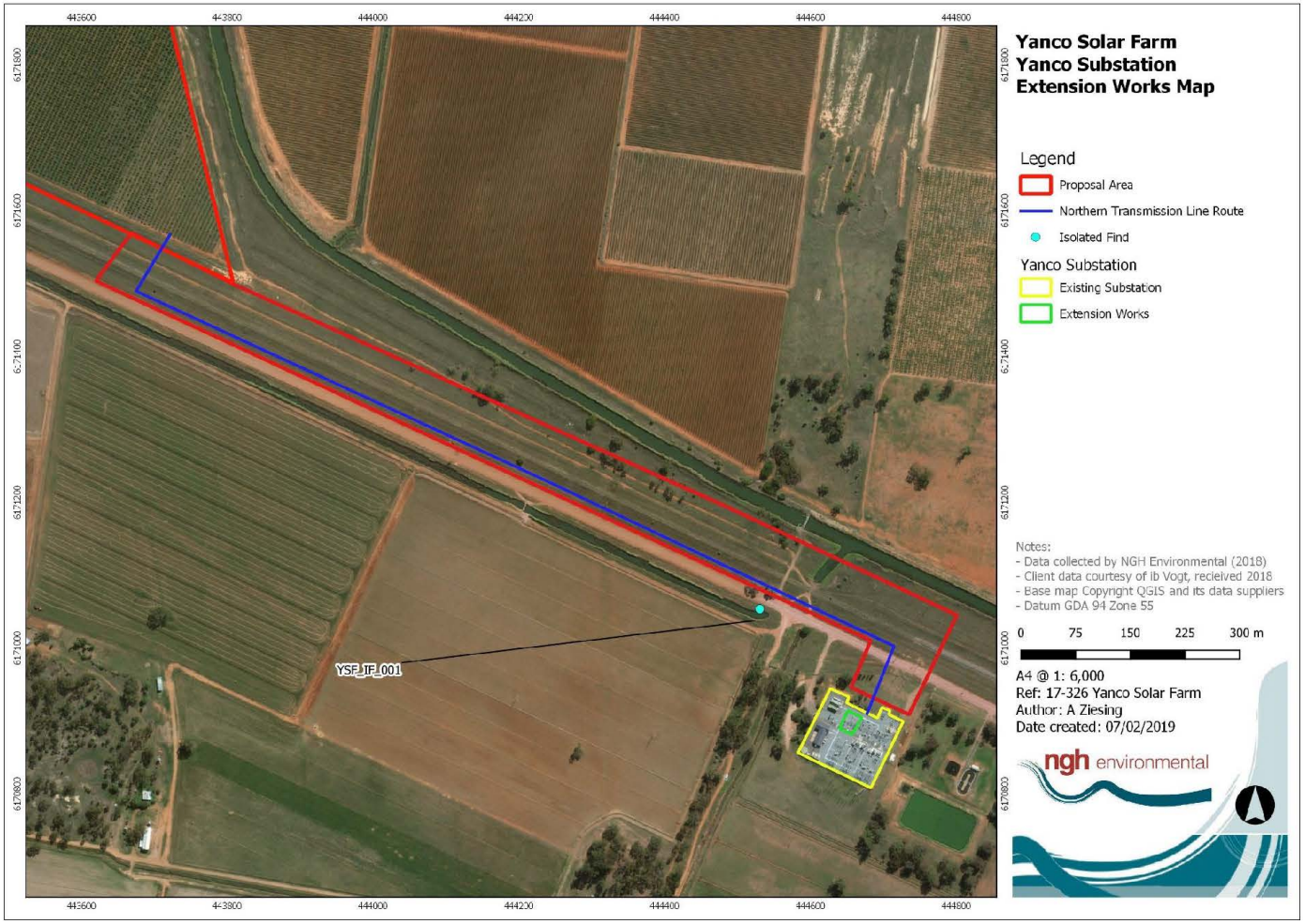

Figure 1. Extension works (**green**) to Yanco Solar Farm development footprint within existing footprint of Yanco Substation.

Addendum email sent to Leeton & District LALC outlining the additional access point from Research Road on the 6th of August 2019.

From: Amy Ziesing
To: admin
Subject: Yanco Solar Farm, additional access point from Research Road
Date: Tuesday, 6 August 2019 10:59:00 AM
Attachments: image001.png
Additional Access Point Map.jpg

Good Morning Karen,

I hope you are well?

NGH would like to inform the Land Council of an additional access point that is being proposed for the Yanco Solar Farm. This is off Research Road, east of the Gogeldrie Branch Canal crossing, in order to access the southern land parcels.
This area was already surveyed during the ACHA fieldwork so does not require any additional heritage investigation. I have attached a map to this email showing the additional access point.

Please let us know if you have any comments or queries regarding these additional works.

Kind Regards,
Amy

AMY ZIESING
HERITAGE
CONSULTANT/ARCHAEOLOGIST

T. 02 6923 1548 M. 0411 781 911
E. amy.z@nghconsulting.com.au
Suite 1, 39 Fitzmaurice Street
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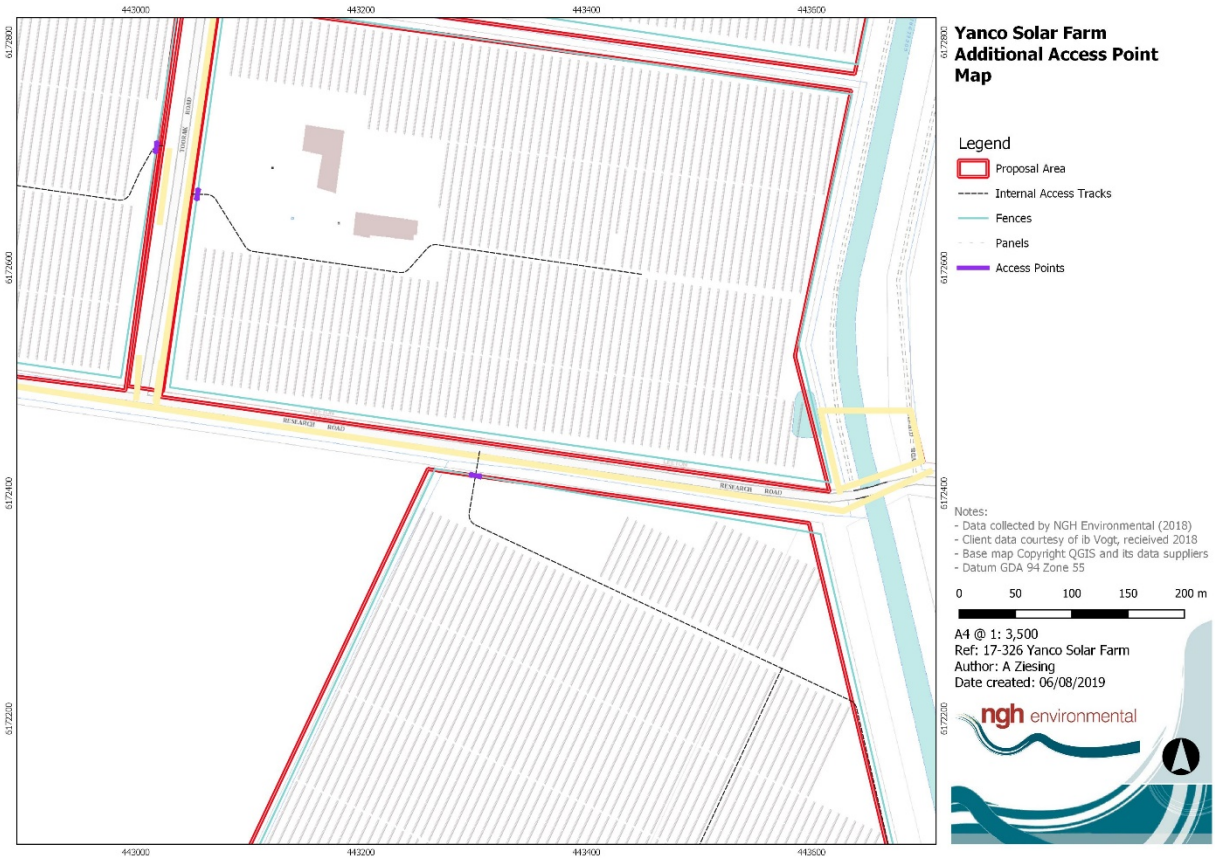
NGH

BEGA · BRISBANE · CANBERRA · GOLD COAST · NEWCASTLE · SYDNEY · WAGGA WAGGA
WWW.NGHCONSULTING.COM.AU



APPENDIX B AHIMS SEARCHES

This information has been removed for cultural reasons.

APPENDIX C ARCHAEOLOGICAL SITES

AHIMS #	Site name	Site type	Location		Description	Photos
49-5-0211	YSF_IF_001	Isolated Find	444530	6171053	This site consists of a single fine-grained red silcrete core measuring 103 mm x 113 mm x 38 mm. Located on the edge of a raised channel bank in a red cracking clay exposure south of Houghton Road. The core has three negative flake scars from two platforms with a secondary reduction stage and 15% pebble cortex. The site is heavily disturbed from channel silt dumping and the ground surface visibility is low (30%) due to the low-lying vegetation and surrounding road base gravels.	 Plate 9 Close up of red silcrete core YSF_IF_001.  Plate 10 View south west over location of YSF_IF_001.

APPENDIX D HERITAGE UNEXPECTED FINDS PROCEDURE

Aboriginal Heritage Unexpected Finds Protocol

Purpose

This unexpected finds protocol has been developed to provide a method for managing unexpected non-Aboriginal and Aboriginal heritage items identified during the construction and maintenance of the Project. The unexpected finds protocol has been developed to ensure the successful delivery of the Project while adhering to the NSW *National Parks and Wildlife Act 1974* (NPW Act).

Despite undertaking appropriate heritage assessment prior to the commencement of the Project, unexpected heritage items may still be identified during construction, operation and maintenance works. If this happens the following unexpected finds protocol plan should be implemented.

What is a Heritage Unexpected Find?

An unexpected heritage find is defined as any possible Aboriginal heritage object or place, that was not identified or predicted by the project's heritage assessment and is not covered by appropriate permits or development consent conditions. Such finds have potential to be culturally significant and may need to be assessed prior to development impact.

Unexpected heritage finds may include:

- Aboriginal stone artefacts, shell middens, modified trees, hearths and rock art; and
- Human skeletal remains.

Aboriginal Heritage places or objects

All Aboriginal objects are protected under the NSW *National Parks and Wildlife Act 1974* (NPW Act).

An Aboriginal object is defined as:

> Any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with the occupation of that area by persons on non-Aboriginal extraction and includes Aboriginal remains.

All Aboriginal objects are protected and it is an offence to harm or desecrate an Aboriginal object or place.

Unexpected finds management procedure

In the event that any unexpected Aboriginal heritage places or objects are unexpectedly discovered during the Project, the following management protocols will be implemented:

1. Works at that identified heritage location will cease with an appropriate buffer zone of at least 20 metres to allow for the assessment and management of the find. All site personal will be informed about the buffer zone with no further works to occur within the buffer zone.
2. An Aboriginal heritage specialist and OEH (131 555) be informed as soon as practical to assess the Aboriginal place or object encountered. Representatives from the registered the Aboriginal Stakeholders for the Project may also be engaged to assess the cultural significance of the place or object;

3. The Project approvals will be reviewed to assess consistency with the approvals to impact Aboriginal heritage within the Project area;
4. No work will be recommended at the particular location unless authorised in writing by OEH;
5. Depending on the nature of the discovery, additional assessment may be required prior to the recommencement of work in the area. At a minimum, any find should be recorded by an archaeologist.

Human Skeletal Remains

Where human skeletal remains are unexpectedly found during works for the Project the following protocol would be adopted:

1. Works at that location will cease, and an appropriate buffer zone of at least 50 metres will be established;
2. The human remains will not be moved;
3. The NSW police will be notified, and if the human remains are deemed a crime scene, the place will be managed by the police;
4. Should the human remains be deemed Aboriginal by the police, OEH must be notified as soon as practical on 131 555 providing any details of the Aboriginal remains to provide further assessment; and
5. Should the human remains be deemed Aboriginal in origin all registered Aboriginal parties and the local Aboriginal community for the Project are to be notified in writing.

The above process functions only to appropriately identify the human remains and secure the site, from which time the management of the remains is to be determined through liaison with the NSW police, OEH and the relevant Aboriginal stakeholders.

APPENDIX F REVISED BDAR

Biodiversity Development Assessment Report

YANCO SOLAR FARM BDAR

JULY 2019

Document Verification

Project Title: Yanco Solar Farm BDAR

Project Number: 17-326

Project File Name: Yanco Solar Farm BDAR

Revision	Date	Prepared by (name)	Reviewed by (name)	Approved by (name)
Final V1.1	9/11/18	J Murphy J Gooding (Accredited BAM Assessor -BAAS18074)	Mitch Palmer (Accredited BAM Assessor -BAAS17051)	Mitch Palmer (Accredited BAM Assessor -BAAS17051)
Final V1.1	16/07/19	J Murphy J Gooding (Accredited BAM Assessor -BAAS18074)	Mitch Palmer (Accredited BAM Assessor -BAAS17051)	Mitch Palmer (Accredited BAM Assessor -BAAS17051)
Final V1.2	24/07/19	J. Gooding - minor changes (Accredited BAM Assessor - BAAS18074)	Mitch Palmer (Accredited BAM Assessor -BAAS17051)	Mitch Palmer (Accredited BAM Assessor -BAAS17051)

NGH Environmental Pty Ltd (ACN: 124 444 622. ABN: 31 124 444 622)

www.nghenvironmental.com.au e: ngh@nghenvironmental.com.au

Sydney Region
18/21 mary st
surry hills nsw 2010 (t 02 8202 8333)

Canberra - NSW SE & ACT
8/27 yallourn st (po box 62)
fyshwick act 2609 (t 02 6280 5053)

Bega - ACT and South East NSW
89-91 auckland st (po box 470)
bega nsw 2550 (t 02 6492 8333)

Newcastle - Hunter and North Coast
1/54 hudson st
hamilton nsw 2303 (t 02 4929 2301)

Wagga Wagga - Riverina and Western NSW
suite 1, 39 fitzmaurice st (po box 5464)
wagga wagga nsw 2650 (t 02 6971 9696)

Brisbane
suite 4, level 5, 87 wickham terrace
spring hill qld 4000 (t 07 3129 7633)

CONTENTS

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

BAM	Biodiversity Assessment Methodology
BC Act	Biodiversity Conservation Act 2016 (NSW)
BDAR	Biodiversity Development Assessment Report
BOM	Australian Bureau of Meteorology
BOS	Biodiversity Offsets Scheme
CEEC	Critically Endangered Ecological Community
CEMP	Construction environmental management plan
Cwth	Commonwealth
DBH	Diameter at breast height
DoE	Department of the Environment (Cwth), now Department of the Environment and Energy
DPE	Department of Planning and Environment (NSW)
DPI	Department of Primary Industries (NSW)
EEC	Endangered ecological community – as defined under relevant law applying to the proposal
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwth)
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
ESCP	Erosion and Sediment Control Plan
FM Act	*Fisheries Management Act 1994* (NSW)
GHG	Greenhouse gases
GIS	Geographic Information System
ha	Hectares
HBT	Hollow-bearing tree
IBRA	Interim Biogeographic Regionalisation for Australia
Ib Vogt	The proponent
km	kilometres
kV	Kilovolts
LEP	Local Environment Plan
LLS Act	*Local Land Services Act 2013* (NSW)
LRET	Large-scale Renewable Energy Target
m	Metres
mm	Millimetres

MIA	Murrumbidgee Irrigation Area
MNES	Matters of National environmental significance under the EPBC Act (*c.f.*)
MW	Megawatts
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
NSW	New South Wales
OEH	(NSW) Office of Environment and Heritage, formerly Department of Environment, Climate Change and Water
PCT	Plant Community Type
PV	Photovoltaic
REAP	Renewable Energy Action Plan
SAII	Serious and Irreversible Impact
SEARs	Secretary's Environmental Assessment Requirements
SEED mapping	Sharing and Enabling Environmental Data Portal
SEPP	State Environmental Planning Policy (NSW)
SIS	Species Impact Statement
sp/spp	Species/multiple species
SSD	State Significant Development
The proposal	Yanco Solar Farm
VIS	Vegetation Information System

EXECUTIVE SUMMARY

ib vogt GmbH (ib vogt) is planning for the construction and operation of a 60 megawatt (AC) / 72 Megawatt (DC) photovoltaic solar farm at Yanco, in the Leeton Local Government Area, NSW. The proposal would develop approximately 183 ha of the 187 ha subject land. This Biodiversity Development Assessment Report (BDAR) has been prepared by NGH Environmental on behalf of the proponent, ib vogt.

The aim of this BDAR is to address the biodiversity matters raised in the Secretary's Environmental Assessment Requirements (SEARs) and to address the requirements of the Biodiversity Conservation Act 2016. This BDAR forms part of an Environmental Impact Statement (EIS) for the State Significant Development (SSD), prepared under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The Biodiversity Assessment Methodology (BAM) is the required assessment methodology for SSDs that trigger the NSW Biodiversity Offsets Scheme, under the NSW *Biodiversity Conservation Act 2016.* This report follows the field work methodologies and assessment format required by the BAM.

Comprehensive mapping and field surveys were completed in accordance with the requirements of the BAM. The development site has been selected to avoid impacts to native vegetation and threatened species. The majority of the development site (190 ha) is comprised of exotic vegetation in the form of orange orchards and vineyards. 0.49 ha of forb-rich Speargrass - Windmill Grass – White Top Grassland of the Riverina Bioregion and 0.05 ha of Weeping Myall Woodland would be cleared for the construction of the transmission line from the solar farm to the substation. Clearing of this native vegetation results in the generation of 11 ecosystem credits.

Two fauna species credit species, the Superb Parrot (*Polytelis swainsonii*) and White-bellied Sea Eagle were observed within the development site during the site surveys. No breeding habitat is present for these species within the development site and no species credits are generated. Impacts to these two species are considered within the ecosystem credits.

One flora species credit species, the Small Scurf Pea (*Cullen parvum*) was unable to be surveyed for during the appropriate survey period and was assumed to be present on site. 11 species credits were generated for this species.

Targeted surveys were undertaken for 14 other species credits species. These threatened species were not detected within the development footprint and no offsets are required for these species.

Impacts to federally listed species that have the potential to occur in the development site have been assessed. Potential impacts have been assessed in accordance with the EPBC guidelines and are considered unlikely to be significant. No referral is considered necessary to the Federal Department of Environment and Energy.

Consideration has been given to avoiding and minimising impacts to biodiversity throughout each phase of the proposal to date. Site selection options have been assessed against key environmental, social and economic criteria. Mitigation and management measures will be put in place to adequately address impacts associated with the proposal, both direct and indirect.

The retirement of the credits generated will be carried out in accordance with the NSW Biodiversity Offsets Policy under the *Biodiversity Conservation Act 2016.* With the retirement of credits and effective implementation of the mitigation measures, the proposal is consistent with the requirements of the BAM.

1 INTRODUCTION

The proposed Yanco Solar Farm is classified as State Significant Development (SSD) under the State and Regional Development State Environmental Planning Policy (SEPP) and therefore a 'major project'. This Biodiversity Development Assessment Report (BDAR) assesses the impacts of the proposed Yanco Solar Farm (the proposal) according to the NSW Biodiversity Assessment Methodology (BAM) as required by the Secretary's Environmental Assessment Requirements (SEARs) for the proposal.

The following terms are used in this document:

- **Development footprint:** the area of land that is directly impacted by the proposal. Includes solar array design, perimeter fence, access roads, transmission line footprint, and ancillary facilities and stockpiles. The development footprint is around 183 hectares (ha).
- **Development site:** the area of land that is subject to a proposed development. The development site is around 210 hectares (ha). The development site is the area surveyed for this assessment.
- **Subject land:** all land within the affected lot boundaries.
- **Buffer area:** all land within 1500 metres (m) of the outside edge of the boundary of the development footprint.

1.1 THE PROPOSAL

Yanco Solar Farm would comprise the installation of a solar plant with a capacity of around 60 megawatts (MW) (AC) / 72 Megawatt (DC) that would supply electricity to the national electricity grid. ib vogt proposes to develop around 183ha of the 210ha development site, retaining existing viable native vegetation remnants that occur on the array site.

The proposal would include the following elements:

- Single axis tracker photovoltaic solar panels mounted on steel frames over most of the site.
- Battery storage to store energy on site;
- Inverter/transformer units;
- Electrical cables and conduits;
- Control room and switchgear to connect the solar farm to a new underground powerline, including synchronous condenser, other associated structures, lightening protection masts, control and protection equipment;
- Communications tower (20m high), adjacent to the control room;
- Site office, vehicle parking areas, access tracks and perimeter fencing;
- Operations and maintenance buildings with associated car parking;
- Vegetative screening;
- An overhead or underground 33kv electrical transmission line to connect the proposal to the Yanco Substation and minor electrical infrastructure works within the substation;
- New access point along Research Road
- Widening existing access points at Toorak Road and intersection upgrades at Toorak Road and Canal Street, Irrigation Way and Canal Street, Toorak Road and Research Road and all associated access points and channel crossings into the proposed solar farm;
- Internal access tracks; and
- Lighting, CCTV system, security fencing.

In total, the construction phase of the proposal is expected to take 10 months. The proposal would be expected to operate for around 30 years. After the initial operating period, the solar farm would either be decommissioned, removing all above ground infrastructure and returning the site to its existing land capability, or upgraded with new photovoltaic (PV) equipment.

1.2 THE DEVELOPMENT SITE

1.2.1 Site location

The proposed location of Yanco Solar Farm is in the Leeton Local Government Area, bordering the township of Leeton around 21 kilometres (km) north-west of Narrandera. The subject land includes the following lots, which are owned by private landholders:

- Lot 142 DP 751745
- Lots 145-152 DP 751745
- Lot 1700 DP 1181161
- Lot 6650 DP 1197165

1.2.2 Site description

The development area is bound by Amato Road, Toorak Road, Hume Road, River Road, Yale Road and the Gogeldrie Branch Canal, and intersected by Research Road, Ronfeldt Road, Houghton Road and the Junee – Hay railway line. Proposed transmission lines would connect to an existing TransGrid substation adjacent to the proposal area, around 1km to the south-east (Figure 1-1).

The proposed development footprint of the Yanco Solar Farm comprises around 183ha of freehold land. The majority of the development site is primarily irrigated cropping, used as grape and orange orchards. The paddocks have been deep ripped and cultivated in past management practices and most of the native vegetation has been removed. Some planted vegetation occurs along fence lines as windbreaks.

Several irrigation canals are present in the development site. Gogeldrie Branch Canal borders the development site.

Several farm buildings and dwellings also occur in the development site.

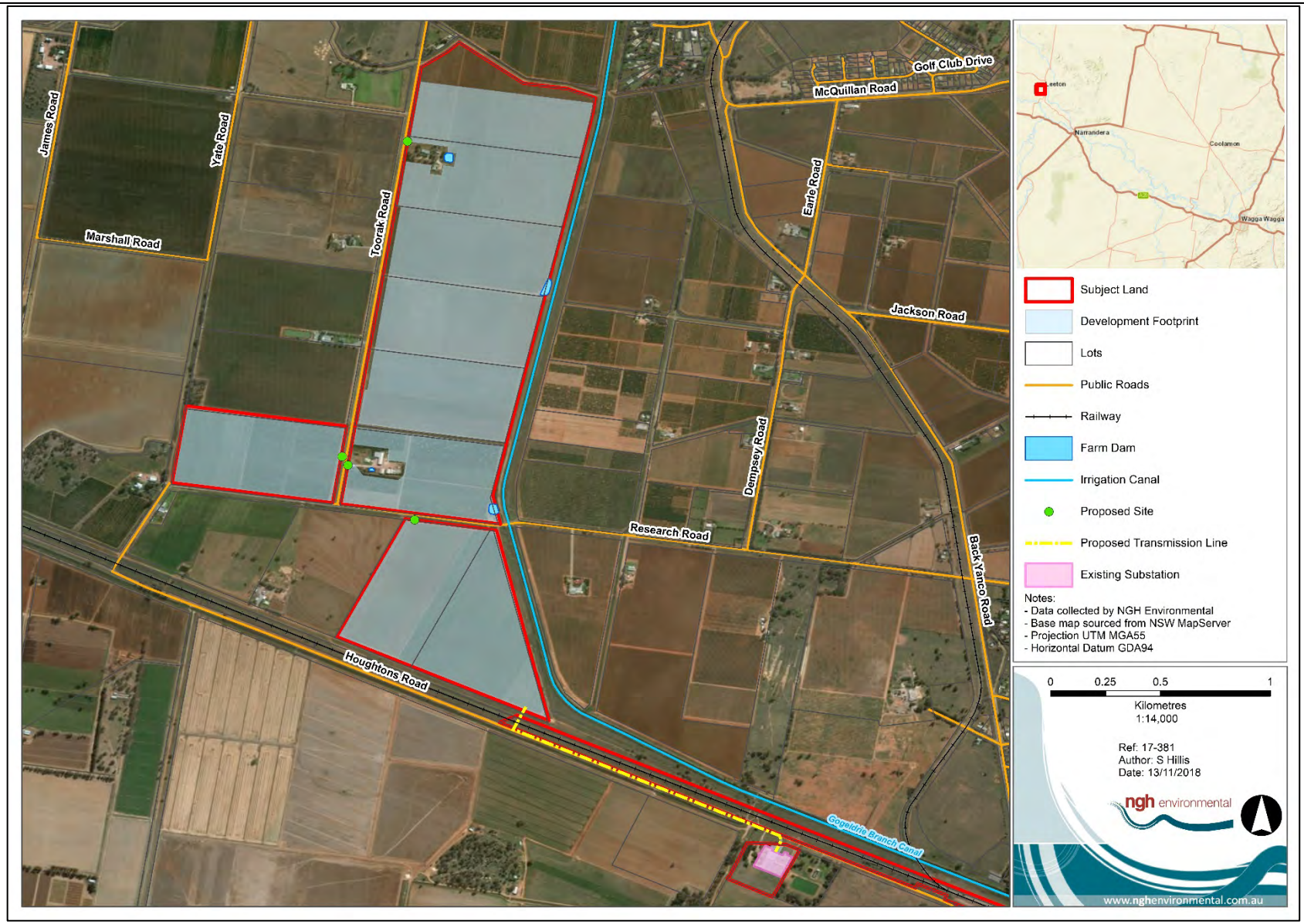


Figure 1-1 Site Map

1.3 STUDY AIMS

This BDAR has been prepared by NGH Environmental on behalf of ib vogt.

The aim of this BDAR is to address the requirements of the BAM, as required in the SEARs and summarised below.

> *Biodiversity – including an assessment of the biodiversity values and the likely biodiversity impacts of the project in accordance with Section 7.9 of the* Biodiversity Conservation Act 2016 (NSW) *the Biodiversity Assessment Method (BAM) and documented in a Biodiversity Development Assessment Report (BDAR), unless OEH and DPE determine that the proposed development is not likely to have any significant impacts on biodiversity values;*
>
> *The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM;*
>
> *An assessment of the likely impacts on listed aquatic threatened species, populations, or ecological communities, scheduled under the* Fisheries Management Act 1994*, and a description of the measures to minimise and rehabilitate impacts.*

No additional specific considerations for any threatened species, populations or communities were specified in the SEARs or by the NSW Office of Environment and Heritage (OEH) for consideration.

This BDAR also addresses the assessment requirements of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.4 SOURCE OF INFORMATION USED IN THE ASSESSMENT

The following information sources were used in this BDAR:

- Proposal layers, construction methods and concept designs provided by ib vogt.
- Australian Government's Species Profiles and Threats (SPRAT) database, accessed at http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl
- NSW OEH's Threatened Species Profiles, accessed at http://www.environment.nsw.gov.au/threatenedspeciesapp/
- DPI profiles of threatened species, population, and ecological communities
- Commonwealth Department of Environment and Energy Protected Matters Search Tool (PMST), accessed at http://environment.gov.au/epbc/protected-matters-search-tool
- Australia's IBRA Bioregions and sub-bioregions, accessed at http://environment.gov.au/land/nrs/science/ibra/australias-bioregions-maps
- Department of Environment and Climate Change NSW (DECC) (2002). Descriptions for NSW (Mitchell) Landscapes, Version 2
- NSW OEH's Biodiversity Assessment Method (BAM) calculator, accessed at http://www.environment.nsw.gov.au/bbccapp/ui/mynews.aspx
- NSW OEH's BioNet threatened biodiversity database, accessed online via login at http://www.bionet.nsw.gov.au/
- NSW OEH Threatened Species Profiles, accessed at http://www.environment.nsw.gov.au/threatenedSpeciesApp/ and www.environment.nsw.gov.au/AtlasApp/UI_Modules/

- OEH BioNet Vegetation Classification Database (OEH 2017), accessed via login at http://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx
- OEH VIS Mapping, accessed at http://www.environment.nsw.gov.au/research/VISmap.htm
- Office of Environment and Heritage (OEH) (2017). Biodiversity Assessment Method.
- NSW Government SEED Mapping, accessed at https://geo.seed.nsw.gov.au/Public_Viewer/index.html?viewer=Public_Viewer&locale=en-AU
- NSW Biodiversity Values Map, accessed at https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BVMap

2 LANDSCAPE FEATURES

2.1 IBRA BIOREGIONS AND SUBREGIONS

Bioregions are large, geographically distinct areas of land with common characteristics such as geology, landform patterns, climate, ecological features, and flora and fauna communities. The development site is located in the Riverina bioregion, in the Murrumbidgee subregion. The bioregion is characterised by a dry semi-arid climate with hot summers and cool winters. The geology is dominated by Quaternary alluvial sediments, with characteristic landforms of complex alluvial fans with numerous distributary channels and floodplains, depression plains, abandoned lake beds with lunettes, and limited source-bordering dunes. The pre-European vegetation type is dominated by:

- Black Box and River Red Gum on channels
- Black Box, Lignum and Cane Grass in swamps
- Saltbush and Bluebush with Old Man Saltbush, Cottonbush, Myall and Grasses on plains
- White Cypress Pine on sandhills

The dominant IBRA subregion impacted by the proposal would be the Murrumbidgee subregion. This was entered into the BAM calculator for the proposal.

2.2 NSW LANDSCAPE REGIONS AND AREA

The development site is in the Murrumbidgee Scalded Plains Mitchell Landscape. This was entered into the BAM calculator for the proposal.

2.3 NATIVE VEGETATION

As determined by GIS mapping from aerial imagery, around 114.3ha of native vegetation occurs in the 1500m buffer area. This native vegetation in the landscape surrounding the development is predominantly Yellow Box – River Red Gum tall grassy riverine woodland (26ha), Black Box Grassy Open Woodland Wetland of rarely flooded depressions (10ha) and Riverine Plain Grassland (51ha).

2.4 CLEARED AREAS

Within the 1500 m buffer area around the development site, approximately 2316 ha occurs as cleared areas. This is comprised of around 2131 ha of primarily irrigated, levelled agricultural land and 185ha of cleared residential areas.

Within the development site, around 184 ha occurs as agricultural land, which includes 82 ha of orange orchards (Figure 2-2) and 102.3 ha of grape vines (Figure 2-2). These areas provide limited foraging habitat for native species including disturbance-tolerant fauna and introduced species such as foxes and rabbits.

Figure 2-1 Example of orange orchard in the development site.

Figure 2-2 Example of vineyard in the development site.

2.5 RIVER AND STREAMS

There are no prescribed streams within the development site.

The development site contains four farm dams (Figure 2-3).

The proposal site is located in the Murrumbidgee Irrigation Area (MIA), and several irrigation channels run throughout the development site (Figure 2-3). These irrigation channels are involved in existing agricultural activities on the subject land. Irrigators in the MIA have licences which allow them to use a prescribed amount of water each year. The natural hydrology of the site has been largely replaced by irrigation and drainage channels, and storage dams. There would be no removal of irrigation channels throughout the development site.

Figure 2-3 Example of irrigation channel (top left) and storage dams (top right; bottom left and bottom right) in the development site.

2.6 WETLANDS

No wetlands occur in or adjacent to the development site. The nearest important wetlands listed under the EPBC Act are the Fivebough and Tuckerbil Swamps, which are located 5km north-west of the development site.

2.7 CONNECTIVITY FEATURES

There are no significant connectivity features in or adjacent to the development site. The remnant and

planted vegetation and orchard/vineyard plantings provide some habitat connectivity for more disturbance-tolerant and mobile species to travel across the landscape. The irrigation channels provide some aquatic connectivity.

2.8 AREAS OF GEOLOGICAL SIGNIFICANCE

No karsts, caves, crevices or cliffs or other areas of geological significance occur in or adjacent to the development site.

2.9 AREAS OF OUTSTANDING BIODIVERSITY VALUE

No areas of Outstanding Biodiversity Value occur within the development site (NSW Biodiversity Values Map, Figure 2-4).

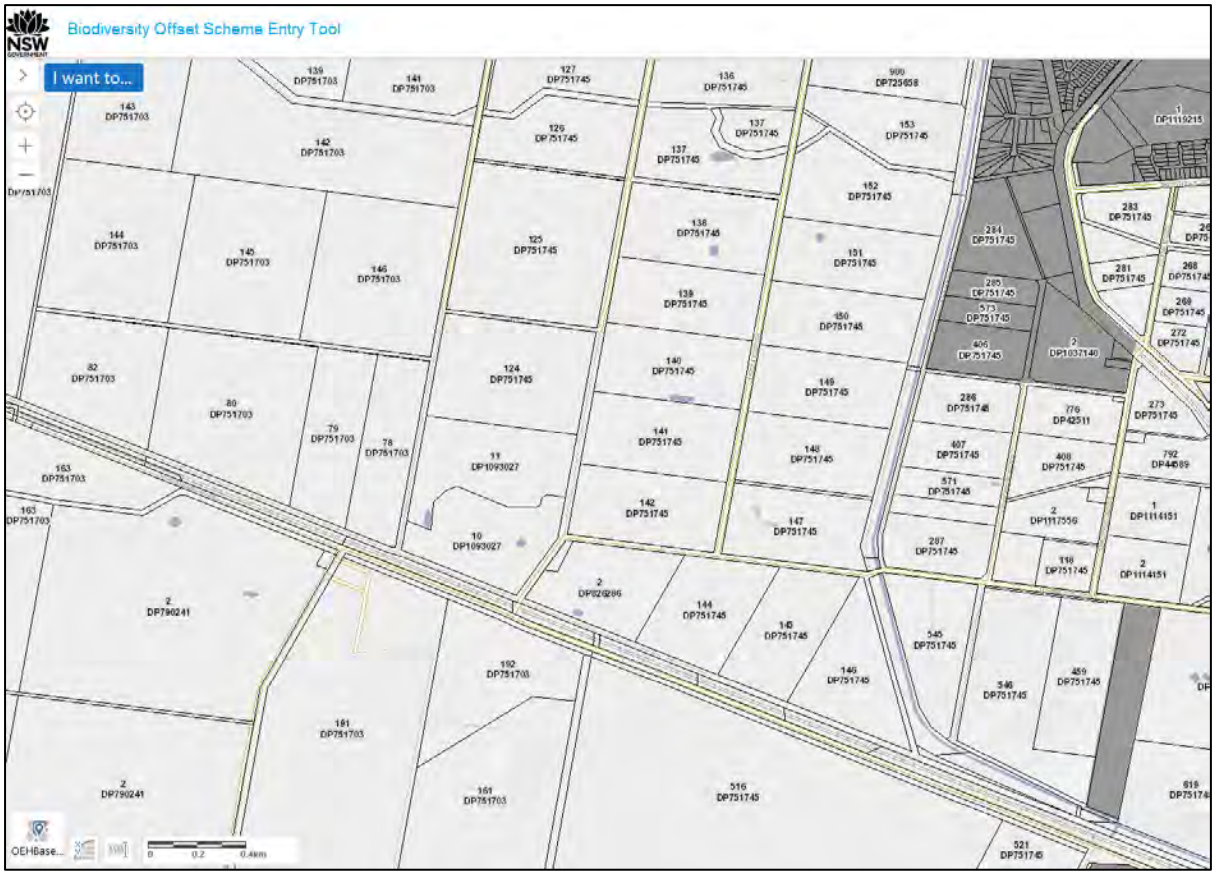


Figure 2-4 Biodiversity Value Map, showing no areas of high biodiversity value in the development site.

2.10 SITE CONTEXT COMPONENTS

Method applied

The proposal conforms to the definition of a *site-based development* under the Biodiversity Assessment Methodology. The site-based development assessment methodology has been used in this BAM assessment.

Percent Native Vegetation Cover

The Percent Native Vegetation Cover within the 1500m buffer area surrounding the development site prior to the development was calculated to be 4.70%. This was entered into the BAM calculator for the proposal.

The total area of the 1500m^2 buffer area is 2430ha. The area of native vegetation in the 1500m buffer area is 114.3ha (Figure 2-5).

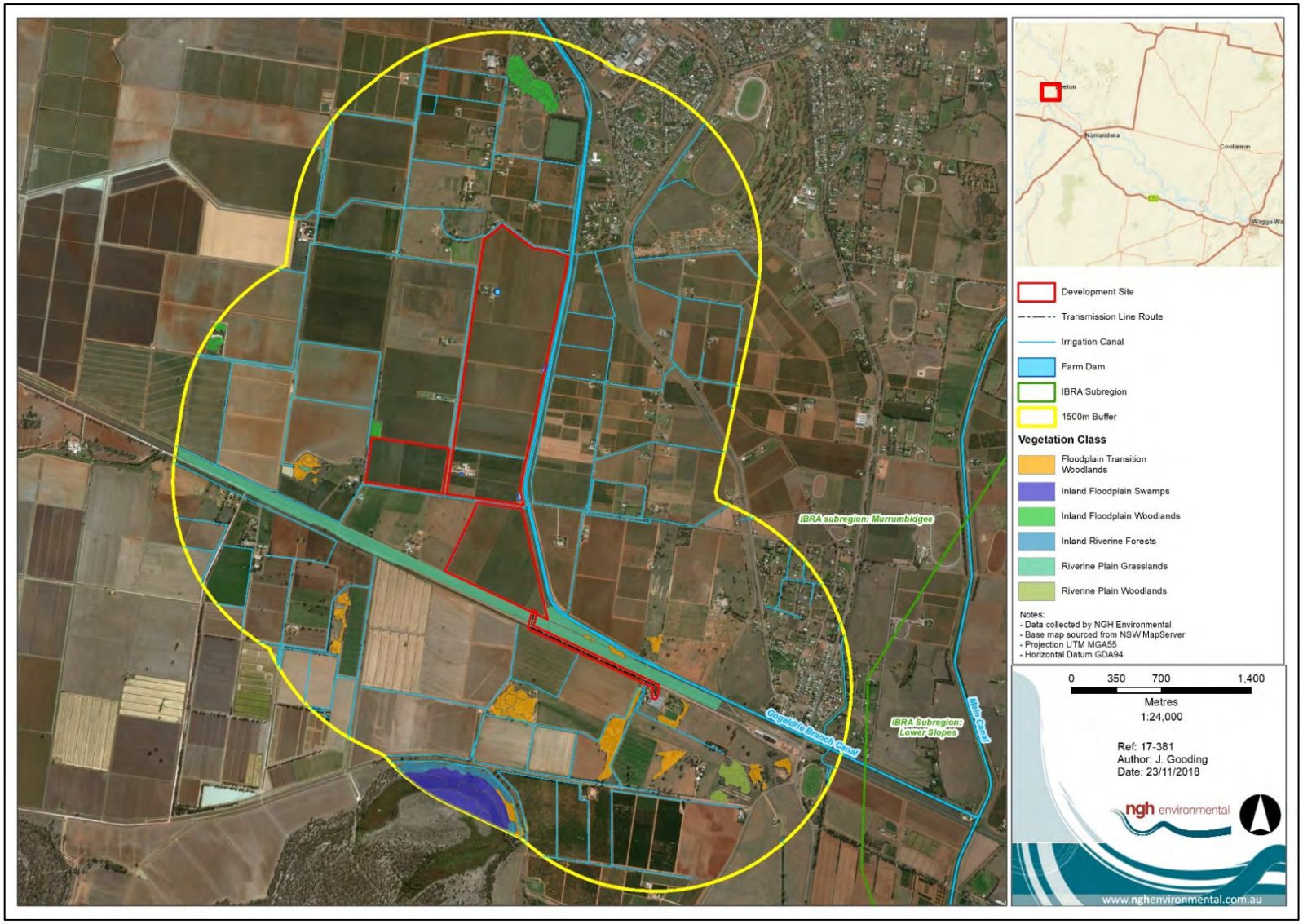


Figure 2-5 Location map showing native vegetation in the development site and in the 1500 m buffer area.

3 NATIVE VEGETATION

3.1 NATIVE VEGETATION EXTENT

Around 26.6ha of native vegetation occurs within the development site (Figure 3-1). This is comprised of:

- 0.68ha of remnant River Red Gum – Yellow Box Woodland,
- <0.1ha of remnant of Weeping Myall Woodland,
- 3.15ha of planted native vegetation, and
- 22.70ha of Riverine Plain Grassland.

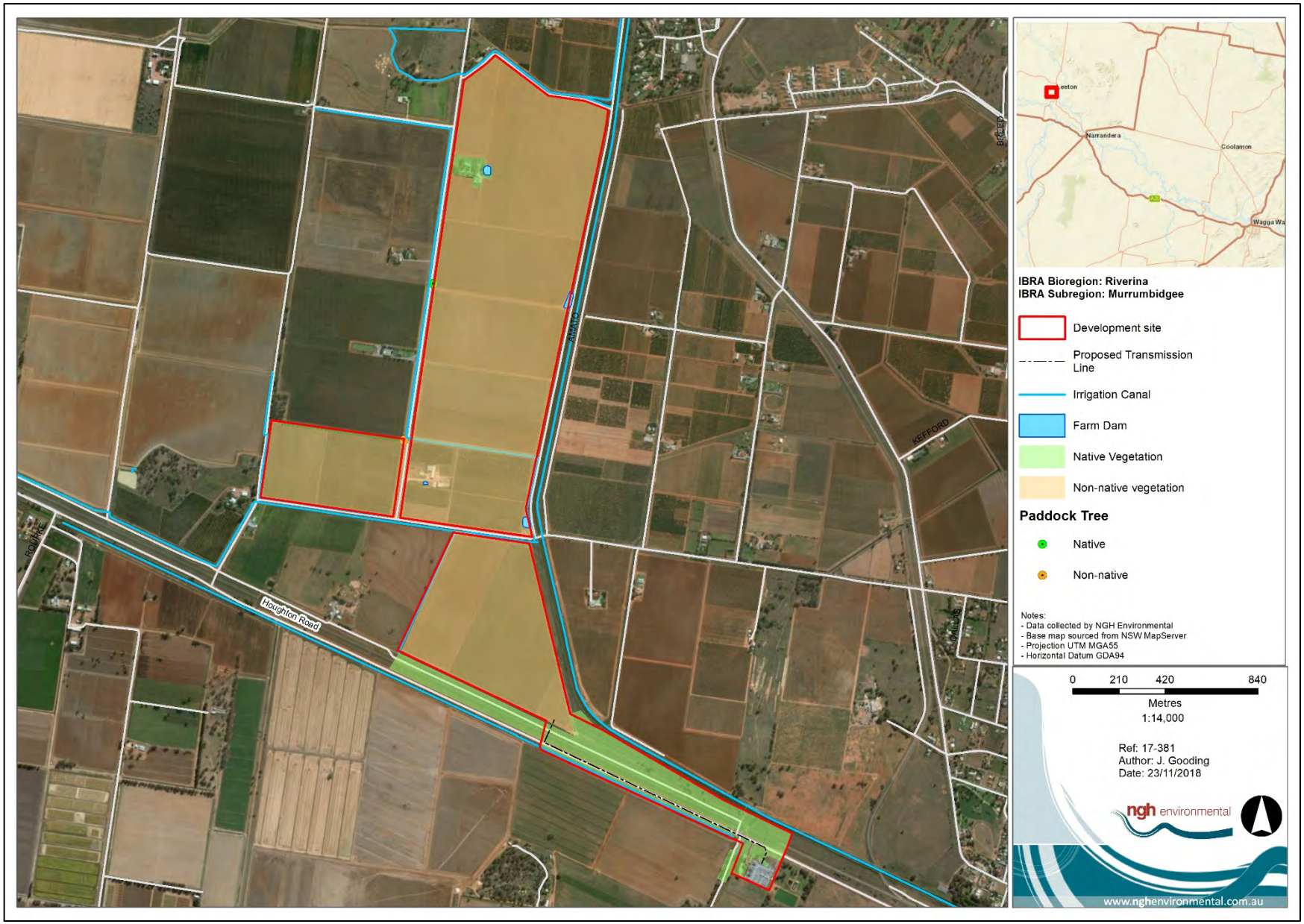


Figure 3-1 Vegetation extent within the development site.

3.2 PLANT COMMUNITY TYPES (PCTS)

3.2.1 Methods to assess PCTs

Review of existing information

A search was undertaken of OEH Vegetation Information System (VIS) database and NSW SEED mapping to access existing vegetation mapping information within the development site. Two relevant existing vegetation maps were assessed.

- **SEED Mapping – Sharing and Enabling Environmental Data (2017).** One PCT (*PCT 44: Forb-rich Speargrass – Windmill grass – White top grassland of the Riverina Bioregion*) was mapped occurring along Houghton Road. No other vegetation communities were mapped within the development site. Small patches of native vegetation occurring in the surrounding areas were PCT 74: *Yellow Box – River Red Gum tall grassy riverine woodland of NSW South Western Slopes and Riverina Bioregion* to the south and *PCT 16: Black Box grassy open woodland of rarely flooded depressions in South Western NSW* to the north.
- **Riverina Regional Native Vegetation Map _VIS_ID 4469.** No vegetation communities were mapped within the development site. Six PCTs were mapped in the 1500m buffer area with the dominant communities being PCT 74, PCT 16 and PCT 10: *River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.*

Floristic survey

A site overview was undertaken on 7 September 2017. The entire subject land was surveyed by car and on foot by an ecologist with NGH Environmental. The aim of this survey was to determine the extent of native vegetation present in the development site, its condition and vegetation type. Random meander searches were conducted in areas of native vegetation to determine the plant species present. PCTs were identified from the native species present, landforms and physiography and location in the IBRA subregion using the BioNet Vegetation Classification Database. The subject land was then stratified into areas of similar condition class to determine vegetation zones for each PCT.

Detailed floristic surveys of vegetation plots were undertaken on 9 August, 24 August and 26 November 2018. The surveys were undertaken using the methodology presented in the BAM (2017). The required number of vegetation integrity plots of 20m by 50m was established in each vegetation zone. Data was collected on the composition, structure and function of the vegetation. Personnel undertaking the field work have been trained in the BAM and were directed by persons accredited under the BAM (Appendix H).

3.2.2 PCTs identified on the development site

Three PCTs were identified during the floristic surveys;

- 44 - Forb-rich Speargrass – Windmill Grass – White Top Grassland of the Riverina Bioregion
- 26 – Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
- 74 – Yellow Box - River Red Gum tall grassy riverine woodland of NSW South Western Slopes Bioregion and Riverina Bioregion

A description of PCT 44 is provided in Table 3-1 belowTable 3-1 Description of PCT 44 in development site.

Forb-rich Speargrass – Windmill Grass – White Top Grassland of the Riverina Bioregion		
Vegetation formation	**Grassland**	
Vegetation class	Riverine Plain Grasslands	
Vegetation type	**PCT ID**	PCT 44
	Common Community Name	Speargrass-Windmill Grass-White Top Grassland
Approximate extent within the development site	22.7ha	
Species relied upon for PCT identification	***Species name***	***Relative abundance***
	Maireana excavata	<1%
	Chloris truncata	<1%
	Austrostipa scabra	<1%
	Rytidosperma caespitosa	0-5%
	Sida corrugata	<1%
Justification of evidence used to identify the PCT	The grassland is heavily disturbed through past construction of roadside, irrigation canals, railway line and powerline easement. It is dominated by exotic species such as silver leaf nightshade (**Solanum elaeagnifolium*), Wild Oats (**Avena fatua*) and Vervain (**Salvia verbenaca*). However, disturbance tolerant native species are still present in the grassland. Five plots were undertaken in this PCT. Three PCTS were considered that occur as grasslands in the Riverina Bioregion. These are PCT 44, 45 and 46. PCT 44 is considered to be the most appropriate PCT based on the following criteria present in the community: • SEED mapping of the area shows the area as PCT 44 • Understorey highly degraded but species that were present are characteristic of the PCT (listed above) • Location within the Murrumbidgee IBRA subregion • Occurs on floodplains and alluvial plains • Grey clay soils	
TEC Status	This community can be associated with the EEC: *Natural Grasslands of the Murray Valley Plains* listed under the EPBC Act. The grassland is not considered part of the EEC based on the following factors: • Falls outside the indicative distribution map (DSEWPaC, 2012) • Based on wooded areas in the close vicinity, is more likely to be a derived grassland from PCT 26 or PCT 74.	

Forb-rich Speargrass – Windmill Grass – White Top Grassland of the Riverina Bioregion	
	• Only one species occurring that is listed as frequent in natural grasslands of the Murray Valley Plains (DSEWPaC, 2012) • No past records of diagnostic indicator fauna species such as plains wanderer.
Estimate of percent cleared	73%
Examples	 Figure 3-2 PCT 44 along Houghton Road.  Figure 3-3 PCT 44 along Houghton Road.

Table 3-2 Description of PCT 26 in development site.

Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion		
Vegetation formation	**Semi-arid Woodland (Grassy Sub-formation)**	
Vegetation class	Riverine Plain Woodland	
Vegetation type	**PCT ID**	PCT 26
	Common Community Name	Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
Approximate extent within the development site	0.05ha	
Species relied upon for PCT identification	***Species name***	***Relative abundance***
	Weeping Myall (*Acacia pendula*)	25%
	Creeping Saltbush (*Atriplex seminbaccata*)	5%
	Ruby Saltbush (*Enchylaena tomentosa*)	10%
	Climbing Saltbush (*Einadia nutans*)	8%
	Small Flowered Wallaby Grass (*Rytidosperma setaceum*)	5%
	Spear Grass (*Austrostipa scabra*)	0.1%
Justification of evidence used to identify the PCT	Weeping Myall Open Woodland is characteristically dominated by the overstorey dominated by *Acacia pendula*. There are four Weeping Myall Woodland PCTs in NSW. These are PCT 26, 27, 116 and 1766. PCT 26 is considered to be the most appropriate PCT based on the following criteria that are present in the community; • The only one of the PCTS listed above that occurs in the Riverina bioregion. • Dominated by an overstorey of *Acacia pendula* • Species present are characteristic of the PCT (listed above) • Located within the lower slopes IBRA subregion • Occurs on alluvial plains • Clay Soils	
TEC Status	Forms part of the TEC: *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray Darling Depressions, Riverina and NSW South Western Slopes bioregion* listed under the BC Act.	
Estimate of percent cleared	90%	

Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion

Examples

Figure 3-4 Example of PCT26: Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion along Houghton Rd.

Figure 3-5 Example of PCT26: Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion along Houghton Rd.

Table 3-3 Description of PCT 74 in development site.

Yellow Box – River Red Gum tall grassy riverine woodland of NSW South Western Slopes Bioregion and Riverina Bioregion.			
Vegetation formation	**Grassy Woodlands**		
Vegetation class	Floodplain Transition Woodlands		
Vegetation type	**PCT ID**	PCT 74	
	Common Community Name	Yellow Box – River Red Gum tall grassy riverine woodland	
Approximate extent within the development site	0.67ha		
Species relied upon for PCT identification	***Species name***		***Relative abundance***
	Yellow Box (*Eucalyptus melliodora*)		0 -10%
	River Red Gum (*Eucalyptus camaldulensis*)		0-25%
	Bimble Box (*Eucalyptus populnea*)		0-12%
	Deane's Wattle (*Acacia deanei*)		<1%
	Climbing Saltbush (*Einadia nutans*)		0-5%
	Oxalis perennans		<1%
	Curly Windmill Grass (*Enteropogon acicularis*)		3-15%
Justification of evidence used to identify the PCT	The community is highly fragmented and disturbed comprising two small patches of only 0.67ha. The overstorey is dominated by a mixture of Bimble Box, River Red Gum and Yellow Box. The eastern patch is comprised of entirely semi mature Bimble Box. PCTs containing Bimble Box in the Riverina Bioregion were considered. These were PCT 72, 82, 103, 105 and 207, however none of these PCTS matched with the other plant species present on site, soil types or landforms. PCT 74 was considered to be the most appropriate PCT based on the following criteria that are present in the community: • All three overstorey species are present in this community • Understorey species present are characteristic of the PCT (listed above) • It occurs in the Murrumbidgee IBRA subregion.		

Yellow Box – River Red Gum tall grassy riverine woodland of NSW South Western Slopes Bioregion and Riverina Bioregion.	
	• Occurs on floodplains and flats • Clay soils
TEC Status	Forms part of the TEC: *White Box-Yellow Box-Blakely's Red Gum Woodland* listed as Endangered under the BC Act.
Estimate of percent cleared	73%
Examples	 Figure 3-6 Example of PCT 74: Yellow Box - River Red Gum tall grassy riverine woodland.

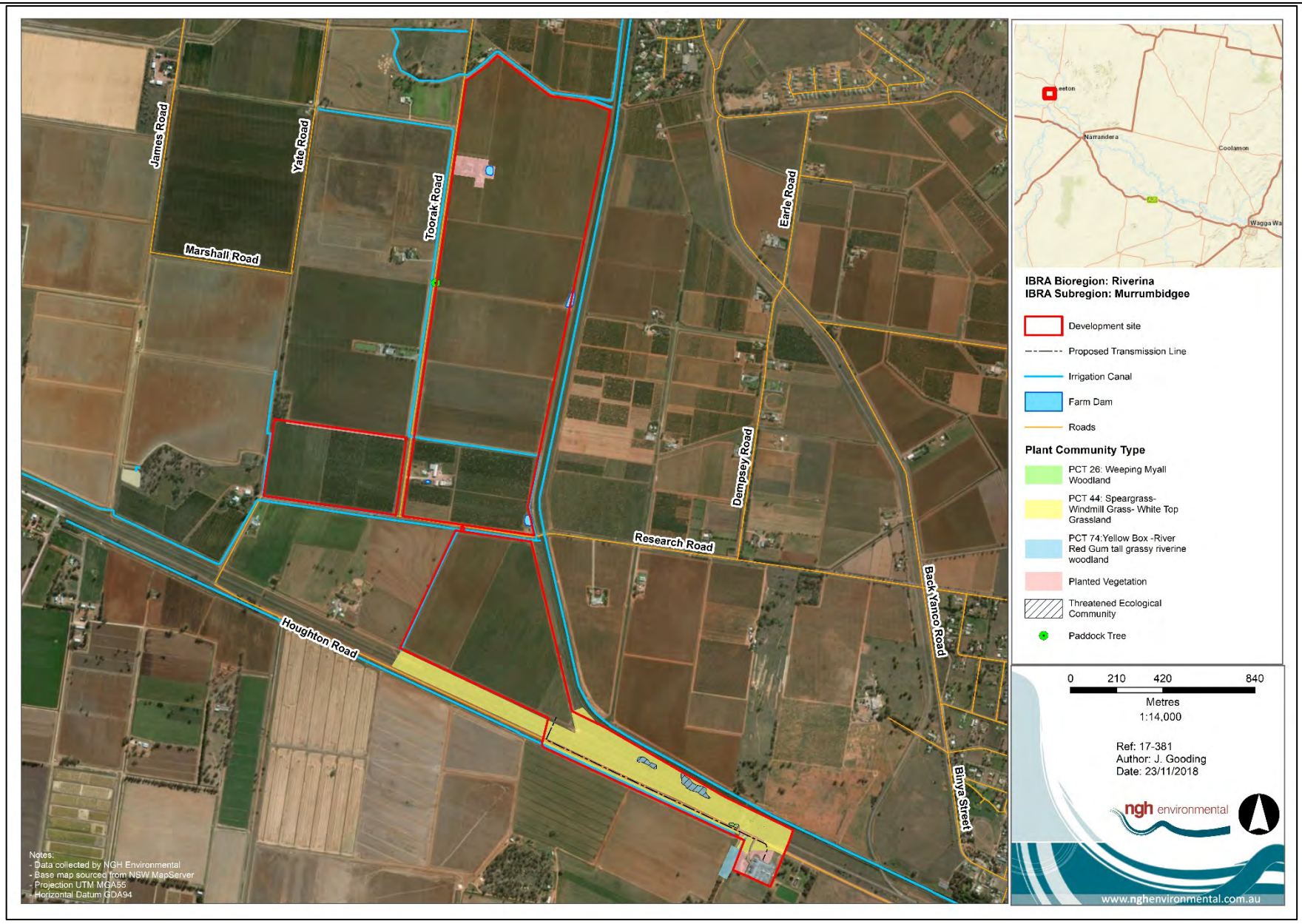


Figure 3-7 Plant Community Types and TECs at the development site.

3.3 VEGETATION INTEGRITY ASSESSMENT

3.3.1 Vegetation zones and survey effort

The random meander, overview inspection and detailed floristic plots have been used to assist the delineation of zones. Three PCTs were identified in the survey area. Each of these PCTs is considered to be in the one condition within the development site and is not broken down into separate zones.

Nine floristic plots were undertaken within the three PCTS. The number of floristic plots undertaken in each zone was in line with the minimum plot requirements per zone area as specified in the BAM (2017).

Table 3-4 Vegetation zones within the development site

Zone ID	PCT ID	Stratification unit / condition	Patch size (ha)	Zone size (ha)	Survey effort (# plots)	Area impacted (ha)
1	**44**	**Low** This zone occurs in the roadside vegetation along Houghton Road. The conditions are considered consistent along the length of the roadside surveyed although there is slight variation in the diversity of species present. The grassland is considered in low condition as it is dominated by exotic species such as silver leaf nightshade (**Solanum elaeagnifolium*), Wild Oats (**Avena fatua*) and Vervain (**Salvia verbenaca*) and has been heavily disturbed through construction of roads, powerlines, irrigation canals and a railway line. This community does not form part of an EEC.	100+	22.7	6	0.49
2	**26**	**Moderate** A small patch of Weeping Myall occurs in the roadside vegetation along Houghton Rd. The understorey is comprised of a mix of native and exotic grasses and forbs. This community forms part of the EEC: *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray Darling Depression, Riverina and NSW South Western Slopes Bioregion*.	0.05	0.05	1	0.05
3	**74**	**Moderate** Two small patches of Yellow Box – River Red Gum Riverine woodland occur in the roadside vegetation along Houghton Rd.	0.67	0.67	2	0

Zone ID	PCT ID	Stratification unit / condition	Patch size (ha)	Zone size (ha)	Survey effort (# plots)	Area impacted (ha)
4	-	**Planted Vegetation** This zone is comprised of several patches of planted vegetation. These are; a planted row of *Casuarina cunninghamiana* in the North West section, a variety of native horticultural plants surrounding the house block in the North of the development site and a landscaped garden bed surrounding the substation in the South. This vegetation does not represent a plant community type.	-	3.15	0	0

3.3.2 Vegetation integrity assessment results

86 plant species were identified within the nine vegetation integrity survey plots, comprising 42 native species and 44 exotic species. The results of the plot field data can be found in Appendix A and Appendix B.

Following a constraints analysis, the areas of PCT 74 were avoided by the proposal. These PCTs were not added into the BAM calculator.

The plot data from the vegetation integrity survey plots for PCT 44 and PCT 26 was entered into the BAM calculator. The results of the vegetation integrity assessment are provided in Table 3-5.

Table 3-5 Table of current vegetation integrity scores for each vegetation zone within the development site.

Zone ID	Plant Community Type (PCT)	Area (Ha)	Composition score	Structure score	Function score	Vegetation Integrity Score
1	PCT 44	0.49	56.7	23.3	n/a	**36.4**
2	PCT 26	0.05	76.6	100	84.5	**86.5**

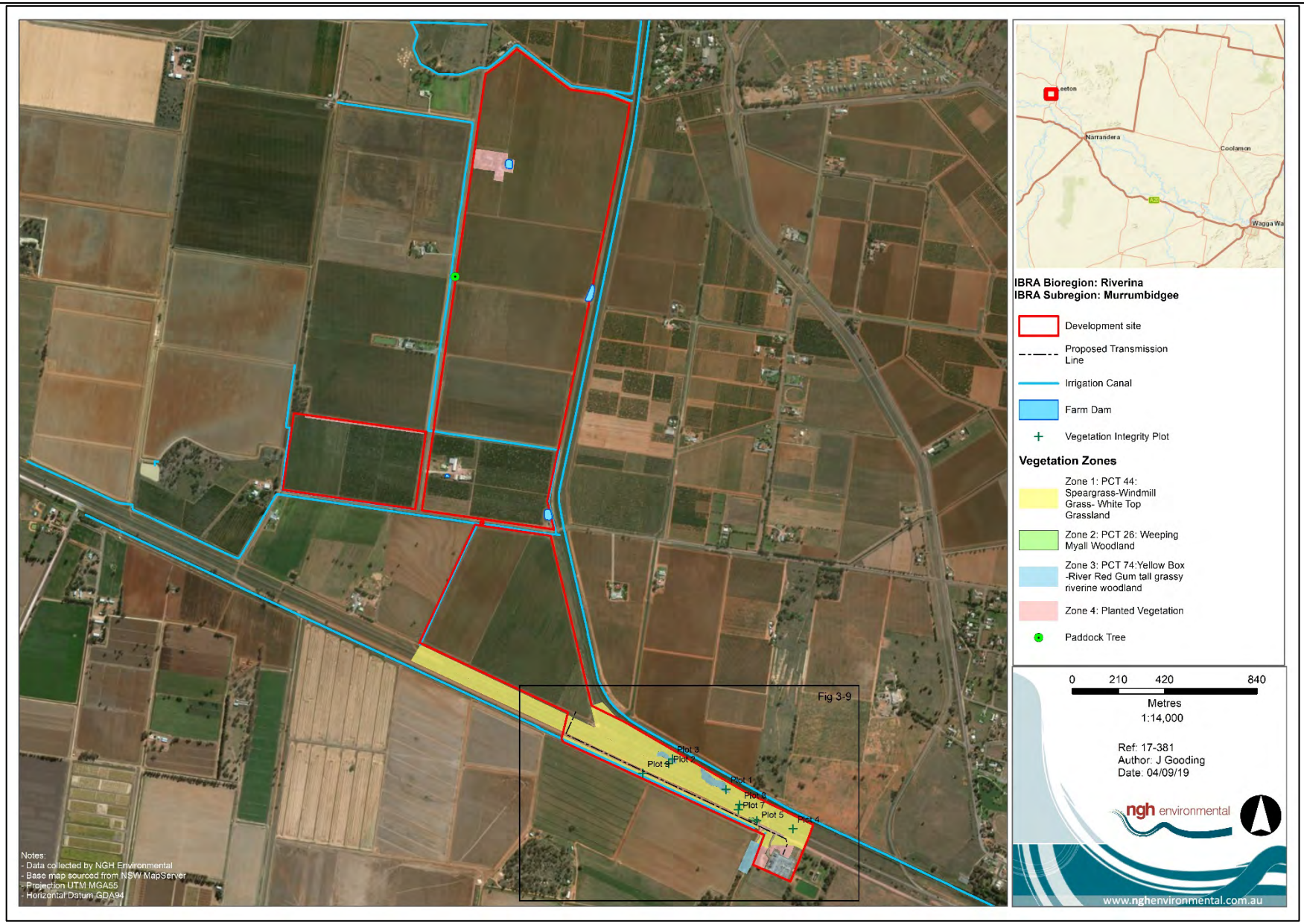


Figure 3-8 Vegetation zones at the development site.

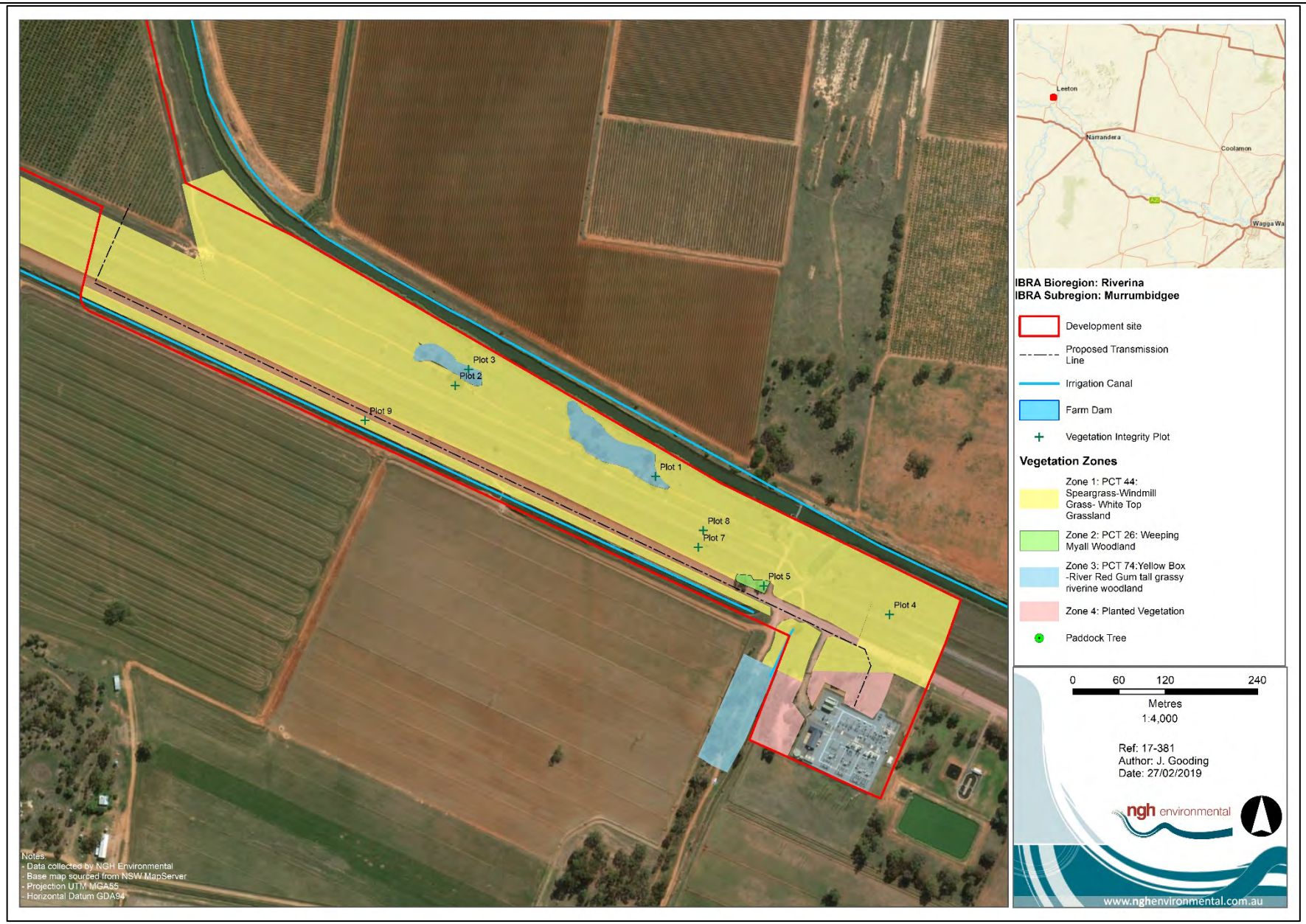


Figure 3-9 Vegetation zones along transmission line route

4 THREATENED SPECIES

4.1 ECOSYSTEM CREDIT SPECIES

The following ecosystem credit species were returned by the calculator as being associated with the PCTs present on the development site. These are assumed to occur and generate credits:

Table 4-1 Ecosystem credit species.

Ecosystem credit species	Vegetation type(s)	NSW Listing Status	National Listing Status
Major Mitchell's Cockatoo *Lophochroa leadbeateri*	PCT 26 – Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Vulnerable	Not listed
Dusky Woodswallow *Artamus cyanopterus cyanopterus*	PCT 44 - Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion PCT 26 – Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Vulnerable	Not listed
White-fronted Chat *Epthianura albifrons*	PCT 44 - Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion	Vulnerable	Not listed
Grey Falcon *Falco hypoleucos*	PCT 44 - Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion PCT 26 – Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Endangered	Not listed
White-bellied Sea-Eagle *Haliaeetus leucogaster*	PCT 44 - Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion PCT 26 –Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Vulnerable	Not listed
Hooded Robin *Melanodryas cucullata cucullata*	PCT 26 – Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Vulnerable	Not listed
Scarlet Robin *Petroica boodang*	PCT 26 – Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Vulnerable	Not listed
Superb Parrot *Polytelis swainsonii*	PCT 26 – Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Vulnerable	Vulnerable
Grey Crowned Babbler *Pomatostomus temporalis temporalis*	PCT 26 – Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Vulnerable	Not listed
Diamond Firetail *Stagonopleura guttata*	PCT 44 - Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion PCT 26 –Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Vulnerable	Not listed

4.1.1 Species excluded from the assessment

No ecosystem credit species were excluded from the assessment; all are assumed to occur and contribute to ecosystem credits.

4.2 SPECIES CREDIT SPECIES

4.2.1 Candidate species to be assessed

The BAM Calculator predicted the following species credit species to occur at the development site.

Table 4-2 Candidate species credit species requiring assessment.

Species Credit Species	Habitat components and geographic restrictions	Sensitivity to gain class	NSW listing status	National listing status
FAUNA				
Australian Bustard *Ardeotis australis*	Tussock and hummock grasslands, low shrublands and low open grassy woodlands; occasionally pastoral and cropping country, golf courses and near dams.	High	Endangered	Not listed
Major Mitchell's Cockatoo *Lophochroa leadbeateri* (Foraging)	Living or dead tree with hollows greater than 10cm diameter	Moderate	Vulnerable	Not listed
Superb Parrot *Polytelis swainsonii* (Foraging)	Breeding habitat can be identified by the presence of habitat features and observed nest or two or more birds seen on site.	High	Vulnerable	Vulnerable
White-bellied Sea-eagle *Haliaeetus leucogaster* (Foraging)	Breeding habitat includes trees up to 30m, rocks and high ground, where trees are not available.	High	Vulnerable	Not listed
Koala *Phascolarctos cinereus*	Areas identified via survey as important habitat. Important habitat defined by density of koalas and quality of habitat determined by on-site survey	Moderate	Vulnerable	Vulnerable
FLORA				
Mossgiel Daisy *Brachyscome papillosa*	Clay soils on Bladder Saltbush and Leafless Bluebush plains; also grassland and Inland grey Box – Cypress Pine woodland.	Moderate	Vulnerable	Vulnerable
Claypan Daisy *Brachyscome muelleroides*	Floodplains on grey-brown or red-brown clays and claypans	Very high	Vulnerable	Vulnerable
Bindweed *Convolvulus tedmoorei*	Grows on self-mulching grey clay. cl Thrives on soil flooded periodically	High	Endangered	Not listed

Species Credit Species	Habitat components and geographic restrictions	Sensitivity to gain class	NSW listing status	National listing status
Small Scurf-pea *Cullen parvum*	Grassland, River Red Gum woodland or Box-Gum woodland, sometimes on grazed land and usually on table drains or adjacent to drainage lines or watercourses, in areas with rainfall 450 –700mm.	High	Endangered	Not listed
Winged Peppercress *Lepidium monoplocoides*	Land containing seasonally damp or waterlogged sites	High	Endangered	Endangered
Lanky Buttons *Leptorhynchos orientalis*	Woodland or grassland, sometimes on margins of swamps. Communities include Bimble Box plain in red-brown soil, dense *Acacia pendula* woodland with herbaceous understorey on red clay to clay loam, open grassland areas on red soils, and red clay plains at edge of Canegrass Swamp.	High	Endangered	Not listed
Chariot Wheels *Maireana cheelii*	Heavy grey clay soils and claypans or shallow depressions.	Moderate	Vulnerable	Vulnerable
Austral Pillwort *Pilularia novae-hollandiae*	Strongly ephemeral - dependent on rain. Only found in drying mud. Presume seedbank based on similar species but unsure; dispersal assumed based on spores but no research to support.	High	Endangered	Not listed
Slender Darling Pea *Swainsona murrayana*	Clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. Bladder Saltbush, Black Box and grassland communities on level plains, floodplains and depressions and often with *Maireana* species. Remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated.	High	Vulnerable	Vulnerable
Silky Swainson-pea *Swainsona sericea*	Natural Temperate Grassland and Snow Gum Woodland on the Monaro; Box-Gum Woodland in the Southern Tablelands and South West Slopes.	High	Vulnerable	Not listed

4.2.2 Inclusions and exclusions based on habitat features

Two species were added to the Credit Calculator based on the presence of suitable habitat and nearby known records (Table 4-3). These species are the Sloane's Froglet and Southern Bell Frog.

Table 4-3 Additional candidate species included for assessment.

Species Credit Species	Habitat components and geographic restrictions	Sensitivity to gain class	NSW listing status	National listing status
Sloane's Froglet *Crinia sloanei*	Periodically inundated areas in grassland, woodland, and disturbed habitats. Known in subregion.	Moderate	Vulnerable	Not listed
Southern Bell Frog *Litoria raniformis*	Requires habitat that contains water for at least four months for tadpole development.	Moderate	Endangered	Vulnerable

Three candidate species were excluded from the credit calculator based on the development site being outside their known range (Table 4-4).

Table 4-4 Candidate species excluded for assessment.

Species Credit Species	Habitat components and geographic limitations	Reason for exclusion	Sensitivity to gain class	NSW listing status	National listing status
A Spear-grass *Austrostipa wakoolica*	South of Murrumbidgee	Development site North of Murrumbidgee River	Moderate	Endangered	Endangered
Turnip Copperburr *Sclerolaena napiformis*	Hay Plain	Development site not within Hay Plain	Moderate	Endangered	Endangered
Red Darling Pea *Swainsona plagiotropis*	Hay Plain	Development site not within Hay Plain	High	Vulnerable	Not listed

4.2.3 Exclusions based on habitat quality

No credit species were excluded from the assessment under justification that habitat is of too poor a quality to be suitable.

4.2.4 Candidate species requiring confirmation of presence or absence

The species listed in Table 4-5 are those that are considered to have habitats present at the development site. Targeted surveys were conducted for most of these species. One species, the Small Scurf-pea (*Cullen parvum*) was not surveyed for during the appropriate survey periods and so was presumed to be present within areas of potential habitat for the purpose of this assessment.

The results from the surveys are summarised below in Table 4-5. Details of the survey methods and results for each surveyed species are provided below. Where relevant, the methods for defining areas of potential habitat are also included. Targeted survey locations are mapped on Figure 4-1.

Table 4-5 Summary of species credit species surveyed at the development site

Species Credit Species	Biodiversity risk weighting	Survey Period	Assumed to occur/survey/ expert report	Present on site?	Species polygon area or count
Fauna					
Australian Bustard *Ardeotis australis* (Breeding)	2.00	All Year	Surveyed Aug & Oct 2018	No	0
Major Mitchell's Cockatoo *Lophochroa leadbeateri* (Breeding)	2.00	Sept - Dec	Surveyed Oct 2018	No	0
Superb Parrot *Polytelis swainsonii* (Breeding)	2.00	Sept - Nov	Surveyed Oct 2018	Yes – however no breeding habitat present on site. Foraging habitat only	0
White-bellied Sea-eagle *Haliaeetus leucogaster* (Breeding)	2.00	July - Dec	Surveyed Aug & Oct 2018	Yes – however no breeding habitat present on site. Foraging habitat only	0
Koala *Phascolarctos cinereus* (Breeding)	2.00	All year	Surveyed Aug & Oct 2018	No	0
Sloane's Froglet *Crinia sloanei*	1.50	July - Aug	Surveyed Aug 2018	No	0
Southern Bell Frog *Litoria raniformis*	2.00	Oct - Jan	Surveyed Oct 2018	No	0
Flora					
Mossgiel Daisy *Brachyscome papillosa*	2.00	Sept - Nov	Surveyed Oct & Nov 2018	No	0
Claypan Daisy *Brachyscome muelleroides*	3.00	Sept - Nov	Surveyed Oct & Nov 2018	No	0
Bindweed *Convolvulus tedmoorei*	2.00	Aug - Nov	Surveyed Oct & Nov 2018	No	0
Small Scurf-pea *Cullen parvum*	2.00	Dec - Feb	Not surveyed for during survey period	Assumed Present	0.54 ha
Winged Peppercress *Lepidium monoplocoides*	2.00	Nov - Feb	Surveyed Oct & Nov 2018	No	0
Lanky Buttons *Leptorhynchos orientalis*	2.00	Sept - Nov	Surveyed Oct & Nov 2018	No	0

Chariot Wheels *Maireana cheelii*	2.00	Sept - Feb	Surveyed Oct & Nov 2018	No	0
Austral Pillwort *Pilularia novae-hollandiae*	3.00	All year	Surveyed Oct & Nov 2018	No	0
Slender Darling Pea *Swainsona murrayana*	2.00	Sept - Feb	Surveyed Oct & Nov 2018	No	0
Silky Swainson-pea *Swainsona sericea*	2.00	Sept - Feb	Surveyed Oct & Nov 2018	No	0

4.2.5 Targeted Survey Methods

Australian Bustard

SURVEY EFFORT

Grassland within the development area was surveyed during daytime hours on 24 and 25 October 2018, with an effort investment of 16 person hours, including transects along the entire grassland area at 10m intervals. The same grassland was subject to two spotlight fauna transects at dusk on 10 August 2018 and 25 October. The weather during the survey period was fine and sunny with very little wind. The evening of 25 October was also clear with very little wind and a full moon.

SURVEY RESULTS

No indication of Bustard nesting or activity was observed.

Major Mitchell's Cockatoo

SURVEY EFFORT

A 20-minute targeted survey for this species was undertaken in the area of Yellow Box – River Red Gum Riverine woodland on 25 October 2018. Opportunistic surveys were undertaken over the four days the development site was surveyed. Potential nesting tree hollows were observed at dusk for a 20-minute period on 24 and 25 October 2018 to see if they were utilised by this species or other birds. The weather during the survey period was clear with little wind with a maximum daytime temperature in the mid-20^{o}C.

SURVEY RESULTS

No Major Mitchell's were observed during the four days the development area was surveyed. Only one tree within the development site contains hollows larger than 10cm that are suitable for Major Mitchell's Cockatoo. No activity was observed around this tree. Hollow bearing trees were avoided by the development and no mature trees would be removed by the proposal. Thus, it is unlikely any breeding Major Mitchell's Cockatoo would occur within the development site.

Superb Parrot

SURVEY EFFORT

A 20-minute targeted survey was undertaken in the area of Yellow Box – River Red Gum Riverine woodland on 25 October 2018. Opportunistic surveys were undertaken over the four days the development site was surveyed. Potential nesting tree hollows were observed at dusk for a 20-minute period on 24 and 25 October 2018 to see if they were utilised by this species or other birds. The weather during the survey period was clear with little wind with a maximum daytime temperature in the mid-20^{o}C.

SURVEY RESULTS

A flock of 10 Superb Parrots was observed flying over the development site on 9 August 2018. Only one tree within the development site contains hollows larger than 10cm that are suitable for Superb Parrot. No activity was observed around this tree. This hollow bearing tree is being avoided by the proposal. Thus, it is unlikely any breeding superb parrots would occur within the development site as the development site provides foraging habitat only.

White-bellied Sea-eagle

SURVEY EFFORT

Opportunistic surveys were undertaken over the four days the development site was surveyed. Tall trees within the development area were checked for stick nests on 24 and 25 October 2018. The weather during the survey period was clear with little wind with a maximum daytime temperature in the mid-20°C.

SURVEY RESULTS

Two small stick nests were observed on 25 October 2018 in the Yellow Box – River Red Gum Woodland, one occupied by Australian Ravens (*Corvus coronoides*) and one by Australian Magpies (*Gymnorhina tibicen*). One White-bellied Sea-eagle was observed high in the sky, circling over grassland of the development site, on the 10th August 2018. No large stick nests that could be used by a raptor were observed in the development site. Thus, it is unlikely any breeding White-bellied Sea-eagle occurs within the development site and the development site provides foraging habitat only.

Koala

SURVEY EFFORT

Eucalyptus trees within the development area were surveyed twice on 10 August 2018 and 25 October 2018 by checking around the base of each tree for scats and characteristic scratches. A total of 2 hours was spent surveying around the trees. The weather during the August survey was cold and overcast but fine. Weather during the October survey was clear, with a maximum in the mid-20°C, with very little wind.

SURVEY RESULTS

There was no evidence observed that koalas were or have recently been within the development area.

Sloane's Froglet

SURVEY EFFORT

A survey for Sloane's Froglet was carried out over two mornings on 9 and 10 August 2018 consisting of frog call playback at three dams and four irrigation canals within the development area. Each session lasted 2.5 hours, for a total of 5 hours of survey effort comprising three separate points at each dam and 200m transects along the canal. The weather on both days was sunny with no rain. Surveys were undertaken in accordance with the *Threatened species survey and assessment guidelines: field survey methods for Amphibians* (DECC, 2009) and Bionet Threatened Species Database (OEH, 2018).

SURVEY RESULTS

No Sloane's Froglets responded to the frog call playback at any of the locations surveyed. The Beeping Froglet (*Crinia parinsignifera*) was heard at various survey points and did respond to playback of their respective calls.

Southern Bell Frog

SURVEY EFFORT

A survey for the Southern Bell Frog was carried out over two nights on 24 and 25 October 2018 consisting of frog call playback at two dams (the third was dry) and four irrigation canals within the development area. Each session lasted 3.5 hours, for a total of 7 hours of survey effort comprising two separate points at each dam and 200m transects along the canal. The weather on both nights was clear with no wind and a full moon. Surveys were undertaken in accordance with the *Threatened species survey and assessment guidelines: field survey methods for Amphibians* (DECC, 2009) and Bionet Threatened Species Database (OEH, 2018).

SURVEY RESULTS

No Southern Bell Frogs responded to the frog call playback at any of the locations surveyed. Other frog species such as the Beeping Froglet (*Crinia parinsignifera*), Spotted Marsh Frog (*Limnodynastes tasmaniensis*), Barking Frog (*Limnodynastes fletcheri*) and Peron's Tree Frog (*Litoria peronii*) were heard at various survey points and did response to playback of their respective calls.

Flora:

Mossgiel Daisy (*Brachyscome papillosa*), Claypan Daisy (*Brachyscome muelleroides*), Bindweed (*Convolvulus tedmoorei*), Winged Peppercress (*Lepidium monoplocoides*), Lanky Buttons (*Leptorhynchos orientalis*), Chariot Wheels (*Maireana cheelii*) Austral Pillwort (*Pilularia novae-hollandiae*), Slender Darling Pea (*Swainsona murrayana*) & Silky Swainson-pea (*Swainsona sericea*).

SURVEY EFFORT

Suitable habitat for the threatened flora occurs in the Native Grassland (PCT 44) along Houghton Road. This area was surveyed in the form of transects every 10m over the entire grassland area. This is in accordance with the *NSW Guide to Surveying Threatened Plants* (OEH, 2016). Areas of damp depressions were surveyed more intensely for Austral Pillwort. Five biometric plots were also undertaken in this area covering a thorough 20m by 20m area surveyed for flora. The surveys were undertaken over 24 and 25 October 2018, with an additional area on the southern side of Houghton Road surveyed on 26 November 2018.

SURVEY RESULTS

No candidate flora species were recorded during the survey. One convolvulus species was detected in abundance throughout the grassland. It was sent to the herbarium for confirmation and determined that the species was *Convolvulus angustissimus*, which is a common and widespread species with no conservation status.

Flora: Small Scurf Pea (*Cullen parvum*)

SURVEY EFFORT

Suitable habitat for the threatened flora occurred in the Native Grassland (PCT 44) along Houghton Road. The survey was undertaken over 24 and 25 October 2018, with an additional area on the Southern side of Houghton Road surveyed on 26 November 2018. Surveys were not undertaken during the optimal survey time between December and February when the species is flowering.

SURVEY RESULTS

This species was not surveyed during the targeted survey period and as such is assumed to occur on site. Small Scurf Pea is associated with Riverine Plain Grasslands and the area of impact is determined as the area of native grassland (PCT 44) that would be impacted.

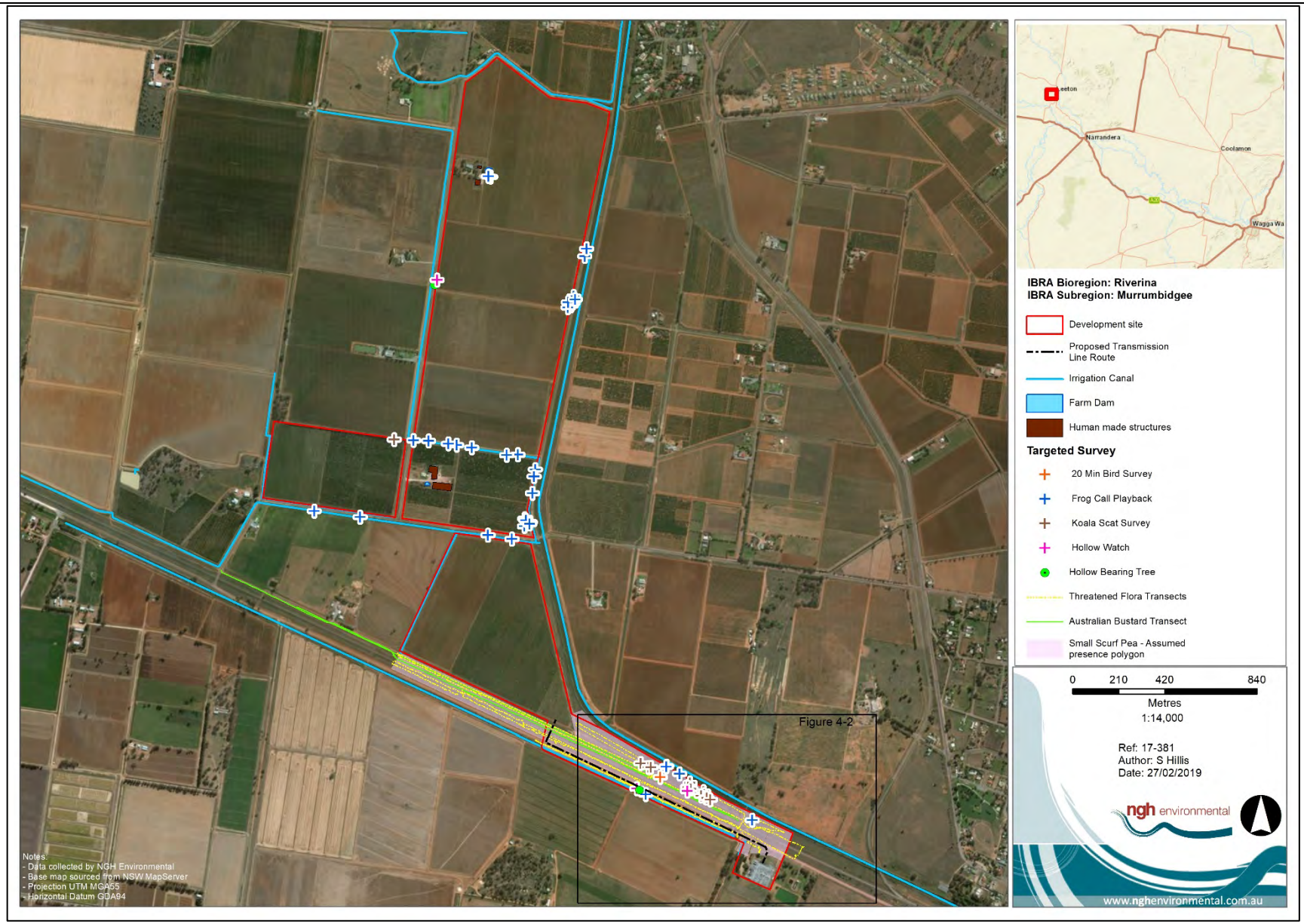


Figure 4-1 Threatened species polygons and targeted survey locations.

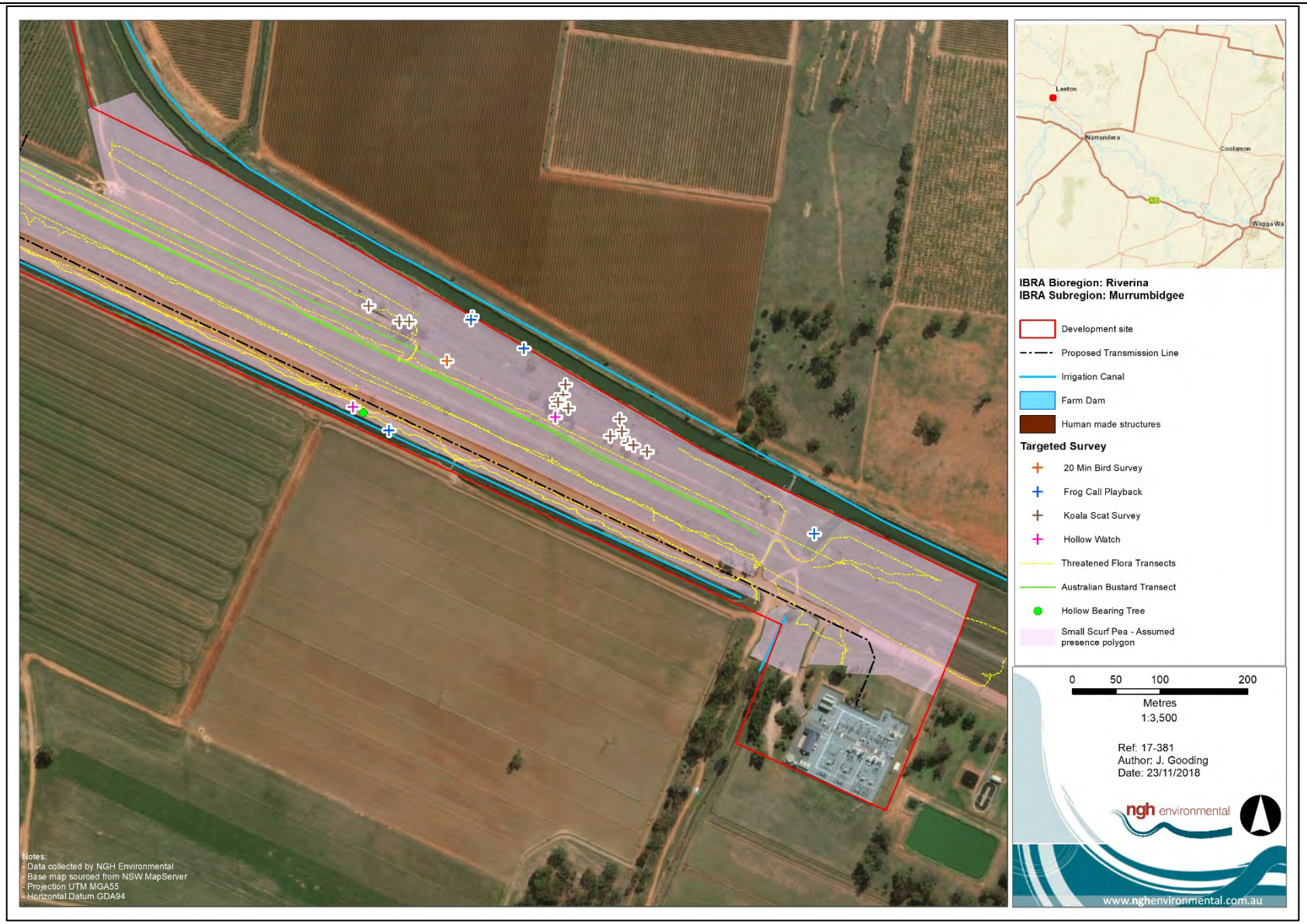


Figure 4-2 Threatened species polygons and targeted survey locations along transmission line route

4.3 ADDITIONAL HABITAT FEATURES RELEVANT TO PRESCRIBED BIODIVERSITY IMPACTS

4.3.1 Occurrences of karst, caves, crevices and cliffs

As verified by the field inspection, there are no occurrences of karst, caves, crevices, or cliffs in the development site.

4.3.2 Occurrences of rock

As verified by the field inspection, there are no occurrences of surface rock in the development site.

4.3.3 Occurrences of human made structures and non-native vegetation

There are several human-made structures on the subject land. There are three farm dams, which provide potential habitat for Sloane's Froglet and Southern Bell Frog. These species were not recorded during targeted surveys. There are two farm buildings, which provide potential roosting habitat for Southern Myotis but will not be removed by the proposed works (Fig 4-1).

Areas of non-native vegetation are planted orange orchards or vineyards. These areas could be utilised by threatened species such as the Grey-headed Flying-fox or raptors such as the White-bellied Sea-eagle as foraging habitat.

4.3.4 Hydrological processes that sustain and interact with the rivers, streams and wetlands

There is a system of irrigation channels and farm dams across the subject land which interact with natural watercourses, including the Murrumbidgee River to the south. Although modified, these features are fringed with native vegetation including sedges. These channels and dams could provide habitat for:

- Sloane's Froglet (*Crinia sloanei*)
- Southern Bell Frog (*Litoria raniformis*)

Neither of these species was detected during targeted site surveys.

No irrigation channels would be removed by the proposed development However, a a small irrigation channel alongside Research Road would be disturbed through the construction of a culvert for a new access road over the channel. Two farm dams would be filled by the proposal. The proposed impacts to these dams and irrigation canals are not anticipated to have any broader impacts to environments that sustain and interact with rivers, streams, and wetlands whether on or off-site.

5 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

An EPBC Protected Matters Report was generated on 13 September 2018 (with a 10km buffer of the development site) to identify Matters of National Environmental Significance (MNES) that have the potential to occur within the development site (Appendix D). Those relevant to biodiversity include:

- Wetlands of International Importance
- Threatened Ecological Communities
- Threatened species
- Migratory species

The potential for these MNES to occur at the development site are discussed below.

5.1 WETLANDS OF INTERNATIONAL IMPORTANCE

Five wetlands of international importance were returned in the Protected Matters report. The nearest of these (within the locality of the development site) are the Fivebough and Tuckerbil swamps. All other wetlands returned from the search are over 300km away. Fivebough and Tuckerbil swamps occur around 5km north-east of the development site. They are fed by the Murrumbidgee River. There is no apparent connectivity between the Yanco development site and the Murrumbidgee River.

5.2 THREATENED ECOLOGICAL COMMUNITIES

Four threatened ecological communities were identified in the PMST report. Two of these communities, Weeping Myall Woodlands and White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland have the potential to occur within the development site based on characteristic species occurring in close proximity to the development site.

Weeping Myall Woodlands

The patch of Weeping Myall Woodland is not considered to form part of the federally listed EEC as it does not meet the condition thresholds for the community (TSSC, 2009). The patch of Weeping Myall Woodland is less than 0.5ha and is not included as part of the listed ecological community.

Box Gum Woodlands

The patch of Yellow Box – River Red Gum grassy riverine woodland is not considered to form part of the federally listed CEEC. The patch does not meet the condition thresholds for the community (TSSC, 2006) as it has:

- less than 12 native understory species (excluding grasses), and
- is not greater than 2ha in area.

The surrounding grassland could have the potential to be a derived native grassland for this community, however it also does not meet the condition threshold for the community as it has:

- less than 12 native understory species (excluding grasses), and
- has less than 20 trees per hectare and no natural regeneration of eucalyptus species.

Natural Grasslands of the Murray Valley Plains

PCT 44 (*Forb-rich Speargrass – Windmill Grass - White Top grassland of the Riverina Bioregion)* can be associated with the federally listed EEC: Natural Grasslands of the Murray Valley Plains. The grassland is not considered part of the EEC based on the following factors.

- It falls outside the indicative distribution map (SEWPaC, 2012)
- Based on the wooded areas and scattered remnant trees in the close vicinity, is more likely to be a derived grassland from PCT 26 or PCT 74.
- Only one species is present that is listed as frequent in natural grasslands of the Murray Valley Plains (SEWPaC, 2012), and
- There are no past records of diagnostic indicator fauna species such as plains wanderer.

No federally listed threatened ecological communities are considered to occur in the development site.

5.3 THREATENED SPECIES

The PMST report identified 21 threatened species with potential to occur in the locality. Of these, 7 species are considered to potentially occur at the development site. Bold entries were targeted during onsite surveys:

- **Superb Parrot (*Polytelis swainsonii*) – Vulnerable, EPBC Act**
- Swift Parrot (*Lathamus discolor*) – Critically Endangered, EPBC Act
- Painted Honeyeater (*Grantiella picta*) – Vulnerable, EPBC Act
- **Australasian Bittern (*Botaurus poiciloptilus*) – Endangered, EPBC Act**
- **Southern Bell Frog *Litoria raniformis* – Vulnerable, EPBC Act**
- Grey-headed Flying-fox (*Pteropus poliocephalus*) – Vulnerable, EPBC Act
- **Koala (*Phascolarctos cinereus*) – Vulnerable, EPBC Act**

5.4 MIGRATORY SPECIES

Twenty migratory species were identified in the PMST report. Of these, five could potentially occur in the development site based on an assessment of habitat and distribution:

- Fork-tailed Swift (*Apus pacificus*) – Migratory, EPBC Act
- Yellow Wagtail (*Motacilla flava*) – Migratory, EPBC Act
- Satin Flycatcher (*Myiagra cyanoleuca*) – Migratory, EPBC Act
- Wood Sandpiper (*Tringa glareola*) – Migratory, EPBC Act
- Latham's Snipe (*Gallinago hardwickii*) – Migratory, EPBC Act

Based on targeted surveys and evaluation of habitat, none of these species are considered likely to occur in the development site regularly or rely on the habitats present. The proposal is therefore unlikely to have a significant impact on these species.

6 AVOID AND MINIMISE IMPACTS

6.1 AVOIDING AND MINIMISING IMPACTS ON NATIVE VEGETATION AND HABITAT

6.1.1 Site selection – consideration of alternative locations/routes

During the site selection process for Yanco Solar Farm, a number of alternative locations were considered. Ib Vogt selected the proposed site for the following reasons:

- Excellent solar exposure
- Excellent access to local and major roads
- Excellent access to the grid transmission network
- Likely low level of environmental impact – the site has been largely cleared and heavily disturbed by agriculture

The development footprint is of a scale that allows for flexibility in the design, allowing ecological and other constraints to be avoided.

6.1.2 Proposal components – consideration of alternate modes or technologies

The Large-Scale Renewable Energy Target (LRET) and Renewable Energy Action Plain (REAP) outline the commitment by both Australia and NSW to reduce greenhouse gas (GHG) emissions and set targets for increasing the supply of renewable energy. Other forms of large-scale renewable energy accounted for in the LRET include wind, hydro, biomass, and tidal energy. The feasibility of wind, solar, biomass, hydro and tidal projects depend on the availability of energy resources and grid capacity.

Photovoltaic solar technology was chosen because it is cost-effective, low profile, durable and flexible regarding layout and siting. It is a proven and mature technology which is readily available for broad-scale deployment at the site. In terms of its impacts on biodiversity, PV solar has a minimal construction footprint, mounts being either pile driven or on small footings. The largest footprint components are the perimeter track and inverter and switch station footings. The layout can be flexible to minimising impacts on site constraints.

6.1.3 Proposal planning phase – detailed design

A Preliminary Constraints Analysis was conducted by NGH Environmental (2018) which informed the site layout design. Vegetation constituting the highest ecological constraints such as forming components of EECs and providing threatened flora and fauna habitat were avoided and minimised as far as practical by:

- Refining the layout to avoid vegetation clearing whenever possible, reducing the clearing footprint of the project
- Locating ancillary facilities in areas with minimal biodiversity values
- Making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on the development site.

The final site layout and location has not been able to completely avoid all areas of biodiversity value because the transmission line is required to cross the road corridor to get to the closest substation.

However, the transmission line route was selected over disturbed areas of grassland and avoided clearing the woodland areas (PCT 74).

The final design footprint is detailed in Figure 6-1 and Figure 6-2

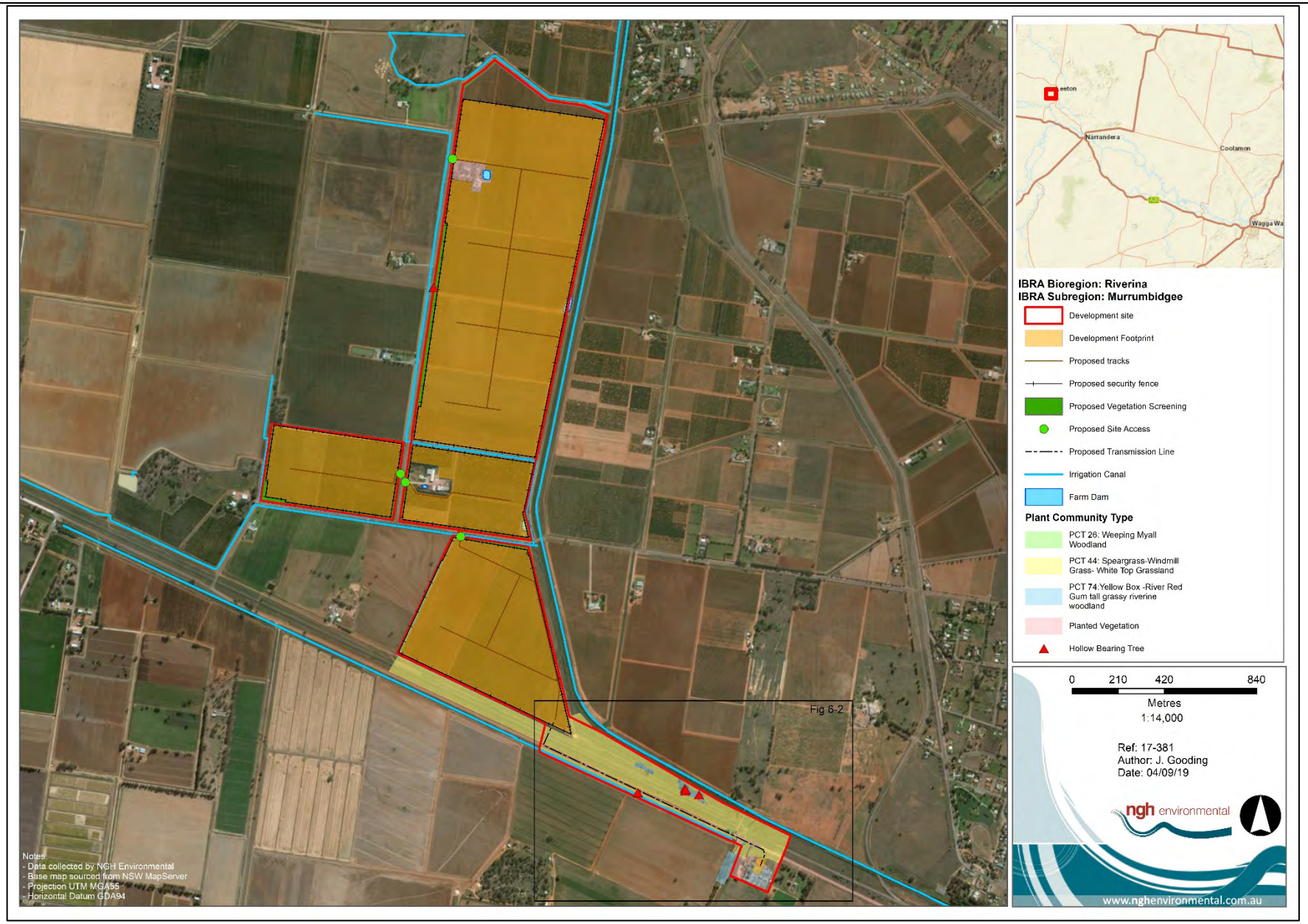


Figure 6-1 Final Project Footprint

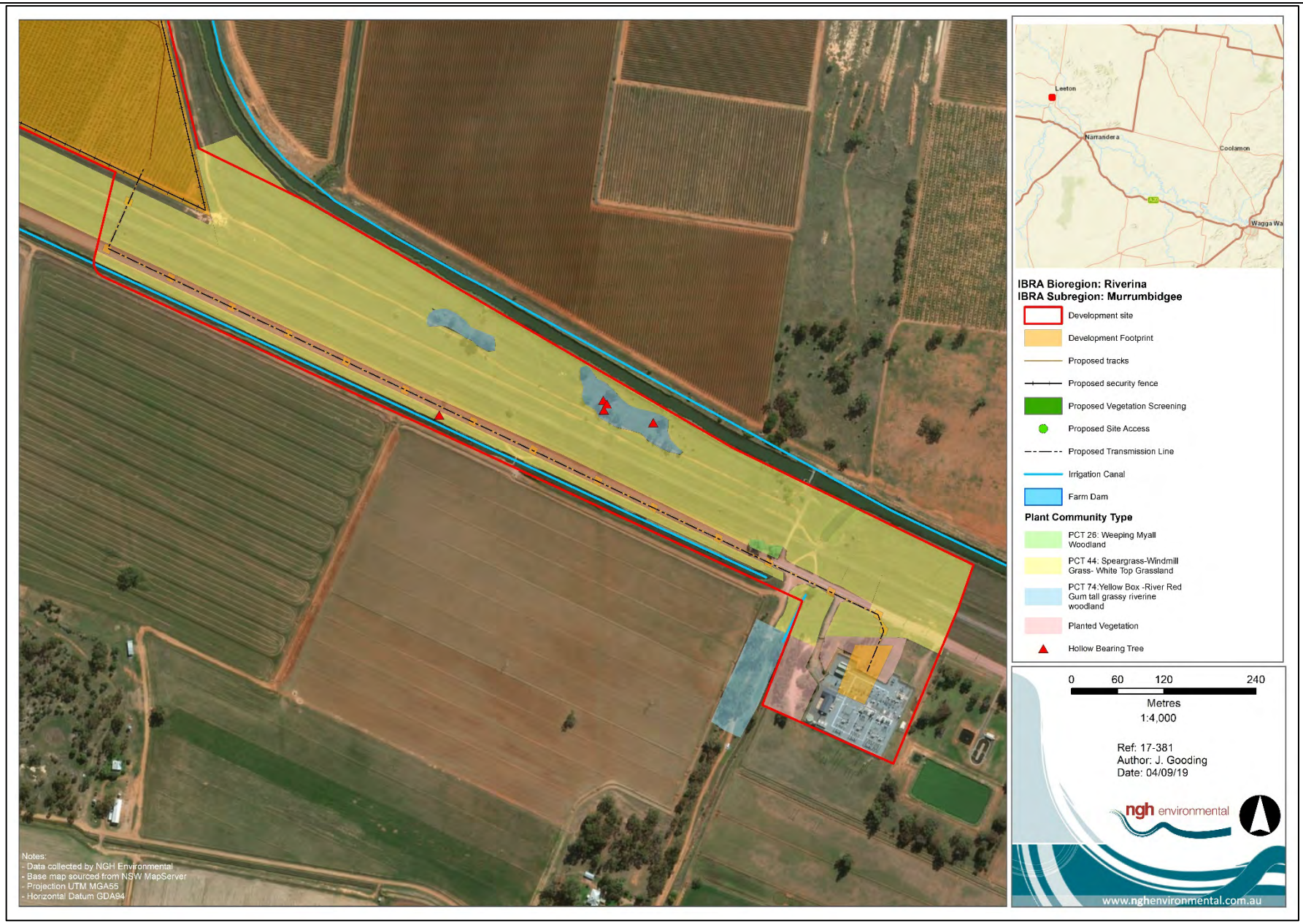


Figure 6-2 Final project footprint along transmission line route

6.2 AVOIDING AND MINIMISING PRESCRIBED BIODIVERSITY IMPACTS

The BC Regulation (clause 6.1) identifies actions that are prescribed as impacts to be assessed under the biodiversity offsets scheme.

The following prescribed impacts are relevant to the proposal:

- Impacts of development on the habitat of threatened species or ecological communities associated with human made structures, or non-native vegetation
- Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range
- Impacts of development on movement of threatened species that maintains their life cycle
- Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities
- Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.

How these prescribed impacts have been avoided and minimised by the proposal is detailed below.

6.2.1 Impacts of development on the habitat of threatened species or ecological communities associated with human-made structures, or non-native vegetation

The farm dams across the development site could provide potential habitat for Sloane's Froglet and Southern Bell Frog, and would be disturbed by the proposed development. However, targeted surveys at each dam did not detect these species, and so the development is not likely to impact their habitat.

Farm buildings (shown in Figure 4-1) provide potential roosting habitat for Southern Myotis. The development footprint of the proposal was selected to avoid impacts to this man-made habitat.

There are also planted areas of non-native vegetation which may be utilised as foraging habitat by threatened species such as White-bellied Sea-eagle and Grey-headed Flying Fox. These areas would be removed by the proposed development.

6.2.2 Impacts of development on the connectivity of different areas of habitat of threatened species that facilitate the movement of these species across the range

The majority of development has been cleared and there are no significant connectivity features in or adjacent to the development site.

The irrigation channels provide some aquatic connectivity. The development footprint would not impact these channels, which would allow aquatic connectivity to be maintained across the landscape.

6.2.3 Impacts of development on movement of threatened species that maintains their life cycle

There are no significant connectivity features in or adjacent to the development site, and so the movement of threatened species that maintains their life cycle is not likely to be impacted.

6.2.4 Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities

The development site contains four farm dams and several irrigation channels. These features are involved in existing agricultural activities on the subject land, and so water quality is likely already low. The natural hydrology of the site has been largely replaced by irrigation and drainage channels, and storage dams. There would be no removal of irrigation channels throughout the proposal site, but some disturbance would occur to the irrigation channel alongside research road through the construction of a new access road over the channel. Two dams would also be disturbed. Targeted surveys found no evidence that these dams or irrigation channels sustain any threatened species or ecological communities.

6.2.5 Impacts of vehicle strikes on threatened species or on animals that are part of a TEC

The proposal would not directly increase impacts of vehicle strikes on threatened species. Threatened species would not be funnelled into transport corridors. However, an increase in vehicle traffic may indirectly increase vehicle strikes on threatened species such as the Superb Parrot. Site design would be unlikely to reduce impacts to vehicle strikes as these species generally fly above the canopy. Site management to enforce and reduce site speed limits would minimise impacts of vehicle strikes.

7 IMPACTS UNABLE TO BE AVOIDED

7.1 DIRECT IMPACTS

The construction and operational phases of the proposal has the potential to impact biodiversity values at the site that cannot be avoided. This would occur through direct impacts such as habitat clearance and installation and existence of infrastructure.

Table 7-1 Potential impacts to biodiversity during the construction and operational phases.

Nature of impact	Extent	Frequency	Duration and timing	Consequence
Direct impacts				
Habitat clearance for permanent and temporary construction facilities (e.g. solar infrastructure, transmission lines, compound sites, stockpile sites, access tracks)	0.54ha	Regular	Construction	• Direct loss of native flora and fauna habitat • Potential over-clearing of habitat outside proposed development footprint • Injury and mortality of fauna during clearing of fauna habitat and habitat trees • Disturbance to stags, fallen timber, and bush rock
Displacement of resident fauna	Unknown	Regular	Construction, operation	• Direct loss of native fauna • Decline in local fauna populations
Injury or death of fauna	Unknown	Regular	Construction	• Direct loss of native fauna • Decline in local fauna populations
Removal of habitat features e.g. HBTs	0.54ha	Regular	Construction	• Direct loss of native fauna habitat • Injury and mortality of fauna during clearing of habitat features
Shading by solar infrastructure	128ha (70% of solar array)	Regular	Operation, long-term	• Modification of native fauna habitat • Potential loss of groundcover resulting in unstable ground surfaces and sedimentation of adjacent waterways
Existence of permanent solar infrastructure	183ha	Regular	Operation, long-term	• Modification of habitat beneath array (mostly exotic) • Reduced fauna movements across landscape due to fencing • Collision risks of fencing to birds and microbats

7.1.1 Changes in vegetation integrity scores

Up to 0.54 ha of native vegetation would be removed by the proposal. The development footprint for the transmission line runs through 0.02ha of Weeping Myall Woodland along Houghtons Road. This patch of Weeping Myall Woodland is very small, only 0.05 ha in size and comprised of 3 mature trees. It is anticipated that direct impacts requiring the removal of even only one of these trees would reduce the long-term viability of the whole patch. Thus, as a worst-case scenario the whole 0.05 ha patch of Weeping Myall Woodland was considered to be impacted and this area was entered into the BAM Calculator for the offset calculations.

The changes in vegetation integrity scores as a result of clearing are documented for each vegetation zone in Table 7-2 below.

Table 7-2 Table of current and future vegetation integrity scores for each vegetation zone within the development site.

Zone ID	PCT	EEC and/or threatened species habitat?	Area (ha)	Current vegetation Integrity Score	Future vegetation Integrity Score
1	44	No	0.49	36.4	0
2	26	Myall Woodlands in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes EEC	0.05	86.5	0

7.1.2 Loss of species credit species habitat or individuals

0.54 ha of Forb-rich Speargrass – Windmill Grass – White Top Grassland and Weeping Myall Open Woodland would be removed by the proposal. The Small Scurf Pea is associated with these vegetation types. As this species was unable to be surveyed for during the appropriate survey period it was assumed to be present in these areas of native vegetation. Planted vegetation to be removed has been highly modified in the understory and would be unlikely to provide any habitat for the Small Scurf Pea. The loss of species credit species habitat as a result of clearing is documented in Table 7-3 below.

Table 7-3 Summary of species credit species loss at the development site.

Species Credit Species	Biodiversity risk weighting	Area of habitat lost
Small Scurf Pea *Cullen parvum*	2.00	0.54ha (Area of native vegetation removed)

7.1.3 Loss of hollow-bearing trees

Six Hollow-bearing Trees (HBTs) were recorded within the development site (Table 7-4). All HBTS have been avoided by the development and no HBTS would need to be removed.

Table 7-4 Hollow Bearing Trees within the development site

ID	Species	DBH (cm)	No of Hollows (#)				Impacted by proposal
			Small (<10cm)	**Medium (10-20cm)**	**Large (>20cm)**	**Fissure**	
1	Bimble Box (*E. populnea*)	159	-	1	2	-	No
2	Bimble Box (*E. populnea*)	30	1	-	-	1	No
3	Bimble Box (*E. populnea*)	50	1	-	-	-	No
4	Bimble Box (*E. populnea*)	65	1	-	-	-	No
5	Kurrajong (*Brachychiton populneus*)	20	1	-	-	-	No
6	Bimble Box (*E. populnea*)	150	2	2	1	-	No

7.2 INDIRECT IMPACTS

Indirect impacts of the proposal include soil and water contamination, creation of barriers to fauna movement, or the generation of excessive dust, light or noise. Table 7-5 below details the type, frequency, intensity, duration and consequence of the direct and indirect impacts of the proposal.

Given the current condition of the site, the following indirect impacts are unlikely to occur or be exacerbated as a result of the development;

- Inhibition of nitrogen fixation and increased soil salinity
- Wood collection
- Bush rock removal and disturbance
- Increase in predatory species populations
- Increase in pest animal populations
- Increased risk of fire
- Loss of breeding habitat
- Disturbance to specialist breeding and foraging habitat
- Reduced viability of adjacent habitat due to edge effects
- Reduced viability of adjacent habitats due to noise, dust or light spill
- Increased risk of starvation, exposure and loss of shade or shelter

Table 7-5 Potential impacts to biodiversity during the construction and operation phases.

Nature of impact	Extent	Frequency	Duration and timing	TEC, threatened species and habitats likely to be affected	Consequence for bioregional persistence
Indirect impacts (those listed below are included in the BAM)					
Inadvertent impacts on adjacent habitat or vegetation	Unknown	Rare	Construction Short-term	• Myall Woodland TEC	• Direct loss of native flora and fauna habitat • Injury and mortality of fauna during clearing of fauna habitat and habitat trees • Disturbance to stags, fallen timber, and bush rock • Increased edge effects
Reduced viability of adjacent habitat due to edge effects	Unknown	Constant	Operation Long-term	• Myall Woodland TEC	• Degradation of Myall Woodland TEC • Loss of native flora and fauna habitat
Reduced viability of adjacent habitat due to noise, dust or light spill	Unknown	Rare	Operation Short-term	• Superb Parrot	• May alter fauna activities and/or movements • Loss of foraging or breeding habitat • Inhibit the function of plant species, soils and dams
Transport of weeds and pathogens from the site to adjacent vegetation	Unknown	Irregular	Construction / operation Long-term	• Myall Woodland TEC	• Degradation of Myall Woodland TEC • Weed establishment and spread
Increased risk of starvation, exposure and loss of shade or shelter	Unknown	Rare	Construction / operation Long-term	• Superb Parrot	• Loss of foraging habitat
Loss of breeding habitats	1 HBT	Constant	Construction Long-term	• Superb Parrot	• Loss of potential breeding habitat • Potential decline in bioregional population
Earthworks and mobilisation of sediments	Unknown	Regular	Construction	• Myall Woodland TEC	• Erosion and sedimentation and/or pollution of soils, dams and downstream habitats
Trampling of threatened flora species	Unknown	Unknown	Construction	• Small Scurf Pea	• Loss of native flora habitat

7.3 PRESCRIBED IMPACTS

The following prescribed biodiversity impacts are relevant to the proposal:

- Impacts of development on the habitat of threatened species or ecological communities associated with human made structures, or non-native vegetation
- Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range
- Impacts of development on movement of threatened species that maintains their life cycle
- Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities
- Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.

These are discussed in detail below and the necessary information required by Section 9.2 of the BAM provided.

7.3.1 Impacts of development on the habitat of threatened species or ecological communities associated with human-made structures, or non-native vegetation

The farm dams across the development site could provide potential habitat for Sloane's Froglet and Southern Bell Frog and would be removed by the proposed development. However, targeted surveys at each dam did not detect these species, and so the development is not likely to impact these species.

Farm buildings (Figure 4-1) provide potential roosting habitat for Southern Myotis. The development footprint of the proposal was selected to avoid impacts to this man-made habitat. There would be some short-term, indirect disturbance associated with construction.

3.15ha of planted native vegetation that does not form part of a PCT occurs in the development site. This included a single row of *Casuarina cunninghamiana* (River She-oak) planted as a windbreak. Planted vegetation may still provide habitat for threatened native species. Targeted surveys for threatened species did not detect any threatened species in this habitat. This vegetation would be avoided by the development.

Areas of non-native vegetation such as orange orchards and vineyards, which may be utilised as foraging habitat by threatened species such as White-bellied Sea-eagle and Grey-headed Flying Fox, would be removed by the proposed development. Based on the abundance of food sources that would remain in the development site, the proposal is not likely to impact on the bioregional persistence of White-bellied Sea-eagle or Grey-headed Flying-fox.

7.3.2 Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range

There are no significant connectivity features in or adjacent to the development site. The irrigation channels provide some aquatic connectivity, however the development footprint would not impact these channels, which would allow aquatic connectivity to be maintained across the landscape. The proposal is therefore not likely to impact on the bioregional persistence of threatened species.

7.3.3 Impacts of the development on movement of threatened species that maintains their life cycle

There are no significant connectivity features in or adjacent to the development site, and so the movement of threatened species that maintains their life cycle is not likely to be impacted.

Superb Parrots remain in the Riverina area year-round, where they nest in the hollows of large trees in open box-gum woodland or isolated paddock trees, including Blakely's Red Gum, Yellow Box, Apple Box and Red Box (OEH, 2018). The White-bellied Sea Eagle is wide ranging and forages over rivers and wetlands.

The habitat to be removed is not likely to be important to the life cycle of these species, given their high mobility (described in Section 7.3.1) and the minimal proportion of habitat to be removed. The proposal is therefore not likely to disrupt the movement of these species and would not have a substantive impact on their bioregional persistence.

7.3.4 Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including subsidence or upsidence resulting from underground mining or other development)

The development site contains four farm dams and several irrigation channels. These features are involved in existing agricultural activities on the subject land, and so water quality is likely already low. The natural hydrology of the site has been largely replaced by irrigation and drainage channels, and storage dams. There would be no removal of irrigation channels throughout the proposal site, but there would be some disturbance to the irrigation channel along Research Road for the construction of an access road over the channel. Two dams would also be impacted and filled in. Targeted surveys found no evidence that these dams or irrigation channels sustain any threatened species or ecological communities, and so the proposed development is not likely to impact their bioregional persistence.

Construction of the proposal would not directly affect surface water quality. Indirectly, the proposed works would involve a range of activities that would disturb soils and potentially lead to sediment-laden runoff, affecting local water ways during rainfall events. These potential impacts are unlikely to significantly impact water quality. The use of fuels and other chemicals on site pose a risk of surface water contamination in the event of a spill. Chemicals used onsite would include fuels, lubricants and herbicides, none of which are considered difficult to manage.

Operation of the proposal would have minimal potential for any impact to surface water quality. Appropriate drainage features would be constructed along internal access roads to minimise the risk of dirty water leaving the site or entering waterways. With the exception of internal roads, parking areas and areas around site offices, the site would be largely vegetated with grass cover (specifically, ground cover would be maintained beneath the solar array). There would be a low risk of contamination in the event of a chemical spill (fuels, lubricants, herbicides etc.) as storage and emergency handling protocols would be implemented.

7.3.5 Impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC

The proposal would not directly increase impacts of vehicle strikes on threatened species. Threatened species would not be funnelled into transport corridors. However, an increase in vehicle traffic may indirectly increase vehicle strikes on threatened species such as the Superb Parrot. Site design would be

unlikely to reduce impacts to vehicle strikes as these species generally fly above the canopy. Site management to enforce and reduce site speed limits would minimise impacts of vehicle strikes.

Superb Parrots have been recorded on site and so may be at risk of vehicle strike. Superb Parrots are particularly vulnerable to vehicle strike when feeding on spilled grain along roadsides (Baker-Gabb, 2011). Superb Parrots recorded during site inspections were flying above the canopy, well above vehicle height.

Mitigation measures will be implemented to enforce a site speed. With the recommended mitigation measures, it is therefore not likely that vehicles associated with the proposal will have a substantive impact on this species.

7.4 IMPACTS TO MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Threatened Fauna

One EPBC-listed species was recorded during the field surveys, Superb Parrots seen flying above the canopy in the south of the development site (transmission line route). Habitat for this species in the development site is primarily limited to isolated hollow-bearing paddock trees, which provide low-quality foraging, shelter, and nesting habitat.

Seven threatened fauna species and five migratory birds identified in the PMST report are considered to have the potential to occur in the development site, including:

- Superb Parrot (*Polytelis swainsonii*) – Vulnerable, EPBC Act
- Swift Parrot (*Lathamus discolor*) – Critically Endangered, EPBC Act
- Painted Honeyeater (*Grantiella picta*) – Vulnerable, EPBC Act
- Australasian Bittern (*Botaurus poiciloptilus*) – Endangered, EPBC Act
- Southern Bell Frog (*Litoria raniformis*)– Vulnerable, EPBC Act
- Grey-headed Flying-fox (*Pteropus poliocephalus*) – Vulnerable, EPBC Act
- Koala (*Phascolarctos cinereus*) – Vulnerable, EPBC Act
- Fork-tailed Swift (*Apus pacificus*) – Migratory, EPBC Act
- Yellow Wagtail (*Motacilla flava*) – Migratory, EPBC Act
- Satin Flycatcher (*Myiagra cyanoleuca*) – Migratory, EPBC Act
- Wood Sandpiper (*Tringa glareola*) – Migratory, EPBC Act
- Latham's Snipe (*Gallinago hardwickii*) – Migratory, EPBC Act

EPBC Assessments of Significance were completed for each of these species. These concluded that a significant impact was unlikely, on the basis that the proposal would not:

- Lead to a reduction of the size or area of occupancy of a population, or fragment or disrupt the breeding cycle of a population
- Affect habitat critical to the survival of any species
- Introduce invasive species harmful to any species
- Introduce disease that would cause any species to decline
- Interfere with the recovery of these species

Specific mitigation measures have been recommended in Section 8.1 to avoid impacts to these species. With the implementation of these measures, impacts to these species are unlikely and no further assessment is required.

A referral to the federal Department of Environment and Energy is not considered necessary.

The EPBC Referral Guidelines for the Koala (DoE 2014) documents the 'Koala habitat assessment tool' to assist proponents in determining if a proposal may impact on habitat critical to the survival of the Koala. The tool is provided as Table 7-6 below as it applies to the proposal. Impact areas that score five or more using the habitat assessment tool contain habitat critical to the survival of the Koala. The assessment in Table 7-6 resulted in a score of 4 and as such habitat within the study area is not considered to be critical to the survival of the Koala and an assessment of significant impact according to the EPBC Act significant impact criteria is not required.

Table 7-6: Koala habitat assessment tool for inland areas (DoE 2014)

Attribute	Score	Inland	Applicable to the proposal?
Koala occurrence	+2 (high)	Evidence of one or more koalas within the last 5 years.	
	+1 (medium)	Evidence of one or more koalas within 2km of the edge of the impact area within the last 10 years.	
	0 (low)	None of the above.	✓
Vegetation composition	+2 (high)	Has forest, woodland or shrubland with emerging trees with 2 or more known koala food tree species, **OR** 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata.	✓ River Red Gum, Bimble Box and Yellow Box are listed food tree species
	+1 (medium)	Has forest, woodland or shrubland with emerging trees with only 1 species of known koala food tree present.	
	0 (low)	None of the above.	
Habitat connectivity	+2 (high)	Area is part of a contiguous landscape ≥1000ha.	
	+1 (medium)	Area is part of a **contiguous landscape** <1000ha, but ≥500ha.	
	0 (low)	None of the above.	✓
Key existing threats	+2 (high)	Little or no evidence of koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence. Areas which score 0 for koala occurrence and have no dog or vehicle threat present	✓ No Koala mortality observed during the survey
	+1 (medium)	Evidence of infrequent or irregular koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, **OR** Areas which score 0 for koala occurrence and are likely to have some degree of dog or vehicle threat present.	

Attribute	Score	Inland	Applicable to the proposal?
	0 (low)	Evidence of frequent or regular koala mortality from vehicle strike or dog attack in the study area at present, **OR** Areas which score 0 for koala occurrence and have a significant dog or vehicle threat present.	
Recovery value	+2 (high)	Habitat is likely to be important for achieving the interim recovery objectives outlined in the EPBC Act referral guidelines. (DoE, 2014)	
	+1 (medium)	Uncertain whether the habitat is important for achieving the interim recovery objectives outlined in the EPBC Act referral guidelines. (DoE, 2014)	
	0 (low)	Habitat is unlikely to be important for achieving the interim recovery objectives outlined in the EPBC Act referral guidelines (DoE, 2014).	✓ Study area is not considered a habitat refuge, nor does it provide important connectivity to large areas surrounding a habitat refuge
Total	**4**	**Decision: Habitat not critical to the survival of the Koala—no assessment of significance required**	

Threatened Flora and TECs

No threatened flora or threatened ecological communities are considered to occur within the development site.

A referral to the federal Department of Environment and Energy is not considered necessary.

7.5 LIMITATIONS TO DATA, ASSUMPTIONS AND PREDICTIONS

It is possible that some species were not recorded during the survey due to the timing of the survey outside their recommended survey period. Where survey effort or timing is not consistent with the BAM or relevant guidelines, this is stated explicitly in the assessment and measures identified to address the limitation; i.e. assumption of occurrence for three species whose survey window could not be met.

Floristic plot surveys were undertaken during dry drought conditions and some grasses and forbs were dried up and difficult to identify. Where identification of a plant was uncertain, it was assumed to be native for the purposes of the BAM assessment. The floristic plots are based on a single visit survey and it is possible that not all plant species were detected that may be present at the site due to seasonal and climatic constraints. In particular, inconspicuous or geophytic species which are present outside the surveyed period may not have been recorded and dry drought conditions may have reduced the abundance and cover of forbs and grasses.

8 MITIGATING AND MANAGING IMPACTS

8.1 MITIGATION MEASURES

A general summary of the key measures required to mitigate the impacts of the proposal are provided below. Mitigation measures proposed to manage impacts, including proposed techniques, timing, frequency, responsibility for implementing each measure, risk of failure and an analysis of the consequences of any residual impacts are provided in Table 8-1.

8.1.1 Impacts from the clearing of vegetation and habitats

1. Time works to avoid critical life cycle events.
2. Implement clearing protocols during tree clearing works, including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological or wildlife handler.
3. Relocate habitat features (fallen timber, hollow logs) from within the development site.

Preparation of a construction and operations environmental management plan.

8.1.2 Indirect impacts

1. Clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance; for example, removal of native vegetation by chainsaw, rather than heavy machinery, is preferable in situations where partial clearing is proposed.
2. Adaptive dust monitoring programs to control air quality.
3. Temporary fencing to protect significant environmental features such as riparian zones.
4. Hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas.
5. Staff training and site briefing to communicate environmental features to be protected and measures to be implemented.
6. Implement fauna monitoring and fauna rescue protocols for security and boundary fences during construction and the first year of operation.

8.1.3 Prescribed impacts

1. Appropriate landscape plantings of local indigenous species derived from local native plant communities.
2. Sediment barriers and spill management protocols to control the quality of water runoff from the site into the receiving environment.
3. Enforce site speed limits to reduce impacts of vehicle strikes on threatened fauna.

Table 8-1 Mitigation measures proposed to avoid and minimise impacts on native vegetation and habitat

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
Displacement of resident fauna through vegetation clearing and habitat removal						
Time works to avoid critical life cycle events.	• If clearing outside this period cannot be achieved, pre-clearing surveys would be undertaken to ensure no impacts to fauna would occur • Dams would be removed in winter to avoid impacts on wetland birds, while Latham's Snipe and Wood Sandpiper are outside Australia, and outside the summer breeding season for Australasian Bittern	Construction	Regular	Contractor	Moderate	Species not detected during pre-clearing surveys may be impacted
Implement clearing protocols including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecologist or licensed wildlife handler.	• Pre-clearing checklist • Tree clearing procedure	Construction	Regular	Contractor	Moderate	Species not detected during pre-clearing surveys may be impacted
Relocate habitat features (fallen timber, hollow logs) from within the development site.	• Tree-clearing procedure including relocation of habitat features to adjacent areas for habitat enhancement	Construction	Regular	Contractor	Low	None
Preparation of a construction and operations environmental management plan.	• Preparation of a Constructions and Operations environmental management plan that would include protocols for: o Protection of native vegetation to be retained	Construction	Regular	Contractor	Low	None

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
	o Best practice removal and disposal of vegetation o Staged removal of hollow-bearing trees and other habitat features such as fallen logs with attendance by an ecologist o Weed management o Unexpected threatened species finds o Rehabilitation of disturbed areas • Rehabilitation and revegetation of linear corridors along Sandigo-Boree Creek Road to enhance connectivity value.					
Indirect impacts on native vegetation and habitat						
Clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance; for example, removal of native vegetation by chainsaw, rather than heavy machinery, is preferable in situations where partial clearing is proposed	• Approved clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing • No stockpiling or storage within the dripline of any mature trees • In areas to clear which are adjacent to those to be retained, chainsaws would be used rather than heavy machinery to minimise risk of unauthorised disturbance	Construction	Regular	Contractor	Low	None

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
Noise barriers or daily/seasonal timing of construction and operational activities to reduce impacts of noise	• Construction Environmental Management Plan will include measures to avoid noise impacts on adjacent habitats such as avoiding night works wherever possible	Construction	Regular	Contractor	Low	None
Light shields or daily/seasonal timing of construction and operational activities to reduce impacts of light spill	• Avoid night works wherever possible • Direct lights away from vegetation	Construction / operation	Regular	Contractor	Low	None
Adaptive dust monitoring programs to control air quality	• Daily monitoring of dust generated by construction activities • Construction to cease if dust is observed being blown from site until control measures were implemented or weather conditions improve • All activities relating to the proposal would be undertaken with the objective of preventing visible dust emissions from the development site	Construction	Regular	Contractor	Moderate	Sedimentation in water bodies (including irrigation channels)
Temporary fencing to protect significant environmental features such as riparian zones	• Prior to construction commencing, exclusion fencing and signage would be installed around habitat to be retained	Construction	Regular	Contractor	Low	None
Hygiene protocols to prevent the spread of weeds or	• A Weed Management Procedure would be developed for the proposal to prevent and minimise	Construction / operation	Regular	Contractor	Moderate	Weed invasion/spread

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
pathogens between infected areas and uninfected areas	the spread of weeds. This would include: o Management protocol for declared priority weeds during and after construction. o Weed hygiene protocol in relation to plant, machinery and fill. • Any occurrences of pathogens such as Myrtle rust and Phytophthora would be monitored, treated, and reported. • The weed management procedure would be incorporated into the Biodiversity Management Plan as part of the CEMP.					
Staff training and site briefing to communicate environmental features to be protected and measures to be implemented	• Site induction • Toolbox talks	Construction	Regular	Contractor	Moderate	Impacts to native vegetation or threatened species from staff training not being followed
Preparation of a vegetation management plan to regulate activity in vegetation and habitat adjacent to the proposed development	• Preparation of a Biodiversity Management Plan that would include protocols for: o Protection of native vegetation to be retained o Best practice removal and disposal of vegetation	Construction	One-off	Contractor	Moderate	Impacts to native vegetation or threatened species from Biodiversity Management Plan not being followed

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
	o Staged removal of hollow-bearing trees and other habitat features such as fallen logs with attendance by ecologist o Weed management o Unexpected threatened species finds o Rehabilitation of disturbed areas					
Erosion and sediment controls	• An Erosion and Sediment Control Plan (ESCP) would be prepared and implemented in conjunction with the final design	Construction	Regular	Contractor	Moderate	Impacts may occur if ESCP not implemented
Implement fauna monitoring and fauna rescue protocols for security and boundary fences during the first year of operation.	• Fauna monitoring strategy for weekly monitoring of security/boundary fences during construction and monthly during the first year of operation • Implement fauna management and rescue procedures including identification of mortalities with regular reporting to OEH	Construction Operation	Weekly Monthly for 1st Year	Contractor	Low	Fauna mortality
Prescribed biodiversity impacts						
Sediment barriers and spill management procedures to control the quality of water runoff from the site into the receiving environment	• An ESCP would be prepared and implemented in conjunction with the final design. • Spill management procedures would be implemented.	Construction	Regular	Contractor	Moderate	Impacts may occur to waterways if ESCP not implemented.

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
Staff training and site briefing to communicate impacts of traffic strike on native fauna	• Awareness training during site inductions regarding enforcing site speed limits. • Site speed limits to be enforced to minimise fauna strike.	Construction, operation	Regular	Contractor	Moderate	Fauna strikes from vehicles
Appropriate landscape plantings of local indigenous species to replace loss of planted vegetation	• Landscape plantings for screening to be comprised of locally indigenous species from local native plant communities.	Operation	Regular	Client	Moderate	Plants not surviving resulting in net loss of planted vegetation

8.2 ADAPTIVE MANAGEMENT STRATEGY

No adaptive management strategy is proposed for the development.

9 SERIOUS AND IRREVERSIBLE IMPACTS (SAII)

The principles used to determine if a development will have serious and irreversible impacts, include impacts that:

- Will cause a further decline of the species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to be in a rapid rate of decline, or
- Will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to have a very small population size, or
- Impact on the habitat of a species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to have a very limited geographic distribution, or
- Impact on a species or ecological community that is unlikely to respond to measures to improve habitat and vegetation integrity and is therefore irreplaceable.

9.1 POTENTIAL SERIOUS AND IRREVERSIBLE IMPACT (SAII) ENTITIES

9.1.1 Threatened ecological communities

There are no SAII candidate EECs recorded at the development site.

9.1.2 Threatened species

There are no SAII candidate species recorded at the development site.

9.1.3 Additional potential entities

No further species or ecological communities were considered to be potential SAII entities.

10 REQUIREMENT TO OFFSET

10.1 IMPACTS REQUIRING AN OFFSET

10.1.1 Ecosystem credits

An offset is required for all impacts of development on PCTs that are associated with:

a) a vegetation zone that has a vegetation integrity score ≥15 where the PCT is representative of an endangered or critically endangered ecological community, or
b) a vegetation zone that has a vegetation integrity score of ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community, or
c) a vegetation zone that has a vegetation integrity score ≥20 where the PCT is not representative of a TEC or associated with threatened species habitat.

The PCTs and vegetation zones requiring offset and the ecosystem credits required are documented in Table 10-1 and mapped in Figure 10-1.

Table 10-1 PCTs and vegetation zones that require offsets.

Zone ID	PCT ID	PCT name	Zone area (ha)	Vegetation integrity score	Ecosystem credits required
1	44	Forb-rich Speargrass – Windmill Grass - White Top grassland of the Riverina Bioregion.	0.49	36.4	9
2	26	Weeping Myall Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	0.05	86.5	2

The full Biodiversity Credit Report generated by the BAM Calculator is provided in Appendix H.

10.1.2 Species credits

An offset is required for the threatened species impacted by the development that require species credits. These species and the species credits required are documented in Table 10-2.

Table 10-2 Species credit species that require offsets.

Species Credit Species	Biodiversity risk weighting	Area of habitat or count of individuals lost	Species credits required
Small scurf Pea (*Cullen parvum*)	2.00	0.54ha	11

The full Biodiversity Credit Report generated by the BAM Calculator is provided in Appendix H.

10.1.3 Offsets required under the EPBC Act

No species listed on the EPBC Act have been identified as having the potential to be significantly impacted by the development. As such, the proposal is not considered to require offsets in accordance with the EPBC Offsets Policy.

10.2 AREAS NOT REQUIRING OFFSETS

185ha of exotic vegetation comprising of orange and grape crops would be impacted by the proposal. No threatened species likely to occur in the development site would be dependent on this habitat. Exotic vegetation is not required to be offset and does not require further assessment.

These areas of habitat are mapped in Figure 10-1.

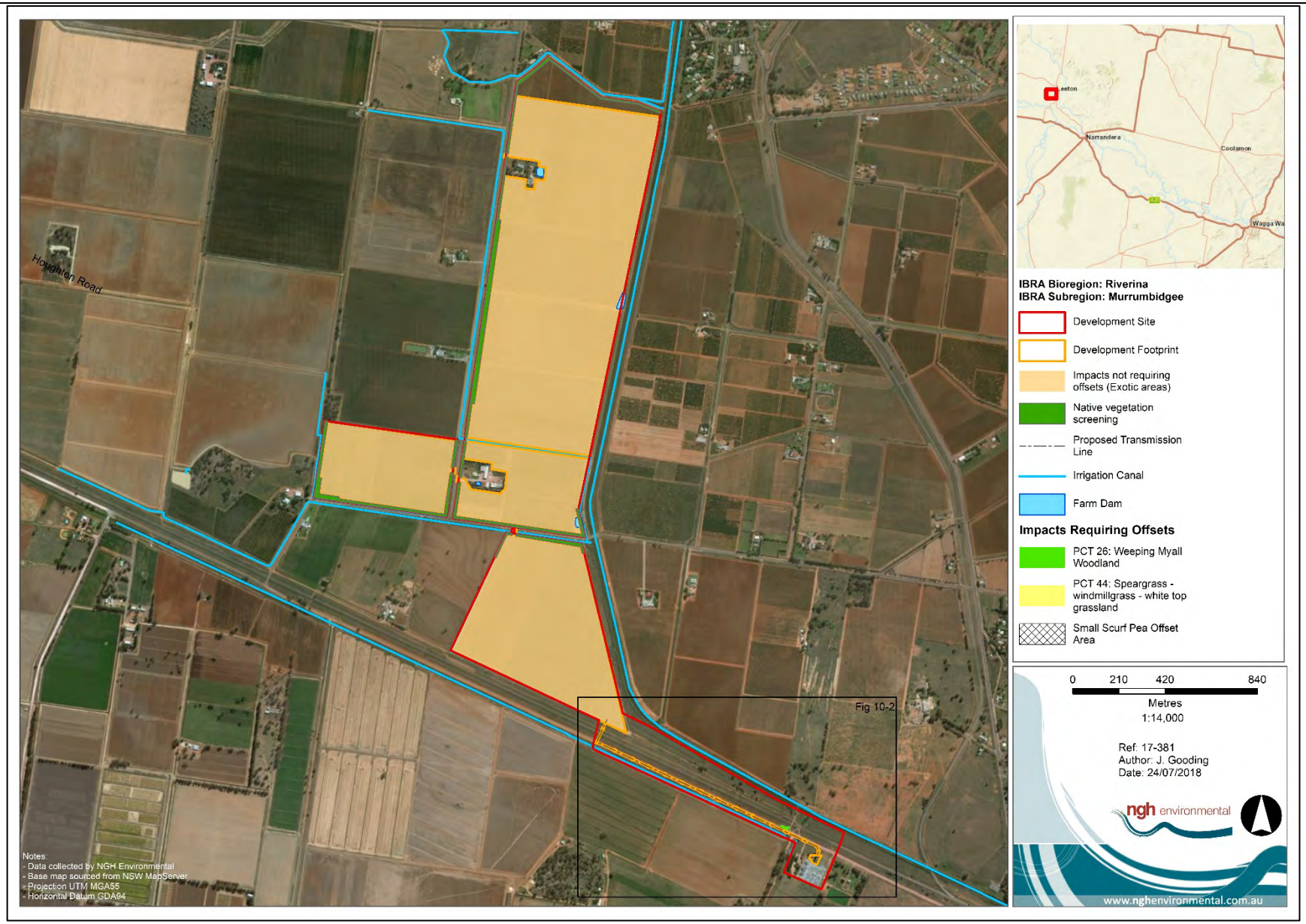


Figure 10-1 Impacts requiring offset, not requiring offset and not requiring assessment.

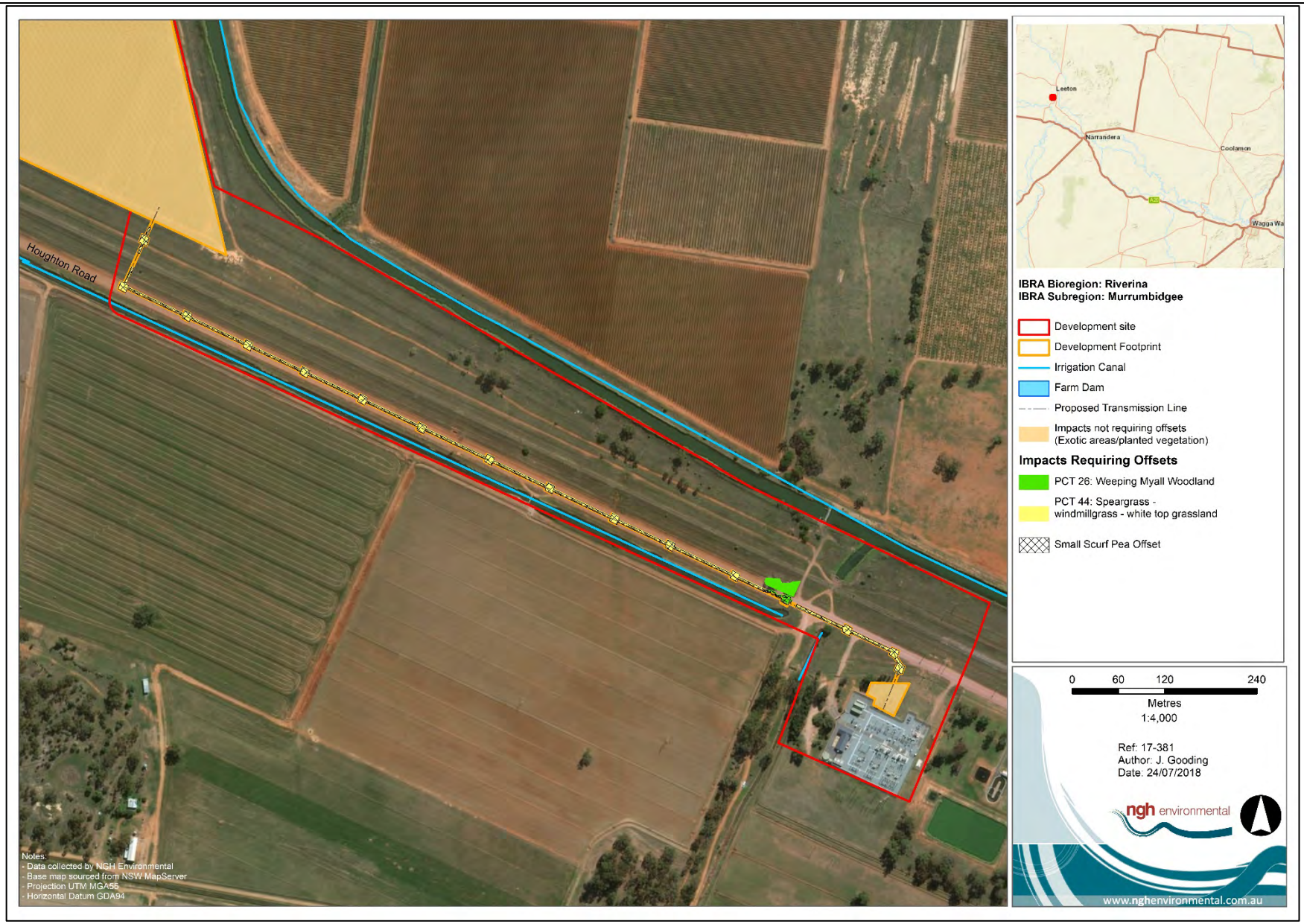


Figure 10-2 Impacts requiring offsets and not requiring offsets along transmission line route

10.3 SUMMARY OF OFFSET CREDITS REQUIRED

Ecosystem Credits	Offset credits required
PCT 44 – Forb-rich Speargrass – Windmill Grass – White Top grassland of the Riverina Bioregion	9
PCT 26 – Weeping Myall Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	2
Species Credits	**Offset credits required**
Small Scurf Pea (*Cullen parvum)*	11

11 CONCLUSIONS

NGH Environmental has prepared this BDAR on behalf of Ib Vogt for Yanco Solar Farm in Yanco, NSW. The purpose of this BDAR was to address the requirements of the BAM, developed for Major Projects, and to address the biodiversity matters raised in the SEARs. In this BDAR, biodiversity impacts have been assessed through:

- Comprehensive mapping and assessment completed in accordance with the BAM
- The identification of two threatened species within the development site and adjacent vegetation, the impacts of which have been adequately assessed
- Mitigation measures which have been outlined to reduce the impacts to biodiversity
- The generation of 9 Ecosystem Credits within the development site for impacts to (PCT 44) Forb-rich Speargrass – Windmill Grass – White Top grassland of the Riverina Bioregion.
- The generation of 2 Ecosystem Credits within the development site for impacts to (PCT 26) Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
- The generation of 11 Species credits for impacts to Small Scurf Pea (*Cullen parvum*).

The requirements of these credits will be carried out in accordance with the NSW Biodiversity Offsets Policy for Major Proposals, and will be achieved by either:

a) Retiring credits under the Biodiversity Offsets Scheme
b) Making payments into the Biodiversity Conservation Fund
c) Funding a biodiversity action

12 REFERENCES

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APPENDIX A PLOT PHOTOS

Plot 1 – PCT 74_Moderate Condition

Plot 2 – PCT 44_Moderate Condition

Plot 3 – PCT 74_Moderate Condition

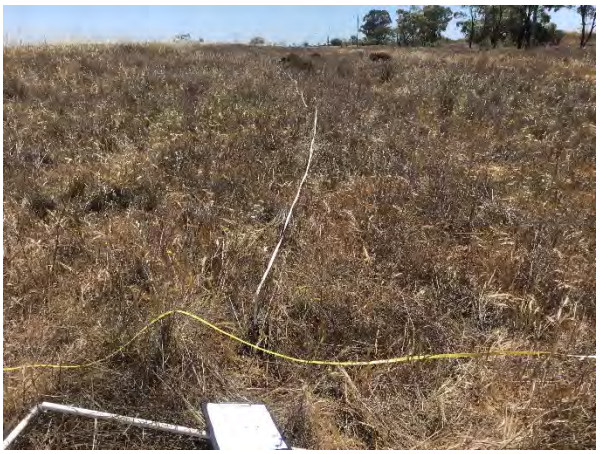
Plot 4 - PCT 44_Moderate Condition

Plot 5 – PCT 26_Moderate Condition

Plot 6 - PCT 26_Roadside

Plot 7 – PCT 44_Moderate Condition

Plot 8 – PCT 44_Moderate Condition



Plot 9 – PCT 44_Moderate Condition

APPENDIX B FLORA SPECIES LISTS

Family	Exotic	Scientific Name	Common Name	PCT 74 Plot 1		PCT 44 Plot 2		PCT 74 Plot 3		PCT 44 Plot 4		PCT 26 Plot 5	
				C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	C (%)	A (#)
TREES													
Fabaceae (Mimosoideae)		*Acacia pendula*	Weeping Myall									25	10
Malvaceae		*Brachychiton populneus*	Kurrajong										
Myrtaceae		*Eucalyptus populnea subsp. bimbil*	Bimble Box	12	2								
Myrtaceae		*Eucalyptus melliodora*	Yellow Box			0.1	1	10	1				
Myrtaceae		*Eucalyptus camaldulensis*	River Red Gum					25	1				
Meliaceae		*Melia azedarach*	White Cedar					5	6				
SHRUBS													
Fabaceae		*Acacia deanei*	Deane's Wattle										
Chenopodiaceae		*Atriplex semibaccata*	Creeping Saltbush					0.1	10			5	30
Chenopodiaceae		*Atriplex suberecta*	Sprawling Saltbush										
Chenopodiaceae		*Enchylaena tomentosa*	Ruby Saltbush	0.1	1			2	10			10	30
Solanaceae	*	*Lycium ferocissimum*	African Boxthorn					5	8			0.1	1
Chenopodiaceae		*Maireana brevifolia*	Bluebush							5	25		
Chenopodiaceae		*Maireana excavata*	Bottle Bluebush									0.2	20
Chenopodiaceae		*Rhagodia spinescens*	Thorny Saltbush										
Rosaceae	*	*Rosa rubiginosa*	Sweet Briar										
Chenopodiaceae		*Salsola australis*	Prickly Saltwort									0.1	5
Chenopodiaceae		*Sclerolaena muricata*	Black Rolypoly	0.1	1							0.5	5
FORBS													
Asphodelaceae	*	*Aloe spp.*										2	10
Chenopodiaceae		*Atriplex suberecta*										2	5

Family	Exotic	Scientific Name	Common Name	PCT 74 Plot 1		PCT 44 Plot 2		PCT 74 Plot 3		PCT 44 Plot 4		PCT 26 Plot 5	
				C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	C (%)	A (#)
Asparagaceae	*	*Asparagus asparagoides*	Bridal Creeper										
Nyctaginaceae		*Boerhavia dominii*	Tarvine									0.1	5
Brassicaceae	*	*Brassica spp.*	Brassica					0.1	10				
Asteraceae	*	*Chondrilla juncea*	Skeleton Weed							2	10		
Anthericaceae	*	*Chlorophytum comosum*?	Spider Plant	1	0.1	20	2	100	1				
Asteraceae	*	*Cirsium vulgare*	Spear Thistle			0.1	10	0.1	10	0.5	30		
Asteraceae	*	*Conyza spp.*	A Fleabane	0.1	1								
Boraginaceae	*	*Echium plantagineum*	Patterson's Curse	0.1	30	0.1	10			0.2	40	0.1	5
Chenopodiaceae		*Einadia nutans subsp. nutans*	Climbing Saltbush	0.1	2			5	30			8	50
Onagraceae		*Epilobium billardierianum*	Willow Herb										
Geraniaceae	*	*Erodium spp.*	Crowfoot							0.1	5		
Euphorbiaceae		*Euphorbia drummondii*	Caustic Weed										
Boraginaceae	*	*Heliotropium europaeum*	Potato Weed										
Asteraceae	*	*Lactuca serriola*	Prickly Lettuce							0.5	10	0.1	1
Brassicaceae	*	*Lepidium sp.*	Peppercress										
Malvaceae	*	*Malva parviflora*	Small-flowered Mallow										
Lamiaceae	*	*Marrubium vulgare*	White Horehound					8	70			0.1	1
Fabaceae (Faboideae)	*	*Medicago sativa*	Lucerne	2	20			1	20			0.1	5
Fabaceae (Faboideae)	*	*Medicago spp.*	A Medic			0.1	10						
Oxalidaceae	*	*Oxalis pes-caprae.*	Soursob			0.1	5			5	1000		
Oxalidaceae		*Oxalis perennans*		0.1	1								
Plantaginaceae	*	*Plantago lanceolata*	Lamb's Tongues	2	400			5	200				
Polygonaceae	*	*Polygonum aviculare*	Wireweed										

Family	Exotic	Scientific Name	Common Name	PCT 74 Plot 1		PCT 44 Plot 2		PCT 74 Plot 3		PCT 44 Plot 4		PCT 26 Plot 5	
				C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	C (%)	A (#)
Asteraceae		*Pseudognaphalium lutealbum*	Jersey Cudweed										
Polygonaceae	*	*Rumex crispus*	Curled Dock	0.1	1					0.1	5		
Polygonaceae	*	*Rumex spp.*	Dock										
Lamiaceae	*	*Salvia verbenaca*	Vervain	0.3	20	2	20	1	80	5	100	0.1	1
Malvaceae		*Sida corrugata*	Corrugated Sida	0.1	10	0.1	1			0.1	10	0.1	20
Solanaceae	*	*Solanum elaeagnifolium*	Silver-leaved Nightshade	25	300	40	500	1	50	20	200	10	100
Asteraceae	*	*Sonchus oleraceus*	Common Sowthistle							0.1	10		
Asteraceae	*	*Taraxacum officinale*	Dandelion							0.1	5		
Asteraceae	*	*Tragopogon porrifolius*	Salsify										
Fabaceae (Faboideae)	*	*Trifolium angustifolium*	Narrow-leaved Clover							0.1	5		
Fabaceae (Faboideae)	*	*Trifolium subterraneum*	Subterranean Clover	0.1	1								
Verbenaceae	*	*Verbena bonariensis*	Purpletop	0.1	5								
Fabaceae (Faboideae)	*	*Vicia sativa*	Common vetch	0.2	50			0.1	20				
Asteraceae		*Vittadinia gracilis*	Woolly New Holland Daisy									0.2	20
Asteraceae		*Vittadinia spp.*	Fuzzweed	0.1	1								
Campanulaceae		*Wahlenbergia spp.*	Bluebell										
Aizoaceae		*Zaleya galericulata*	Hogweed									0.1	2
GRASS /GRASSLIKE													
Poaceae		*Austrostipa scabra*	Speargrass									0.1	5
Poaceae		*Austrostipa sp.*	Spear Grass	0.2	5					0.5	20	15	200
Poaceae	*	*Avena fatua*	Wild Oats	5	500	40	1000			40	1000	4	50

Family	Exotic	Scientific Name	Common Name	PCT 74 Plot 1		PCT 44 Plot 2		PCT 74 Plot 3		PCT 44 Plot 4		PCT 26 Plot 5	
				C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	C (%)	A (#)
Poaceae		*Bothriochloa macra*	Red Grass	5	40					5	50		
Poaceae	*	*Bromus diandrus*	Great Brome									10	1000
Poaceae	*	*Bromus molliformis*	Soft Brome										
Poaceae	*	*Bromus spp.*	A Brome										
Cyperaceae		*Carex spp.*								0.1	4		
Poaceae		*Chloris truncata*	Windmill Grass										
Poaceae		*Cynodon dactylon*	Common Couch	2	5							0.2	5
Poaceae		*Enteropogon acicularis*	Curly Windmill Grass	15	80	5	30			3	50		
Juncaceae		*Juncus spp.*	A Rush										
Poaceae	*	*Lolium spp.*	A Ryegrass	40	1000	20	1000	5	100			4	1000
Iridaceae	*	*Moraea setifolia*	Thread Iris										
Poaceae	*	*Panicum spp.*								0.3	20		
Poaceae		*Panicum effusum*	Hairy Panic			0.1	10					0.1	10
Poaceae	*	*Paspalum dilatatum*	Paspalum					2	20				
Poaceae		*Paspalidium spp.*								30	200	0.1	10
Poaceae	*	*Poa annua*	Winter Grass							0.1	1		
Iridaceae	*	*Romulea rosea var. australis*	Onion Grass							0.2	200		
Poaceae		*Rytidosperma caespitosum*	Ringed Wallaby Grass										
Poaceae		*Rytidosperma setaceum*	Small-flowered Wallaby-grass									5	80
Poaceae		*Rytidosperma sp.*	Wallaby Grass	5	40			5	50	0.1	4		
Poaceae	*	*Vulpia myuros*	Rat's Tail Fescue										
Poaceae		*Walwhalleya proluta*	Panic Grass										
OTHER													

Family	Exotic	Scientific Name	Common Name	PCT 74 Plot 1		PCT 44 Plot 2		PCT 74 Plot 3		PCT 44 Plot 4		PCT 26 Plot 5	
				C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	C (%)	A (#)
Convolvulaceae		*Convolvulus spp.*	A Bindweed	0.1	1	0.1	1			0.1	1	2	30
Loranthaceae		*Amyema quandang*	Grey Mistletoe									0.2	1
Cactaceae	*	*Opuntia stricta*	Common Prickly Pear										

Family	Exotic	Scientific Name	Common Name	PCT 26 Plot 6		PCT 44 Plot 7		PCT 44 Plot 8		PCT 44 Plot 9		Incidentals
				C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	
TREES												
Fabaceae (Mimosoideae)		*Acacia pendula*	Weeping Myall	40	25							
Malvaceae		*Brachychiton populneus*	Kurrajong									√
Myrtaceae		*Eucalyptus populnea subsp. bimbil*	Bimble Box									
Myrtaceae		*Eucalyptus melliodora*	Yellow Box									
Myrtaceae		*Eucalyptus camaldulensis*	River Red Gum									
Meliaceae		*Melia azedarach*	White Cedar									
SHRUBS												
Fabaceae		*Acacia deanei*	Deane's Wattle									√
Chenopodiaceae		*Atriplex semibaccata*	Creeping Saltbush							2	5	
Chenopodiaceae		*Enchylaena tomentosa*	Ruby Saltbush	5	30	1	20			2	50	
Solanaceae	*	*Lycium ferocissimum*	African Boxthorn	2	10							
Chenopodiaceae		*Maireana brevifolia*	Bluebush							4	30	
Chenopodiaceae		*Maireana excavata*	Bottle Bluebush	0.1	20	0.2	20	0.1	3			
Chenopodiaceae		*Rhagodia spinescens*	Thorny Saltbush	70	60							
Rosaceae	*	*Rosa rubiginosa*	Sweet Briar									√

Family	Exotic	Scientific Name	Common Name	PCT 26 Plot 6		PCT 44 Plot 7		PCT 44 Plot 8		PCT 44 Plot 9		Incidentals
				C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	
Chenopodiaceae		*Salsola australis*	Prickly Saltwort							2	200	
Chenopodiaceae		*Sclerolaena muricata*	Black Rolypoly	0.1	2	0.2	2	0.1	1	5	30	
FORBS												
Asphodelaceae	*	*Aloe spp.*										
Chenopodiaceae		*Atriplex suberecta*	Sprawling Saltbush			0.4	5			2	100	
Asparagaceae	*	*Asparagus asparagoides*	Bridal Creeper									√
Nyctaginaceae		*Boerhavia dominii*	Tarvine	0.1	2	0.1	1	0.1	1	2	50	
Brassicaceae	*	*Brassica spp.*	Brassica	0.1	2							
Asteraceae	*	*Chondrilla juncea*	Skeleton Weed							0.1	2	
Anthericaceae	*	*Chlorophytum comosum*?	Spider Plant									
Asteraceae	*	*Cirsium vulgare*	Spear Thistle			0.1	1	0.1	1	0.1	1	
Asteraceae	*	*Conyza spp.*	A Fleabane									
Boraginaceae	*	*Echium plantagineum*	Patterson's Curse	0.1	5			0.2	30	1	50	
Chenopodiaceae		*Einadia nutans subsp. nutans*	Climbing Saltbush	0.2	10	0.1	1			1	50	
Onagraceae		*Epilobium billardierianum*	Willow Herb			0.1	1					
Geraniaceae	*	*Erodium spp.*	Crowfoot									
Euphorbiaceae		*Euphorbia drummondii*	Caustic Weed							0.1	20	
Boraginaceae	*	*Heliotropium europaeum*	Potato Weed					0.1	1			
Asteraceae	*	*Lactuca serriola*	Prickly Lettuce	0.1	20			0.1	2	0.1	30	
Brassicaceae	*	*Lepidium sp.*	Peppercress							0.1	2	
Malvaceae	*	*Malva parviflora*	Small-flowered Mallow							0.1	1	
Lamiaceae	*	*Marrubium vulgare*	White Horehound	0.1	2	0.2	5	0.1	1	0.1	2	
Fabaceae (Faboideae)	*	*Medicago sativa*	Lucerne			0.1	1					

Family	Exotic	Scientific Name	Common Name	PCT 26 Plot 6		PCT 44 Plot 7		PCT 44 Plot 8		PCT 44 Plot 9		Incidentals
				C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	
Fabaceae (Faboideae)	*	*Medicago spp.*	A Medic									
Oxalidaceae	*	*Oxalis pes-caprae.*	Soursob									
Oxalidaceae		*Oxalis perennans*		0.1	5	0.1	10	0.1	1	0.1	1	
Plantaginaceae	*	*Plantago lanceolata*	Lamb's Tongues							0.1	10	
Polygonaceae	*	*Polygonum aviculare*	Wireweed							0.1	5	
Asteraceae		*Pseudognaphalium lutealbum*	Jersey Cudweed							0.1	1	
Polygonaceae	*	*Rumex crispus*	Curled Dock									
Polygonaceae	*	*Rumex spp .*	Dock			0.1	1					
Lamiaceae	*	*Salvia verbenaca*	Vervain			1	40	0.3	30	4	200	
Malvaceae		*Sida corrugata*	Corrugated Sida	0.1	2	0.1	10	0.2	20			
Solanaceae	*	*Solanum elaeagnifolium*	Silver-leaved Nightshade			10	200	5	100	20	200	
Asteraceae	*	*Sonchus oleraceus*	Common Sowthistle							0.1	10	
Asteraceae	*	*Taraxacum officinale*	Dandelion									
Asteraceae	*	*Tragopogon porrifolius*	Salsify							0.1	30	
Fabaceae (Faboideae)	*	*Trifolium angustifolium*	Narrow-leaved Clover									
Fabaceae (Faboideae)	*	*Trifolium subterraneum*	Subterranean Clover									
Verbenaceae	*	*Verbena bonariensis*	Purpletop									
Fabaceae (Faboideae)	*	*Vicia sativa*	Common vetch			0.1	5					
Asteraceae		*Vittadinia gracilis*	Woolly New Holland Daisy			0.1	10					
Asteraceae		*Vittadinia spp.*	Fuzzweed									

Family	Exotic	Scientific Name	Common Name	PCT 26 Plot 6		PCT 44 Plot 7		PCT 44 Plot 8		PCT 44 Plot 9		Incidentals
				C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	
Campanulaceae		*Wahlenbergia spp.*	Bluebell									√
Aizoaceae		*Zaleya galericulata*	Hogweed					0.1	2	0.1	2	
GRASS /GRASSLIKE												
Poaceae		*Austrostipa scabra*	Speargrass							0.1	2	
Poaceae		*Austrostipa sp.*	Spear Grass	0.2	5	0.1	2					
Poaceae	*	*Avena fatua*	Wild Oats	0.2	50	5	1000	15	1000	5	1000	
Poaceae		*Bothriochloa macra*	Red Grass							0.1	2	
Poaceae	*	*Bromus diandrus*	Great Brome	0.5	200	5	1000	20	1000			
Poaceae	*	*Bromus molliformis*	Soft Brome			1	100					
Poaceae	*	*Bromus spp.*	A Brome	0.5	50							
Cyperaceae		*Carex spp.*										
Poaceae		*Chloris truncata*	Windmill Grass	0.1	5							
Poaceae		*Cynodon dactylon*	Common Couch			0.2	5	0.1	2			
Poaceae		*Enteropogon acicularis*	Curly Windmill Grass					15	200	1	20	
Juncaceae		*Juncus spp.*	A Rush					0.1	3			
Poaceae	*	*Lolium spp.*	A Ryegrass	0.2	100	1	200	1	100	0.5	200	
Iridaceae	*	*Moraea setifolia*	Thread Iris									√
Poaceae	*	*Panicum spp.*										
Poaceae		*Panicum effusum*	Hairy Panic	0.1	1	1	30					
Poaceae	*	*Paspalum dilatatum*	Paspalum							0.1	1	
Poaceae		*Paspalidium spp* (*constrictum*?).				0.1	1	1	30			
Poaceae	*	*Poa annua*	Winter Grass									
Iridaceae	*	*Romulea rosea var. australis*	Onion Grass									

Family	Exotic	Scientific Name	Common Name	PCT 26 Plot 6		PCT 44 Plot 7		PCT 44 Plot 8		PCT 44 Plot 9		Incidentals
				C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	C (%)	A (#)	
Poaceae		*Rytidosperma caespitosum*	Ringed Wallaby Grass									
Poaceae		*Rytidosperma setaceum*				0.2	10	0.1	10			
Poaceae		*Rytidosperma sp.*	Wallaby Grass	0.2	20							
Poaceae	*	*Vulpia myuros*	Rat's Tail Fescue	0.1	50							
Poaceae		*Walwhalleya proluta*	Panic Grass							0.1	10	
OTHER												
Convolvulaceae		*Convolvulus spp.*	A Bindweed			0.3	5	0.5	10			
Loranthaceae		*Amyema quandang*	Grey Mistletoe	3	20							
Cactaceae	*	*Opuntia stricta*	Common Prickly Pear									√

APPENDIX C FAUNA SIGHTINGS

Common Name	Scientific Name	Status (BC/EPBC)	Observation Type
BIRDS			
Australasian Grebe	*Tachybaptus novaehollandiae*	Not listed	Seen
Australian Magpie	*Cracticus tibicen*	Not listed	Seen
Australian Pelican	*Pelecanus conspicillatus*	Not listed	Seen
Australian Raven	*Corvus coronoides*	Not listed	Seen
Blackbird	**Turdus merula*	Not listed	Seen
Common Starling	**Sturnus vulgaris*	Not listed	Seen
Corella sp.	*Cacatua* sp.	Not listed	Seen
Crested Pigeon	*Ocyphaps lophotes*	Not listed	Seen
Eastern Rosella	*Platycercus eximius*	Not listed	Seen
Feral Pigeon	**Columba livia domestica*	Not listed	Seen
Fork-tailed Kite	*Milvus migrans*	Not listed	Seen
Galah	*Eolophus roseicapilla*	Not listed	Seen
Great Egret	*Ardea modesta*	Not listed	Seen
Laughing Kookaburra	*Dacelo novaeguineae*	Not listed	Seen
Little Black Cormorant	*Phalacrocorax sulcirostris*	Not listed	Seen
Little Pied Cormorant	*Microcarbo melanoleucos*	Not listed	Seen
Little Raven	*Corvus mellori*	Not listed	Seen
Nankeen Kestrel	*Falco cenchroides*	Not listed	Seen
Noisy Friarbird	*Philemon corniculatus*	Not listed	Seen
Noisy Miner	*Manorina melanocephala*	Not listed	Seen
Pacific Black Duck	*Anas superciliosa*	Not listed	Seen
Peewee	*Grallina cyanoleuca*	Not listed	Seen
Pied Butcherbird	*Cracticus nigrogularis*	Not listed	Seen
Pied Currawong	*Strepera graculina*	Not listed	Seen
Red-capped Robin	*Petroica goodenovii*	Not listed	Seen
Straw-necked Ibis	*Threskiornis spinicollis*	Not listed	Seen

Striated Pardalote	*Pardalotus striatus*	Not listed	Seen
Sulphur-crested Cockatoo	*Cacatua galerita*	Not listed	Seen
Superb Blue Wren	*Malurus cyaneus*	Not listed	Seen
Superb Parrot	*Polytelis swainsonii*	Vulnerable	Seen
Welcome Swallow	*Hirundo neoxena*	Not listed	Seen
White-bellied Sea-eagle	*Haliaeetus leucogaster*	Vulnerable	Seen
White-faced Heron	*Egretta novaehollandiae*	Not listed	Seen
Willy Wagtail	*Rhipidura leucophrys*	Not listed	Seen
Wood Duck	*Chenonetta jubata*	Not listed	Seen
Yellow Rosella	*Platycercus elegans flaveolus*	Not listed	Seen
Zebra Finch	*Taeniopygia guttata*	Not listed	Seen
AMPHIBIANS			
Barking Frog	*Limnodynastes fletcheri*	Not listed	Heard
Beeping Froglet	*Crinia parinsignifera*	Not listed	Heard
Peron's Tree Frog	*Litoria peronii*	Not listed	Heard
Spotted Marsh Frog	*Limnodynastes tasmaniensis*	Not listed	Heard
REPTILES			
Eastern Brown Snake	*Pseudonaja textilis*	Not listed	Seen

*Indicates non-native species

APPENDIX D EPBC PROTECTED MATTERS SEARCH

Australian Government
Department of the Environment and Energy

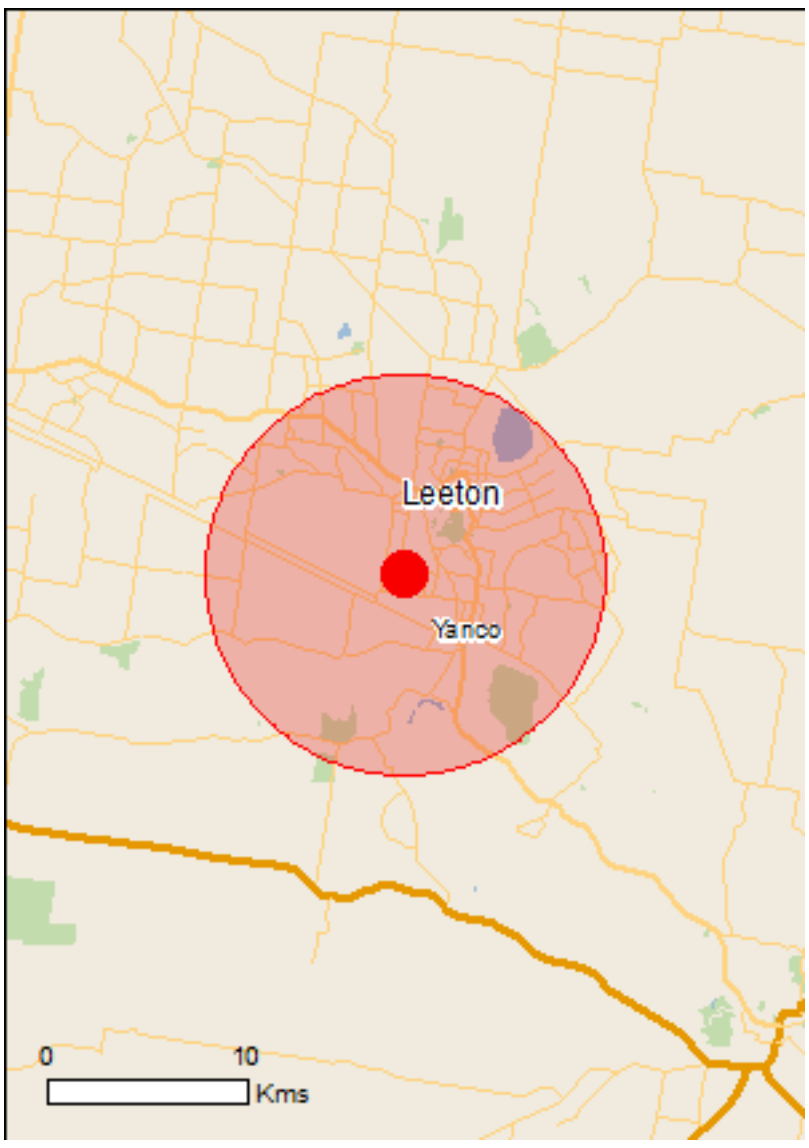
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 13/09/18 11:10:46



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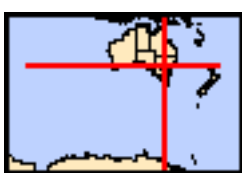

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	5
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	23
Listed Migratory Species:	20

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	5
Commonwealth Heritage Places:	None
Listed Marine Species:	31
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	29
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Banrock station wetland complex	500 - 600km upstream
Fivebough and tuckerbil swamps	Within Ramsar site
Hattah-kulkyne lakes	300 - 400km upstream
Riverland	400 - 500km upstream
The coorong, and lakes alexandrina and albert wetland	600 - 700km upstream

Listed Threatened Ecological Communities		[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions	Endangered	Community may occur within area
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
[Pedionomus torquatus](#) Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area
[Polytelis swainsonii](#) Superb Parrot [738]	Vulnerable	Breeding known to occur within area
[Rostratula australis](#) Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Fish		
[Galaxias rostratus](#) Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow [84745]	Critically Endangered	Species or species habitat may occur within area
[Maccullochella peelii](#) Murray Cod [66633]	Vulnerable	Species or species habitat known to occur within area
[Macquaria australasica](#) Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Frogs		
[Litoria raniformis](#) Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog [1828]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
[Nyctophilus corbeni](#) Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
[Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)](#) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
[Pteropus poliocephalus](#) Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Plants		
[Austrostipa wakoolica](#) [66623]	Endangered	Species or species habitat may occur within area
[Brachyscome papillosa](#) Mossgiel Daisy [6625]	Vulnerable	Species or species habitat may occur within area
[Caladenia arenaria](#) Sand-hill Spider-orchid [9275]	Endangered	Species or species habitat may occur within area
[Sclerolaena napiformis](#) Turnip Copperburr [11742]	Endangered	Species or species habitat may occur within area
[Swainsona murrayana](#) Slender Darling-pea, Slender Swainson, Murray Swainson-pea [6765]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		

Name	Threatened	Type of Presence
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis		
Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Commonwealth Bank of Australia
Commonwealth Land - Telstra Corporation Limited
Defence - LEETON ARES DEPOT ; 4/3 RNSWR ANNEX & POL STORE

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
[Calidris ruficollis](#) Red-necked Stint [860]		Species or species habitat known to occur within area
[Calidris subminuta](#) Long-toed Stint [861]		Species or species habitat known to occur within area
[Charadrius bicinctus](#) Double-banded Plover [895]		Species or species habitat known to occur within area
[Charadrius ruficapillus](#) Red-capped Plover [881]		Species or species habitat known to occur within area
[Chrysococcyx osculans](#) Black-eared Cuckoo [705]		Species or species habitat known to occur within area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
[Haliaeetus leucogaster](#) White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
[Himantopus himantopus](#) Pied Stilt, Black-winged Stilt [870]		Species or species habitat known to occur within area
[Lathamus discolor](#) Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area
[Limosa lapponica](#) Bar-tailed Godwit [844]		Species or species habitat known to occur within area
[Limosa limosa](#) Black-tailed Godwit [845]		Species or species habitat known to occur within area
[Merops ornatus](#) Rainbow Bee-eater [670]		Species or species habitat may occur within area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat may occur within area
[Myiagra cyanoleuca](#) Satin Flycatcher [612]		Species or species habitat may occur within area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
[Philomachus pugnax](#) Ruff (Reeve) [850]		Species or species habitat known to occur within area
[Pluvialis fulva](#) Pacific Golden Plover [25545]		Species or species habitat known to occur within area
[Recurvirostra novaehollandiae](#) Red-necked Avocet [871]		Species or species habitat known to occur

Name	Threatened	Type of Presence within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Stiltia isabella Australian Pratincole [818]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Murrumbidgee Valley	NSW

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Cylindropuntia spp. Prickly Pears [85131]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Fivebough Swamp	NSW

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-34.58086 146.38293

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX E EPBC HABITAT ASSESSMENT

Species and Status	Description of habitat[1]	Presence of habitat	Likelihood of occurrence	Potential for impact?
Aves				
Superb Parrot *Polytelis swainsonii* V BC V EPBC	Inhabit Box-Gum, Box-Cypress, and Boree Woodlands and River Red Gum Forests. They nest in hollows of large trees in tall open forest or woodland.	**Present** Patches of Box – Gum woodland.	**Possible** Breeding known in locality.	**Yes** AoS completed.
Swift Parrot *Lathamus discolor* E BC CE EPBC	In NSW mostly occurs on the coast and south west slopes. Areas where eucalypts are flowering profusely or where there are abundant lerp infestations. Favoured feed trees include winter flowering species such as Swamp Mahoghany, Spotted Gum, Red Bloodwood, Mugga Ironbark and White Box.	**Present** Patches of woodland including River Red Gum which can flower in winter.	**Known** Recorded during surveys.	**Yes** AoS completed.
Painted Honeyeater *Grantiella picta* V BC V EPBC	Occur in Boree/Weeping Myall, Brigalow, and Box-Gum Woodlands and Box-Ironbark Forests.	**Present** Patches of Box-Gum woodland.	**Possible** Known in locality.	**Yes** AoS completed.
Fork-tailed Swift *Apus pacificus* M EPBC	Fork-tailed Swifts are found flying over open habitat including semi-arid areas, coasts, islands, and occasionally forests and cities.	**Present** Open agricultural habitat.	**Possible** Likely in locality.	**Yes** AoS completed.

[1] Information sourced from species profiles on NSW OEH's threatened species database, NSW DPI's listed profiles of threatened species, populations and ecological communities, and the Australian Government's *Species Profiles and Threats* database (SPRAT) unless otherwise stated.

OEH threatened species database: http://www.threatenedspecies.environment.nsw.gov.au/index.aspx

DPI listed threatened species, populations and ecological communities profiles: http://www.dpi.nsw.gov.au/fishing/species-protection/conservation/what-current#key

SPRAT: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Species and Status	Description of habitat[1]	Presence of habitat	Likelihood of occurrence	Potential for impact?
Yellow Wagtail *Motacilla flava* M EPBC	Yellow Wagtails occur in variable habitat, but typically flat, open, grassy area near water, which may include grasslands, air strips, pastures, sports fields, and edges of wetlands, rivers, and dams. Roosts in mangroves and dense vegetation. No breeding habitat in Australia.	**Present** Open grassy habitat near water bodies.	**Possible** May occur in locality.	**Yes** AoS completed.
Satin Flycatcher *Myiagra cyanoleuca* M EPBC	Satin Flycatchers are found in eucalypt forest and woodland, especially tall, wet sclerophyll forests along gullies and water courses, and open, grassy areas of woodland.	**Present** Patches of eucalypt woodland along irrigation channels.	**Possible** May occur in locality.	**Yes** AoS completed.
Australasian Bittern *Botaurus poiciloptilus* E BC E EPBC	Favour permanent freshwater wetlands with tall, dense vegetation, particularly bulrushes (*Typha* spp.) and spikerushes (*Eleoacharis* spp.).	**Present** Water bodies with dense vegetation.	**Possible** Known in locality.	**Yes** AoS completed.
Wood Sandpiper *Tringa glareola* M EPBC	Well-vegetated, shallow, freshwater wetlands. Typically associated with emergent aquatic plants or grass and dominated by taller fringing vegetation. Also inundated grasslands, short herbage or wooded floodplains, in receding floodwaters, and irrigated crops.	**Present** Irrigation channels in fruit crops.	**Possible** Known in locality.	**Yes** AoS completed.
Latham's Snipe *Gallinago hardwickii* M EPBC	Latham's Snipe occurs in permanent and ephemeral wetlands, usually open freshwater wetlands with low, dense vegetation such as swamps, flooded grasslands or heathlands, and bogs, but also in saline or brackish water bodies, and in both modified and artificial habitats.	**Present** Dams and irrigation channels with fringing vegetation.	**Possible** Known in locality.	**Yes** AoS completed.
Australian Painted Snipe *Rostratula australis/benghalensis* E BC E EPBC	Australian Painted Snipes generally inhabit shallow terrestrial freshwater or occasionally brackish wetlands, including temporary and permanent lakes, swamps, and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms, and bore drains.	**Absent** No shallow wetlands.	**Possible** Likely in locality.	**No** No suitable habitat in proposal area.

Species and Status	Description of habitat[1]	Presence of habitat	Likelihood of occurrence	Potential for impact?
Plains-wanderer *Pedionomus torquatus* E BC CE EPBC	Plains-wanderers are found in semi-arid, lowland native grasslands on hard red-brown soils, in a typical habitat structure of 50% bare ground, 10% fallen litter, and 40% herbs, forbs, and grasses.	**Absent** No native grassland with suitable habitat structure.	**Possible** May occur in locality.	**No** No suitable habitat in proposal area.
Common Sandpiper *Actitis hypoleucus* M EPBC	Forages in shallow water and on bare soft mud at the edges of wetlands, often where obstacles project from substrate. Sometimes venture into grassy areas adjoining wetlands.	**Absent** No mudflats or shallow wetlands.	**Possible** May occur in locality.	**No** No suitable habitat in proposal area.
Sharp-tailed Sandpiper *Calidris acuminata* M EPBC	Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh, or other low vegetation. This includes dams, waterholes, soaks, bore drains and bore swamps, saltpans, and hypersaline salt lakes, and inundated paddocks, sedgelands, and other ephemeral wetlands inland.	**Present** No wetlands with shallow muddy edges.	**Unlikely** Known in locality.	**No** No suitable habitat in proposal area.
Pectoral Sandpiper *Calidris melanotos* M EPBC	Prefers shallow fresh to saline wetlands. Usually found in coastal or near-coastal habitat but occasionally found further inland. Prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation.	**Absent** No wetlands with fringing mudflats.	**Unlikely** Known in locality.	**No** No suitable habitat in proposal area.
Red-necked Stint *Calidris ruficollis* M EPBC	Coastal areas, including sheltered inlets, bays, lagoons and estuaries with intertidal mudflats. Saltworks and sewage farms, saltmarshes, shallow wetlands, flooded paddocks and damp grasslands. Forage on bare wet mud on intertidal mudflats or sandflats, or in very shallow water.	**Absent** No mudflats or shallow wetlands.	**Unlikely** Known in locality.	**No** No suitable habitat in proposal area.
Long-toed Stint *Calidris subminuta* M EPBC	Shallow freshwater or brackish wetlands, muddy shorelines, growths of short grass, weeds, sedges, low or floating aquatic vegetation, reeds, rushes and occasionally stunted samphire. Open, less vegetated shores of larger lakes and ponds. Common on muddy fringes of drying ephemeral lakes and swamps. Forages on wet mud or in shallow water, often among low vegetation around the edges of wetlands,	**Absent** No mudflats or shallow wetlands.	**Unlikely** Known in locality.	**No** No suitable habitat in proposal area.

Species and Status	Description of habitat[1]	Presence of habitat	Likelihood of occurrence	Potential for impact?
Common Greenshank *Tringa nebularia* M EPBC	Inland wetland and sheltered coastal habitats, such as harbours, embayments, estuaries, deltas, and lagoons, typically with large mudflats and saltmarsh, mangroves, or seagrass. Forages at edge of wetlands, in soft mud on mudflats, in channels, or in shallows around edges of water.	**Absent** No mudflats or wetlands with shallow edges.	**Possible** May occur in locality.	**No** No suitable habitat in proposal area.
Black-tailed Godwit *Limosa limosa* V BC M EPBC	Seen on coastal sandy shores, mud-flats and marshes, probing, sweeping and jabbing into mud or sand between the tides for small crustaceans and worms.	**Absent** No coastal habitat or mudflats.	**Unlikely** Known in locality.	**No** No suitable habitat in proposal area.
Bar-tailed Godwit *Limosa lapponica* M EPBC	Coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. Rarely found on inland wetlands or areas of short grass, such as farmland, paddocks and airstrips. Forages near edge of water or in shallow water.	**Absent** No coastal habitats or shallow wetlands.	**Possible** Species or habitat known in locality.	**No** No suitable habitat in proposal area.
Ruddy Turnstone M EPBC	Coastal regions with exposed rock coast lines or coral reefs.	**Absent** No coastal regions.	**Possible** Species or habitat known in locality.	**No** No suitable habitat in proposal area.
Curlew Sandpiper *Calidris ferruginea* E BC CE, M EPBC	Curlew Sandpipers mainly occur on intertidal mudflats in both fresh and brackish waters in sheltered coastal areas, such as estuaries, bays, inlets, and lagoons. They are also recorded inland, including around ephemeral and permanent lakes, dams, and waterholes, usually with bare edges of mud or sand.	**Absent** No mudflats or sandflats.	**Possible** Known in locality.	**No** No suitable habitat in proposal area.
Eastern Curlew *Numenius madagascariensis* CE, M EPBC	Eastern Curlews are mostly commonly found on large intertidal mudflats often with seagrass beds along sheltered coasts including in estuaries, bays, harbours, inlets, lagoons, and among saltmarshes and mangroves.	**Absent** No intertidal mudflats.	**Possible** May occur in locality.	**No** No suitable habitat in proposal area.

Species and Status	Description of habitat[1]	Presence of habitat	Likelihood of occurrence	Potential for impact?
Double-banded Plover *Charadrius bicinctus* M EPBC	Littoral, estuarine and fresh or saline terrestrial wetlands and also saltmarsh, grasslands and pasture. Muddy, sandy, shingled or sometimes rocky beaches, bays and inlets, harbours and margins of fresh or saline terrestrial wetlands such as lakes, lagoons and swamps, shallow estuaries and rivers. Further inland, open grassy areas including short pasture, ploughed or newly cropped paddocks, swards, airstrips and sports grounds.	**Absent** No wetlands or open grassy areas.	**Possible** Known in locality.	**No** No suitable habitat in proposal area.
Ruff *Philomachus pugnax* M EPBC	Fresh, brackish or saline wetlands with exposed mudflats at the edges.	**Absent** No mudflats.	**Possible** Known in locality.	**No** No suitable habitat in proposal area.
Pacific Golden Plover *Pluvialis fulva* M EPBC	Usually coastal habitats; occasionally around inland wetlands. Forages on sandy or muddy shores or margins of sheltered areas such as estuaries or lagoons, and occasionally in vegetation such as saltmarsh, mangroves, pasture or crops.	**Absent** No coastal habitat or suitable wetlands.	**Possible** Known in locality.	**No** No suitable habitat in proposal area.
Marsh Sandpiper *Tringa stagnatilis* M EPBC	Permanent or ephemeral wetlands of varying salinity, foraging in shallow water at the edge of wetlands. Probe in mudflats or among marshy vegetation.	**Absent** No shallow wetlands or mudflats.	**Possible** Known in locality.	**No** No suitable habitat in proposal area.
Malleefowl *Leipoa ocellate* E BC V EPBC	Mallee communities, preferring tall, dense and floristically-rich mallee in higher rainfall areas. Uses mallee with spinifex understorey, but usually at lower densities than areas with shrub understorey. Prefers areas of light sandy to sandy loam soils and habitats with dense but discontinuous canopy and dense and diverse shrub and herb layers.	**Absent** No Mallee communities.	**Possible** Likely in locality.	**No** No suitable habitat in proposal area.
Amphibians				
Southern Bell Frog *Litoria raniformis* E BC V EPBC	Southern Bell Frogs are only known to exist in isolated populations in the Coleambally Irrigation Area, the Lowbidgee floodplain, and around Lake Victoria. The species is usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps or billabongs along floodplains and river valleys, and where there is no available natural habitat they may occur in irrigated rice crops.	**Present** Farms dams and irrigation channels.	**Possible** Likely in locality.	**Yes** AoS completed.

Species and Status	Description of habitat[1]	Presence of habitat	Likelihood of occurrence	Potential for impact?
Mammals				
Grey-headed Flying-fox *Pteropus poliocephalus* V BC V EPBC	Subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps, urban gardens and cultivated fruit crops. Generally roost within 20 km of a regular food source, commonly in gullies, close to water, in vegetation with a dense canopy.	**Present** Patches of eucalypt woodland within cultivated fruit crops.	**Possible** May occur in locality.	**Yes** AoS completed.
Koala *Phascolarctos cinereus* V BC V EPBC	Range of temperate, subtropical and tropical eucalypt woodlands and forests where suitable food trees grow, of which there are more than 70 eucalypt species and 30 non-eucalypt species that are particularly abundant on fertile clay soils.	**Present** River Red Gum forest (koala feed tree).	**Possible** Known in locality.	**Yes** AoS completed.
Corben's Long-eared Bat *Nyctophilus corbeni* V BC V EPBC	Corben's Long-eared Bats inhabit a variety of vegetation types, most commonly Mallee, Bulloke, and Box-dominated communities, but are most common in vegetation which has a distinct canopy and dense understorey. They roost in tree hollows, crevices, and under loose bark.	**Absent** No dense understorey.	**Possible** May occur in locality.	**No** No suitable habitat in proposal area.
Fishes				
Flathead Galaxias *Galaxias rostratus* CE FM CE EPBC	Flathead Galaxias prefer still or slow-flowing habitats including billabongs, lakes, swamps, and rivers.	**Absent** Only dams and irrigation channels.	**Possible** May occur in locality.	**No** No suitable habitat in proposal area.
Murray Cod *Maccullochella peelii* V EPBC	Wide range of warm water habitat including clear rocky streams, slow turbid rivers, and billabongs. Usually found near complex structural cover such as rocks, woody debris, and overhanging vegetation, and most frequently found in main river channel and larger tributaries but occasionally in floodplain channels during floods.	**Absent** Only dams and irrigation channels.	**Possible** May occur in locality.	**No** No suitable habitat in proposal area.

Species and Status	Description of habitat[1]	Presence of habitat	Likelihood of occurrence	Potential for impact?
Macquarie Perch *Macquaria australasica* E FM E EPBC	Macquarie Perch are found in rivers, clear, deep, rocky holes with plenty of cover including aquatic vegetation, large boulders, large woody debris, and overhanging banks.	**Absent** No rivers in study area.	**Possible** May occur in locality.	**No** No suitable habitat in proposal area.

E BC = listed as Endangered under Schedule 1 of the NSW *Biodiversity Conservation Act 2016.*

E EPBC = listed as Endangered under the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999.*

V BC = listed as Vulnerable under Schedule 1 of the NSW *BC Act 2016.*

V EPBC = listed as Vulnerable under the Commonwealth *EPBC Act 1999.*

M EPBC = listed as Migratory under the Commonwealth *EPBC Act 1999.*

CE EPBC = listed as Critically Endangered under the Commonwealth *EPBC Act 1999.*

Species	Description of habitat	Presence of habitat	Likelihood of occurrence	Possible impact?
Herbs & Forbs				
Spear Grass *Austrostipa wakoolica* E BC E EPBC	Grows on floodplains of Murray River tributaries, in open woodland on grey, silty clay or sandy loam soils. Habitats include edges of lignum swamp with box and mallee, creek banks in grey, silty clay, mallee and lignum sandy-loam flat, open cypress forest on low sandy range, and a low, rocky rise.	**Absent** No woodland on Murray River tributary floodplains.	**Possible** May occur in locality.	**No** No suitable habitat in proposal area.
Mossgiel Daisy *Brachyscome papillosa* V BC V EPBC	Recorded primarily in clay soils on Bladder Saltbush and Leafless Bluebush plains, but also in grassland and in Inland Grey Box – Cypress Pine woodland.	**Present** Box woodland on clay soil.	**Unlikely** Targeted surveys did not detect species on site.	**No** Species not recorded in impact area.
Sand-hill Spider Orchid *Caladenia arenaria* E BC	Woodland with sandy soil, especially dominated by White Cypress Pine.	**Absent** No woodland with sandy soil and cypress pines.	**Possible** May occur in locality.	**No** No suitable habitat in proposal area.

Species and Status	Description of habitat[1]	Presence of habitat	Likelihood of occurrence	Potential for impact?
Turnip Copperburr *Sclerolaena napiformis* E BC	Confined to remnant grassland habitat on clay-loam soils. Level plains in tussock grassland of *Austrostipa nodosa* and *Chloris truncata*, in grey cracking clay to red-brown loamy clay. Grows in areas with intermittent light grazing.	**Absent** No native tussock grasslands present.	**Possible** May occur in locality.	**No** No suitable habitat in proposal area.
Slender Darling-pea *Swainsona murrayana* V EPBC	Clay-based soils, ranging from grey, red, and brown cracking clays to red-brown earths and loams. Variety of vegetation types including Bladder Saltbush, Black Box, and grassland communities on level plains, floodplains, and depressions. Also found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated.	**Present** Open pastoral land on clay soils. Riverine Plain Grasslands is associated vegetation type.	**Unlikely** Targeted surveys did not detect species on site.	**No** Species not recorded in impact area.

E BC = listed as Endangered under Schedule 1 of the NSW *Biodiversity Conservation Act 2016.*

E EPBC = listed as Endangered under the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999.*

V BC = listed as Vulnerable under Schedule 1 of the NSW *Biodiversity Conservation Act 2016.*

V EPBC = listed as Vulnerable under the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999.*

EEC BC = Endangered Ecological Community listed under Schedule 2 of the NSW *Biodiversity Conservation Act 2016.*

CE EPBC = listed as Critically Endangered under the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999.*

APPENDIX F EPBC ASSESSMENT OF SIGNIFICANT

Endangered/Critically Endangered Species

- Swift Parrot (*Lathamus discolor*) – Critically Endangered, EPBC Act)
- Australasian Bittern (*Botaurus poiciloptilus*) – Endangered, EPBC Act)

a) Will the action lead to a long-term decrease in the size of a population of a species?
Swift Parrot
Swift Parrots breed in Tasmania in summer, and the entire population migrates to the mainland in winter. In NSW, Swift Parrots forage on winter flowering eucalypt species and lerp-infested eucalypts. There is potential foraging habitat for Swift Parrot in the development site that would be removed by the proposal. Surveys did not detect these species and so the development site is not considered known habitat, but does provide potential foraging habitat. The proposal would involve the removal of around 0.05ha of Weeping Myall Woodland and 0.5ha of Forb-rich speargrass - windmill grass - white top grassland. There would also be some disturbance associated with construction, including noise, vibration, light, and risk of introduction or spread of weeds, pests, and pathogens. The quality of potential habitat for this species is low, being highly disturbed and fragmented within an existing road, railway line and powerline easement. Given the relatively small amount of habitat to be removed, and with the recommended mitigation measures, the likelihood of the proposal leading to a long-term decrease in the size of a population of Swift Parrot is minimal.
Australasian Bittern
Australasian Bitterns breed in relatively deep, densely vegetated freshwater swamps and pools, building their nests under dense cover over shallow water. The proposal would involve the removal of around 0.3ha of aquatic habitat in farm dams. There would also be some disturbance of irrigation channels, which provide potential nesting habitat, including noise, vibration, light, and risk of introduction or spread of weeds, pests, and pathogens. The quality of potential habitat for this species is low, being artificially constructed and managed, and highly disturbed by agriculture. Given the relatively small amount of habitat to be removed or disturbed, and with the recommended mitigation measures, the likelihood of the proposal leading to a long-term decrease in the size of a population of Australasian Bittern is minimal.
b) Will the action reduce the area of occupancy of the species?
Swift Parrot
The proposal would impact around 0.05ha of woodland habitat in total. The habitat to be removed is similar to the habitat that exists in the rest of the locality, and is low quality due to being largely cleared and highly disturbed. In this context, the removal of a relatively small area of low-quality habitat as a result of the proposal is unlikely to reduce the area of occupancy of Swift Parrot.
Australasian Bittern
The proposal would impact around 0.3ha of aquatic habitat in total. The habitat to be removed is similar to the habitat that exists in the rest of the locality, and is low quality due to being artificially constructed and managed, and highly disturbed. In this context, the removal of a relatively small area of low-quality habitat as a result of the proposal is unlikely to reduce the area of occupancy of Australasian Bittern.
c) Will the action fragment an existing population into two or more populations?
Swift Parrot

The proposal would impact an area of low-quality habitat in an area surrounded by similar habitat. The proposal will not prevent the movement of this highly mobile species through the landscape. In this context, the proposal would not fragment an existing Swift Parrot population into two or more populations.

Australasian Bittern

The proposal would impact an area of low-quality habitat in an area surrounded by similar habitat. The proposal will not prevent the movement of this highly mobile species through the landscape. In this context, the proposal would not fragment an existing Swift Parrot population into two or more populations.

d) Will the action adversely affect habitat critical to the survival of a species?

Swift Parrot

No areas of critical habitat have been declared for Swift Parrot.

Australasian Bittern

No areas of critical habitat have been declared for Australasian Bittern.

e) Will the action disrupt the breeding cycle of a population?

Swift Parrot

Swift Parrots breed in Tasmania, and so the proposal area is outside suitable breeding areas. The proposal is therefore unlikely to disrupt the breeding cycle of the Swift Parrot.

Australasian Bittern

Australasian Bitterns breed in deep water under dense vegetation cover, which could provide some low-quality breeding habitat. The proposal would result in indirect impacts to a small area of artificially constructed and managed, highly disturbed potential habitat. With the recommended mitigation measures, the likelihood of the proposal disrupting the breeding cycle of a population of Australasian Bitterns is minimal.

f) Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Swift Parrot

The proposal would involve the removal of around 0.05ha of woodland habitat, reducing the total availability of habitat in the locality, as well as some indirect disturbance associated with construction which could decrease the quality of some habitat.

The habitat to be impacted is similar to the habitat that exists in the rest of the locality, and is highly disturbed due to the agricultural history of the site.

In this context, and with the recommended mitigation measures, the proposal is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that Swift Parrots are likely to decline.

Australasian Bittern

The proposal would involve the removal of around 0.3ha of aquatic habitat, reducing the total availability of habitat in the locality, as well as some indirect disturbance associated with construction which could decrease the quality of some habitat.

The habitat to be impacted is similar to the habitat that exists in the rest of the locality, and is highly disturbed due to the agricultural history of the site.

In this context, and with the recommended mitigation measures, the proposal is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that Australasian Bitterns are likely to decline.

g) Will the action result in invasive species that are harmful to a critically endangered or endangered/vulnerable species becoming established in the endangered / critically endangered /vulnerable species habitat?
The proposal has the potential to contribute to the spread of invasive species in the proposal area through the transfer and introduction of plant material and soil on machinery. Mitigation measures have been recommended to prevent the spread of weeds on site. The proposal is therefore unlikely to result in invasive species that are harmful to these species becoming established in their potential habitat.
h) Will the action introduce disease that may cause the species to decline?
There is a risk that pathogens could be established or spread in the proposal area via machinery during construction. However, with the recommended mitigation measures, the action is unlikely to introduce any disease which may cause these species to decline.
i) Will the action interfere with the recovery of the species?
Swift Parrot
The National Recovery Plan for Swift Parrot lists the following recovery objectives: 1. To identify and prioritise habitat and sites used by the species across its range, on all land tenures. 2. To implement management strategies to protect and improve habitats and sites on all land tenures. 3. To monitor and manage the incidence of collisions, competition, and Beak and Feather Disease (BFD). 4. To monitor population trends and distribution throughout the range. The proposal would not interfere with any of these objectives.
Australasian Bittern
A recovery plan has not been prepared for Australasian Bittern. The proposal is consistent with general recovery plan principles, and so is unlikely to interfere with the recovery of the Australasian Bittern.

A significant impact is not considered likely on the Swift Parrot and Australasian Bittern, on the basis that the proposal would not:

- Lead to a reduction of the size or area of occupancy of a population, or fragment or disrupt the breeding cycle of a population
- Affect habitat critical to the survival of any species
- Introduce invasive species harmful to any species
- Introduce disease that would cause any species to decline
- Interfere with the recovery of these species

Vulnerable Species

- Canopy birds:
  - Superb Parrot (*Polytelis swainsonii*) – Vulnerable, EPBC Act
  - Painted Honeyeater (*Grantiella picta*) – Vulnerable, EPBC Act
- Southern Bell Frog (*Litoria raniformis*)– Vulnerable, EPBC Act
- Grey-headed Flying-fox (*Pteropus poliocephalus*) – Vulnerable, EPBC Act
- Koala (*Phascolarctos cinereus*) – Vulnerable, EPBC Act

a) Will the action lead to a long-term decrease in the size of an important population of a species?
Canopy birds
Superb Parrots occur in Box-Gum, Box-Cypress and Boree Woodlands and River Red Gum Forest, and nest between September and December in hollows of large trees along rivers. Painted Honeyeaters occur in Boree/Weeping Myall, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests, feeding on the fruits of mistletoes and nesting in the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches. There is potential foraging habitat for Superb Parrot in the development site that would be removed by the proposal, and the species was recorded during site surveys. There is potential foraging and breeding habitat for Painted Honeyeater in the development site that would be removed by the proposal. The proposal area is not located in a known important population of either of these species. The proposal would involve the removal of around 0.05ha of Weeping Myall Woodland and 0.5ha of Forb-rich Speargrass – Windmill Grass – White Top Grassland. There would also be some disturbance associated with construction, including noise, vibration, light, and risk of introduction or spread of weeds, pests, and pathogens. The quality of potential habitat for this species is low, being largely cleared and highly disturbed between the existing road, powerline and railway line easement. Given the relatively small amount of habitat to be removed, and with the recommended mitigation measures, the likelihood of the proposal leading to a long-term decrease in the size of an important population of Superb Parrot or Painted Honeyeater is minimal.
Southern Bell Frog
Southern Bell Frog can occur in artificial water bodies such as farm dams, irrigation channels, irrigated rice crops and disused quarries in disturbed areas. Permanent water bodies, or those in close proximity to permanent water, are favoured for breeding. The proposal area is not located in a known important population of this species. The proposal would involve the removal of 0.3ha of aquatic habitat in farm dams. There would also be some disturbance of irrigation channels, which provide potential nesting habitat, including noise, vibration, light, and risk of introduction or spread of weeds, pests, and pathogens. Targeted surveys were carried out for this species, which found no evidence that the species occurs on site. It is therefore unlikely to support an important population of Southern Bell Frog. The quality of potential habitat for this species is low, being artificially constructed and managed, and highly disturbed by agriculture. Given the relatively small amount of low-quality habitat to be removed or disturbed, and with the recommended mitigation measures, the likelihood of the proposal leading to a long-term decrease in the size of an important population of Southern Bell Frog is minimal.
Grey-headed Flying-fox
Grey-headed Flying-fox feed on the nectar and pollen of native trees, fruits of rainforest trees and vines, and in cultivated gardens and fruit crops. They breed in large camps, in gullies, close to water, and in vegetation with a dense canopy. The proposal area is not located in a known important population of this species. The proposal would involve the removal of around 0.05ha of Weeping Myall woodland, 0.5ha of Forb-rich Speargrass - Windmill Grass – White Top Grassland and 204ha of fruit crops. There would also be

some disturbance associated with construction, including noise, vibration, light, and risk of introduction or spread of weeds, pests, and pathogens.

The habitat to be impacted is similar to the habitat that exists in the rest of the locality, and is highly disturbed due to the agricultural history of the site.

In this context, and with the recommended mitigation measures, the likelihood of the proposal leading to a long-term decrease in the size of an important population of Grey-headed Flying-fox is minimal.

Koala

Potential foraging and breeding habitat for Koala (including potential feed trees) occurs within the proposal area and would be impacted by the proposal. The proposal area is not located in a known important population of this species.

The proposal would involve the removal of around 0.05ha of Weeping Myall woodland and 0.5ha of Forb-rich Speargrass - Windmill Grass – White Top Grassland. There would also be some disturbance associated with construction, including noise, vibration, light, and risk of introduction or spread of weeds, pests, and pathogens.

The quality of potential habitat for this species is low, being largely cleared and highly disturbed by agriculture. Given the relatively small amount of habitat to be removed, and with the recommended mitigation measures, the likelihood of the proposal leading to a long-term decrease in the size of an important population of Koala is minimal.

b) Will the action reduce the area of occupancy of an important population of a species?

Canopy birds

The proposal would impact around 0.05ha of woodland habitat in total. The habitat to be removed is low quality due to being largely cleared and highly disturbed. The proposal area is not located in a known important population of these species.

In this context, the removal of a relatively small area of low-quality habitat as a result of the proposal is unlikely to reduce the area of occupancy of an important population of Superb Parrot or Painted Honeyeater.

Southern Bell Frog

The proposal would impact around 0.3ha of aquatic habitat in total. The habitat to be removed is similar to the habitat that exists in the rest of the locality, and is low quality due to being artificially constructed and managed, and highly disturbed. The proposal area is not located in a known important population of this species.

In this context, the removal of a relatively small area of low-quality habitat as a result of the proposal is unlikely to reduce the area of occupancy of Southern Bell Frog.

Grey-headed Flying-fox

The proposal would impact around 0.05ha of woodland habitat and 204ha of fruit crop habitat in total. The habitat to be removed is similar to the habitat that exists in the rest of the locality, and is low quality due to being largely cleared and highly disturbed. The proposal area is not located in a known important population of this species.

In this context, the removal of a relatively small area of low-quality habitat as a result of the proposal is unlikely to reduce the area of occupancy of an important population of Grey-headed Flying-fox.

Koala

The proposal would impact around 0.05ha of woodland habitat in total. The habitat to be removed is low quality due to being largely cleared and highly disturbed. The proposal area is not located in a known important population of this species.

In this context, the removal of a relatively small area of low-quality habitat as a result of the proposal is unlikely to reduce the area of occupancy of an important population of Koala.

c) Will the action fragment an existing important population into two or more populations?

Canopy birds

The proposal would impact an area of low-quality habitat in an area surrounded by similar habitat. The proposal will not prevent the movement of these mobile species through the landscape. The proposal area is not located in a known important population of these species. In this context, the proposal would not fragment existing important Superb Parrot or Painted Honeyeater populations into two or more populations.

Southern Bell Frog

The habitat to be removed is similar to the habitat that exists in the rest of the locality, and is low quality due to being artificially constructed and managed, and highly disturbed. The proposal area is not located in a known important population of this species.

In this context, the proposal would not fragment an existing important Southern Bell Frog population into two or more populations.

Grey-headed Flying-fox

The proposal would impact an area of low-quality habitat in an area surrounded by similar habitat. The proposal will not prevent the movement of this highly mobile species through the landscape. The proposal area is not located in a known important population of this species. In this context, the proposal would not fragment an existing important Grey-headed Flying-fox population into two or more populations.

Koala

The proposal would impact an area of low-quality habitat in an area surrounded by similar habitat. The proposal will not prevent the movement of this mobile species through the landscape. The proposal area is not located in a known important population of this species. In this context, the proposal would not fragment an existing important Koala population into two or more populations.

d) Will the action adversely affect habitat critical to the survival of a species?

Canopy birds

No areas of critical habitat have been declared for these species.

Southern Bell Frog

No areas of critical habitat have been declared for this species.

Grey-headed Flying-fox

No areas of critical habitat have been declared for this species.

Koala

No areas of critical habitat have been declared for this species.

e) Will the action disrupt the breeding cycle of an important population?

Canopy birds

Superb Parrot nests between September and December in hollows of large trees. The proposal area is not suitable breeding habitat for Superb Parrot. Painted Honeyeaters breed in Boree/Weeping Myall, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests, nesting in the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.

The proposal would involve the removal of a small area of potential low-quality breeding habitat, in an area that is surrounded by similar habitat. The proposal area is not located in a known important population of this species. The proposal is unlikely to disrupt the breeding cycle of an important population of Painted Honeyeater.

Southern Bell Frog

Southern Bell Frog occur in artificial water bodies such as farm dams, irrigation channels, irrigated rice crops and disused quarries in disturbed areas, and favour permanent water bodies, or those in close

proximity to permanent water, for breeding. The proposal area is not located in a known important population of this species, and was not recorded on site in targeted surveys.

The proposal would involve impacts to a small area of potential low-quality breeding habitat, in an area that is surrounded with areas of similar habitat.

The proposal is unlikely to disrupt the breeding cycle of an important population of Southern Bell Frog.

Grey-headed Flying-fox

Grey-headed Flying-fox breeds in large camps, in gullies, close to water, in vegetation with a dense canopy. The proposal area is not suitable breeding habitat for this species. The proposal is unlikely to disrupt the breeding cycle of an important population of Grey-headed Flying-fox.

Koala

Potential foraging and breeding habitat for Koala (including feed tree species) occurs within the proposal area and would be impacted by the proposal. The proposal area is not located in a known important population of this species.

The proposal would involve the removal of a small area of potential low-quality breeding habitat, in an area that is surrounded by similar habitat. The proposal area is not located in a known important population of this species. The proposal is unlikely to disrupt the breeding cycle of an important population of Koala.

f) Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Canopy birds

The proposal would involve the removal of around 0.05ha of woodland habitat, reducing the total availability of habitat in the locality, as well as some indirect disturbance associated with construction which could decrease the quality of some habitat.

The habitat to be impacted is similar to the habitat that exists in the rest of the locality, and is highly disturbed due to the agricultural history of the site.

In this context, and with the recommended mitigation measures, the proposal is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that Superb Parrot or Painted Honeyeater are likely to decline.

Southern Bell Frog

The proposal would involve the removal of around 0.3ha of aquatic habitat, reducing the total availability of habitat in the locality, as well as some indirect disturbance associated with construction which could decrease the quality of some habitat.

The habitat to be impacted is similar to the habitat that exists in the rest of the locality, and is highly disturbed due to the agricultural history of the site.

In this context, and with the recommended mitigation measures, the proposal is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that Southern Bell Frogs are likely to decline.

Grey-headed Flying-fox

The proposal would involve the removal of around 0.05ha of woodland habitat and 204ha of fruit crop habitat, reducing the total availability of foraging habitat in the locality, as well as some indirect disturbance associated with construction which could decrease habitat quality.

The habitat to be impacted is similar to the habitat that exists in the rest of the locality, and is highly disturbed due to the agricultural history of the site.

In this context, and with the recommended mitigation measures, the proposal is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that Grey-headed Flying-fox is likely to decline.

Koala

The proposal would involve the removal of around 0.05ha of Weeping Myall woodland reducing the total availability of habitat in the locality, as well as some indirect disturbance associated with construction which could decrease habitat quality.

The habitat to be impacted is similar to the habitat that exists in the rest of the locality, and is highly disturbed due to the agricultural history of the site.

In this context, and with the recommended mitigation measures, the proposal is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that Koalas are likely to decline.

g) Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?

The proposal has the potential to contribute to the spread of invasive species in the proposal area through the transfer and introduction of plant material and soil on machinery. Mitigation measures have been recommended to prevent the spread of weeds on site. The proposal is therefore unlikely to result in invasive species that are harmful to these vulnerable species becoming established in their potential habitat.

h) Will the action introduce disease that may cause the species to decline?

There is a risk that pathogens could be established or spread in the proposal area via machinery during construction. However, with the recommended mitigation measures, the action is unlikely to introduce any disease which may cause these species to decline.

i) Will the action interfere substantially with the recovery of the species?

Canopy birds

The National Recovery Plan for Superb Parrot lists the following specific objectives:

1. Determine population trends in the Superb Parrot.
2. Increase the level of knowledge of the Superb Parrot's ecological requirements.
3. Develop and implement threat abatement strategies.
4. Increase community involvement in and awareness of the Superb Parrot recovery program.

The Conservation Advice for Painted Honeyeater lists the following primary conservation objectives:

1. Stable population at key sites.
2. No further clearance of suitable habitat.
3. Adequate numbers of mature trees and mistletoe populations across its distribution.

The proposal would not interfere with any of these objectives.

Southern Bell Frog

The National Recovery Plan for Southern Bell Frog lists the following recovery objectives:

1. Secure extant populations of Southern Bell Frogs, particularly those occurring in known breeding habitats, and improve their viability through increases in size and/or area of occurrence.
2. Determine distribution, biology and ecology of the Southern Bell Frog, and identify causes of the decline of the species across its geographic range.
3. Address known or predicted threatening processes, and implement appropriate management practices where possible to ensure that land use activities do not threaten the survival of the Southern Bell Frog.
4. Increase community awareness of and support for Southern Bell Frog conservation.

The proposal would not interfere with any of these objectives.

Grey-headed Flying-fox

The National Recovery Plan for Grey-headed Flying Fox lists the following specific objectives:

1. Identify, protect and enhance native foraging habitat critical to the survival of the Grey-headed Flying Fox.

2. Identify, protect and enhance roosting habitat of Grey-headed Flying Fox camps.
3. Determine population trends in Grey-headed Flying Foxes so as to monitor the species' national distribution and conservation status.
4. Build community capacity to co-exist with Flying Foxes and minimise the impacts on urban settlements from existing camps without resorting to dispersal.
5. Increase public awareness and understanding of Grey-headed Flying Foxes and the recovery program, and involve the community in the recovery program where appropriate.
6. Improve the management of Grey-headed Flying Fox camps in sensitive areas.
7. Significantly reduce levels of deliberate Grey-headed Flying Fox destruction associated with commercial horticulture.
8. Support research activities that will improve the conservation status and management of Grey-headed Flying Foxes.
9. Assess and reduce the impact on Grey-headed Flying Foxes of electrocution on power lines, and entanglement in netting and on barbed wire.

The proposal would not interfere with any of these objectives.

Koala

The NSW Recovery Plan for Koala lists the following specific objectives:

1. To conserve koalas in their existing habitat.
2. To rehabilitate and restore koala habitat and populations.
3. To develop a better understanding of the conservation biology of koalas.
4. To ensure that the community has access to factual information about the distribution, conservation and management of koalas at a national, state and local scale.
5. To manage captive, sick or injured koalas and orphaned wild koalas to ensure consistent and high standards of care.
6. To manage over browsing to prevent both koala starvation and ecosystem damage in discrete patches of habitat.
7. To coordinate, promote the implementation, and monitor the effectiveness of the NSW Koala Recovery Plan across NSW.

The proposal would not interfere with any of these objectives.

A significant impact is not considered likely on the Superb Parrot, Painted Honeyeater, Southern Bell Frog, Grey-headed Flying Fox and Koala, on the basis that the proposal would not:

- Lead to a reduction of the size or area of occupancy of a population, or fragment or disrupt the breeding cycle of a population
- Affect habitat critical to the survival of any species
- Introduce invasive species harmful to any species
- Introduce disease that would cause any species to decline
- Interfere with the recovery of these specie

Migratory Species

- Fork-tailed Swift (*Apus pacificus*) – Migratory, EPBC Act
- Yellow Wagtail (*Motacilla flava*) – Migratory, EPBC Act
- Satin Flycatcher (*Myiagra cyanoleuca*) – Migratory, EPBC Act
- Shorebirds:
    - Wood Sandpiper (*Tringa glareola*) – Migratory, EPBC Act
    - Latham's Snipe (*Gallinago hardwickii*) – Migratory, EPBC Act

a) Will the action substantially modify (including by fragmenting, alerting fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?

Fork-tailed Swift

The proposal would impact an area of around 205ha, including 0.05ha of woodland, 0.5ha of grassland and 204ha of fruit crops. There would also be some disturbance associated with construction which could decrease habitat quality. The proposal would not directly impact the aerial habitat of this species.

The habitat to be impacted is the same as the habitat that would remain in the rest of the locality, and is highly disturbed by agriculture. The proposal area is not located in a known area of important habitat for this species.

With the implementation of the recommended mitigation measures, the likelihood of the action substantially modifying, destroying, or isolating an area of important habitat for Fork-tailed Swift is minimal.

Yellow Wagtail

The proposal would impact an area of around 205ha, including 0.05ha of woodland, 0.5ha of grassland and 204ha of fruit crops in areas close to irrigation channels. There would also be some disturbance associated with construction which could decrease habitat quality.

The habitat to be impacted is the same as the habitat that would remain in the rest of the locality, and is highly disturbed due to the industrial history of the site. The proposal area is not located in a known area of important habitat for this species.

With the implementation of the recommended mitigation measures, the likelihood of the action substantially modifying, destroying, or isolating an area of important habitat for Yellow Wagtail is minimal.

Satin Flycatcher

The proposal would impact an area of around 0.05ha of woodland and 0.5ha of grassland. There would also be some disturbance associated with construction which could decrease habitat quality.

The habitat to be impacted is the same as the habitat that would remain in the rest of the locality, and is highly disturbed by agriculture. The proposal area is not located in a known area of important habitat for this species.

With the implementation of the recommended mitigation measures, the likelihood of the action substantially modifying, destroying, or isolating an area of important habitat for Satin Flycatcher is minimal.

Shorebirds

The proposal would involve the removal of around 0.3ha of aquatic habitat in farm dams. There would also be some disturbance associated with construction which could decrease habitat quality.

The habitat to be impacted is the same as the habitat that would remain in the rest of the locality, and is highly disturbed by agriculture. The proposal area is not located in a known area of important habitat for these species.

With the implementation of the recommended mitigation measures, the likelihood of the action substantially modifying, destroying, or isolating an area of important habitat for Wood Sandpiper or Latham's Snipe is minimal.

b) Will the action result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?

There is a risk that invasive species could be introduced to the proposal area via machinery, vehicles, and materials during construction and operation. However, with the implementation of the recommended mitigation measures, the likelihood of the action resulting in harmful invasive species becoming established in the habitat of these species is minimal.

c) Will the action seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?

Fork-tailed Swift

The proposal would impact an area of around 205ha, including 0.05ha of woodland, 0.5ha of grassland and 204ha of fruit crops There would also be some disturbance associated with construction which could decrease habitat quality. The proposal would not directly impact the aerial habitat of this species, and the proposal area is outside the breeding habitat of Fork-tailed Swift in Siberia.

The quality of potential habitat in the proposal area is low, and it is therefore unlikely to support an ecologically significant proportion of the population of Fork-tailed Swift. The habitat to be impacted is the same as the habitat that would remain in the rest of the locality.

With the recommended mitigation measures, the likelihood of the action seriously disrupting the lifecycle of an ecologically significant proportion of the population of Fork-tailed Swift is minimal.

Yellow Wagtail

The proposal would impact an area of around 205ha, including 0.05ha of woodland, 0.5ha of grassland and 204ha of fruit crops in areas close to irrigation channels. There would also be some disturbance associated with construction which could decrease habitat quality.

The quality of potential habitat in the proposal area is low, and it is therefore unlikely to support an ecologically significant proportion of the population of Yellow Wagtail. The habitat to be impacted is the same as the habitat that would remain in the rest of the locality.

With the recommended mitigation measures, the likelihood of the action seriously disrupting the lifecycle of an ecologically significant proportion of the population of Yellow Wagtail is minimal.

Satin Flycatcher

The proposal would impact an area of around 0.05ha of woodland. There would also be some disturbance associated with construction which could decrease habitat quality.

The habitat to be impacted is the same as the habitat that would remain in the rest of the locality, and is highly disturbed by agriculture. The proposal area is not located in a known area of important habitat for this species.

The quality of potential habitat in the proposal area is low, and it is therefore unlikely to support an ecologically significant proportion of the population of Satin Flycatcher. The habitat to be impacted is the same as the habitat that would remain in the rest of the locality.

With the recommended mitigation measures, the likelihood of the action seriously disrupting the lifecycle of an ecologically significant proportion of the population of Satin Flycatcher is minimal.

Shorebirds

The proposal would involve the removal of around 0.3ha of aquatic habitat in farm dams. There would also be some disturbance associated with construction which could decrease habitat quality. The proposal area is outside the breeding habitat of Wood Sandpiper in Eurasia, and Latham's Snipe in Japan and eastern Russia.

The quality of potential habitat in the proposal area is low, and it is therefore unlikely to support an ecologically significant proportion of the population of this species. The habitat to be impacted is the same as the habitat that would remain in the rest of the locality.

With the implementation of the recommended mitigation measures, the likelihood of the action seriously disrupting the lifecycle of an ecologically significant proportion of the population of Wood Sandpiper or Latham's Snipe is minimal.

A significant impact is not considered likely on the Fork-tailed Swift, Yellow Wagtail, Satin Flycatcher, Wood Sandpiper and Latham's Snipe on the basis that the proposal would not:

- Lead to a reduction of the size or area of occupancy of a population, or fragment or disrupt the breeding cycle of a population
- Affect habitat critical to the survival of any species
- Introduce invasive species harmful to any species
- Introduce disease that would cause any species to decline
- Interfere with the recovery of these species

APPENDIX G FIELD DATA SHEETS

Zone 2 PCT74-RRG-YB Woodland

-This document has not been endorsed or approved by Office of Environment and Heritage or Muddy Boots Environmental Training-

BAM Site – Field Survey Form

Site Sheet no:

Survey Name	Zone ID	Recorders
Yanco	2 - Zone 2	J. Gooding

Date	Zone	Datum	Plot ID	Plot dimensions	Photo #
9 8 17	55H		1.	20 x 50	

Easting	Northing	IBRA region	Midline bearing from 0 m
444427	6171210	SW Slopes	288° N

Vegetation Class		Confidence: H M L
Plant Community Type	Bimble Box	EEC: / Confidence: H M L

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	1
	Shrubs	2
	Grasses etc.	6
	Forbs	4
	Ferns	0
	Other	1
Sum of Cover of native vascular plants by growth form group	Trees	12
	Shrubs	0.2
	Grasses etc.	27.3
	Forbs	0.4
	Ferns	0
	Other	0.1
High Threat Weed cover		25.1

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm		
50 – 79 cm		
30 – 49 cm	111	–
20 – 29 cm		–
10 – 19 cm		–
5 – 9 cm	√1	–
< 5 cm	1,1	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	2m, .05, 0.5, 1m	4m.

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	70 70 60 75 75			
Average of the 5 subplots	70			

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture	Sandy loam	Soil Colour	Red Brown	Soil Depth	
Slope	Flat	Aspect		Site Drainage		Distance to nearest water and type	irrigation channel

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			- ~~understorey~~ between 2 powerline easements.
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			Dominated by silver leaf Nightshade along roadside
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date: 9 8 17	Yanco	(1)	J. GOODING

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable		N, E or HTE	Cover	Abund	stratum	voucher
	Silver leaf Nightshade	Solanum elaeagnifolium	HTE	25%	~~2~~ 200		
T	Bimble Box	Eucalyptus populnea	N	~~12~~ 1.	2		
	common vetch	Vicia sativa		0.2	50		
	Lambs tongue	Plantago lanceolata		2%	400		
	Rye Grass	Lolium sp		~~4~~0%	1000+		
F	Sida corrugata		N	0.1	10		
G	Red Grass	Bothriochloa macra	N	~~5~~	~~5~~0		
G	Curly windmill Grass.	Enteropogon acicularis	N	15%	80		
	Lucerne.	Medicago sativa		2%	~~2~~0		
	Wild Oats. (seedlings)	Avena fatua		5	500		
	Rumex crispus			0.1	1		
	~~Lepidium~~			0.1	1		
	Vervain	Salvia verbanaca		0.3	20		
O	Convolvulus		N	0.1	1		
	Purple top. (dead)	Verbena bonarensis		0.1	5		
G	Rhytidosperma sp. (No seeds)		N	5%	~~20~~40		
G	Austrostipa sp.		N	0.2	5		
G	Hairy grass (Rhytidosperma)		N	0.1	10		1
F	Einadia nutans		N	0.1	2		
	Flaxbane	Conyza bonariensis		0.1	1		
S	Ruby saltbush	Enchylaena tomentosa	N	0.1	1		
	Subterraneum clover	Medicago subterraneum		0.1	1		
S	Sclerolaena muricata		N	0.1	1		
G	Couch	Cynodon dactylon	N	2%	5		
F	Vittadinia sp		N	0.1	1		
	Pattersons curse	Echium plantagineum		0.1	30		
E	oxalis perennens		N	0.1	1		
	outside plot						
	- African Boxthorn						
	- white cedar						
	- horehound						

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Zone 1. PCT44 - Riverine Plain Grassland

BAM Site – Field Survey Form

Site Sheet no:

		Survey Name	Zone ID	Recorders			
Date	09 08 18	Plot 2 - Yanco	(a) 1	J MURPHY / J GOODING			
Zone 55	Datum	Plot ID	(2)	Plot dimensions	50 x 20	Photo #	
Easting 444147	Northing 6171337	IBRA region	SW Slopes	Midline bearing from 0 m	285°		
Vegetation Class		Derived grassland				Confidence: H M L	
Plant Community Type				EEC:		Confidence: H M L	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	1
	Shrubs	0
	Grasses etc.	1
	Forbs	1
	Ferns	0
	Other	1
Sum of Cover of native vascular plants by growth form group	Trees	0.1
	Shrubs	0
	Grasses etc.	5 %
	Forbs	0.1
	Ferns	0
	Other	0.1
High Threat Weed cover		40 %

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	0	
50 – 79 cm	0	
30 – 49 cm	0	
20 – 29 cm	0	
10 – 19 cm	0	
5 – 9 cm	0	
< 5 cm	1	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0	

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	30	50	40	60	30															
Average of the 5 subplots	42 %																			

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture	Clay loam	Soil Colour	Brown	Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date: 09 05 18	Yanco	(1)	J. GOODING

GF Code	*Top 3 native species in each growth form group: Full species name mandatory. All other native and exotic species: Full species name where practicable*		N, E or HTE	Cover	Abund	stratum	voucher
	Silver leaf nightshade	Solanum elaeagnifolium	HTE	40	500		
	Rye Grass (seedling)	Lolium sp.		20%	1000+		
	Vervain	Salvia verbenaca		2%	20		
G	Curly Windmill Grass	Enteropogon acicularis	N	5%	30		
	Oxalis ~~perennans~~.	Oxalis pes caprae		0.1	5		
	Soldierplant.	- Garden escape. Chlorophytum comosum		0.1	20		
	Spear thistle.	Cirsium vulgare		0.1	10		
	Panicum sp. (annual)			0.1	10		
T	Yellow Box - Juvenile	Eucalyptus melliodora	N	0.1	1		
	Patterson's curse	Echium plantagineum		0.1	10		
O	Convolvulus sp.		N	0.1	1		
	Medicago sp.			0.1	10		
	Wild Oats (seedling)	Avena fatua		40	1000+		
F	Sida corrugata		N	0.1	1		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Zone 2 - PCT74 - YB-RRG Woodland

'96
9
6
16

BAM Site – Field Survey Form

Site Sheet no: 1 of

		Survey Name	Zone ID	Recorders			
Date	09 08 18	Yanco	Zone 2	S MURPHY / J GOODING			
Zone	Datum	Plot ID	3	Plot dimensions	20x50	Photo #	
Easting	Northing	IBRA region	SW Slopes	Midline bearing from 0 m	275°		
444165	6171358						
Vegetation Class						Confidence: H M L	
Plant Community Type 277		Yellow Box - RRG Woodland		EEC:		Confidence: H M L	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	3
	Shrubs	2
	Grasses etc.	1
	Forbs	1
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	40
	Shrubs	2.1
	Grasses etc.	5
	Forbs	5
	Ferns	0
	Other	0
High Threat Weed cover		8

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	1 (165cm)	
50 – 79 cm	–	
30 – 49 cm	IIII	
20 – 29 cm	–	
10 – 19 cm	II	
5 – 9 cm	–	
< 5 cm	–	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	10 + 11 + 4	25m

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	15	60	40	20	10			
Average of the 5 subplots	29							

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 09 08 18	Yanco	3	J. GOODING

GF Code	*Top 3 native species in each growth form group: Full species name mandatory* *All other native and exotic species: Full species name where practicable*		N, E or HTE	Cover	Abund	stratum	voucher
	Lambs tongue	Plantago lanceolata		5%	200		
T	~~Blakely's red Gum~~	Eucalyptus camaldulensis	N	25%	1		
T	White Cedar	Melia azedarach	N	5%	6		
	African Boxthorn	Lycium ferocissimum	HTE	5%	8		
	Vervain	Salvia verbanacea		1%	80		
	Spiderplant?	Garden escape		2%	100		
	Lucerne	Medicago sativa		1%	~~20~~		
G	Rhytidosperma sp.		N	5%	~~50~~		
	Horehound	Marrubium vulgare		8%	70		
	Paspalum dilatum		HTE	2%	20		
F	Einadia nutans		N	5%	30		
	Common vetch	Vicia sativa		0.1	20		
	Wild Brassica	Brassica sp		0.1	10		
	Rye Grass (seedling)	Lolium sp.		5	100		
	Silver leaf nightshade	Solanum Elaegnifolium	HTE	1%	50		
T	Yellow Box	Eucalyptus Melliodora	N	10%	1		
	Spear thistle	Cirsium Vulgare		0.1	10		
S	Ruby Saltbush	Enchylaena tomentosa	N	2%	10		
S	creeping saltbush	Atriplex semibaccata	N	0.1	1		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Zone 1 -PCT44- Derived Grassland

BAM Site – Field Survey Form

Site Sheet no: 1 of

		Survey Name	Zone ID	Recorders			
Date	09 08 18	Yanco	1	J MURPHY / J GOODING			
Zone 55	Datum	Plot ID	4 - PLOT 4	Plot dimensions	50x20	Photo #	
Easting 447 12	Northing 6171039	IBRA region	SW Slopes	Midline bearing from 0 m	113°		
Vegetation Class		Grassland - Derived				Confidence: H M L	
Plant Community Type				EEC:		Confidence: H M L	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	0
	Shrubs	2
	Grasses etc.	5
	Forbs	3
	Ferns	0
	Other	1
Sum of Cover of native vascular plants by growth form group	Trees	0
	Shrubs	5.1
	Grasses etc.	38.6
	Forbs	6.2
	Ferns	0
	Other	0.1
High Threat Weed cover		20.2

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm		
50 – 79 cm		
30 – 49 cm		
20 – 29 cm		
10 – 19 cm		
5 – 9 cm		
< 5 cm		n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0m	

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	30	30	80	70	50			
Average of the 5 subplots	52							

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage	D	Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			adjacent to railway line
Cultivation (inc. pasture)			
Soil erosion			Drainage from Railway line
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	15 8 18	Yanco SF	(4)	J GOODING

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*		N, E or HTE	Cover	Abund	stratum	voucher
	silver leaf nightshade	Solanum elaeagnifolium	HTE	20%	200		
	Panicum sp. (annual exotic)			0.3	20		
	Onion Grass (Fat	Romulea rosea	HTE	0.2	200		
	Skeleton Weed.	Chondrilla juncea		2%	10		
	Patterson's curse	Echium plantagineum		0.2	40		
G	Curly Windmill Grass	Enteropogon acicularis	N	3%	50		
	Prickly Lettuce	Lactuca serriola		0.5	10		
	Wild Oats	Avena fatua		40%	1000+		
F	Cicla corrugata		N	0.1	10		
	Vervain	Salvia verbanaca		~~5%~~ 5%	100		
S	Maireana brevifolia		N	5%	25		
	Spear thistle	Cirsium vulgare		0.5	30		
	Rumex crispus			0.1	5		
F	Geranium	Erodium sp.	N	0.1	5		
	Sow thistle	Sonchus sp.		0.1	10		
G	Grass (unidentified - dead)	(paspalidium?) _spring grass	N	30%	200		
	Narrow leaf clover	Trifolium angustifolium		0.1	5		
G	Austrostipa sp.		N	0.5	20		
	Dandelion.	Taraxacum officinale		0.1	5		
G	Red Grass	Bothriochloa macra	N	5%	50		
F	Oxalis sp.		N	5%	1000		
0	Convolvulus sp. (no flowers/fruit)		N	0.1	1		
S	Monotoca (mid shrub)		N	0.1	4		V1
G	Carex Sedge (Curly Carex Sedge)			0.1	4		
G	~~Hairy Panic~~ Rythdosperma	(no fruit)	N	0.1	1		
	Winter Grass	poa annua		0.1	10		
	-~~Very~~ many dead grasses - perennial						

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Zone 3 - Myall Woodland

BAM Site – Field Survey Form

Site Sheet no:

		Survey Name	Zone ID	Recorders			
Date	24 10 18	Yanco SF	3	Bridgette Poulton			
Zone 55	Datum GDA 94	Plot ID	5	Plot dimensions	20m x 50m	Photo #	
Easting ~~[illegible]~~ 442557	Northing 6171084	IBRA region	SW Slopes	Midline bearing from 0 m	322°		
Vegetation Class		Myall Woodland				Confidence: H M L	
Plant Community Type				EEC:		Confidence: H M L	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	1
	Shrubs	5
	Grasses etc.	6
	Forbs	6
	Ferns	0
	Other	2
Sum of Cover of native vascular plants by growth form group	Trees	25%
	Shrubs	15.8%
	Grasses etc.	20.5
	Forbs	10.5
	Ferns	0
	Other	2.2
High Threat Weed cover		20.1

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm		
50 – 79 cm		
30 – 49 cm	II	
20 – 29 cm	IIII	
10 – 19 cm	IIIII II	
5 – 9 cm	II	
< 5 cm	IIIII IIIII IIIII IIIII II	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	~~35~~ 1, 3, 3.5, 3, 4, 4, 5, 2.5	(30.5m)

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30 ... 100, 200, 300 ...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	99, 20, 60, 50, 60	0, 70, 0, 5, 0	0, 0, 0, 0, 0	0, 10, 0, 0, 0
Average of the 5 subplots	56	15	0	2

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	modified	Landform Element	Brown loam	Landform Pattern		Microrelief	
Lithology	soil/no rocks.	Soil Surface Texture	fine/organic/silty	Soil Colour	Brown	Soil Depth	>6 cm
Slope	flat	Aspect	0	Site Drainage	(regated	Distance to nearest water and type	30 m/canal

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			Cleared roadside verge with drainage line
Cultivation (inc. pasture)			Verge - weed dominated. / heavy earth works.
Soil erosion			NIL
Firewood / CWD removal			Yes - some large tree stumps.
Grazing (identify native/stock)			No
Fire damage			No
Storm damage			No
Weediness			Yes
Other			Railway line just to the west side of road. (E&T)

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Weeping Myall

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 24 10 18	Yanco SF	(5)	JGOODING

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
T	Acacia Pendula	N	25%	10		
	Silver leaf nightshade Solanum elaeagnifolium	HTE	10%	100		
O	Convolvulus sp	N	2%	30		0
	Patterson's curse Echium plantagineum	E	0.1	5		
F	Einadia nutans (~~HTE~~) ssp nutans	N	8%	50		
F	~~Hogweed~~ Hogweed Zaleya galericulata	N	0.1	2		
	Great Brome Bromus diandrus	HTE	10%	1000+		
S	Maireana excavata ~~enchylaenoides~~.	N	0.2	20		
F	Sida corrugata	N	0.1	20		
S	Ruby saltbush Enchylaena tomentosa	N	10%	30		
~~F~~	~~Einadia nutans (Hyalina)~~	~~D~~	~~5%~~	~~50~~		
G	Rhytidosperma setaceum	N	5%	~~100~~ 80		
G	Austrostipa sp	N	15%	200		
S	Atriplex semibaccata	N	5%	30		
	Avena fatua	E	4%	50		
	Horehound Marrubium Vulgare	E	0.1	1		
G	Panicum effusum	E	0.1	10		
S	~~Blackbelly Poly~~ Sclerolaena muricata	N	0.5	5		
F	Tarvine Boerhavia domunu	N	0.1	5		
	Salvia verbenacea	E	0.1	1		
F	Vittadinia gracilis	N	0.2	20		
	~~Bro~~ Medicago sativa	E	0.1	5		
S	Dysoola australis	N	0.1	5		
G	Warrego summer grass Paspalidium (constrictum)	N	0.1	10		
	Lactuca serriola	E	0.1	1		
F	Atriplex sp (suberecta)	N	2%	5		
G	Austrostipa scabra	N	0.1	5		
G	couch Cynadon dactylon	N	0.2	5		
	Lolium sp.	E	4%	1000		
	~~Creeping Mullumbimby - longleaf~~		~~0.2~~	20		
	Succulent :- Aloe sp	E	2%	10		
	African Boxthorn Lycium ferocissimum	HTE	0.1	1		
O	Grey Mistletoe Amyema quandang	N	0 2	1		
	Dry Drought conditions					
	Rabbit Diggings.					

0.1

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, …, 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, …, 10, 20, 30, … 100, 200, …, 1000, …

Zone 4 - Myall Woodland (Roadside)

BAM Site – Field Survey Form

Site Sheet no:

		Survey Name	Zone ID	Recorders			
Date	24 10 18	Yanco	~~64~~	Bridgette Poulton			
Zone: 55	Datum: GDA 94	Plot ID	Plot 6	Plot dimensions	20m x 50m	Photo #	
Easting: 443584	Northing: 6176457	IBRA region	SW Slopes	Midline bearing from 0 m	~~320°~~ 170°		
Vegetation Class						Confidence: H M L	
Plant Community Type	Myall Woodland			EEC:		Confidence: H M L	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	1
	Shrubs	4
	Grasses etc.	3
	Forbs	4
	Ferns	0
	Other	1
Sum of Cover of native vascular plants by growth form group	Trees	40.1
	Shrubs	75.2
	Grasses etc.	0.5
	Forbs	0.5
	Ferns	0
	Other	3
High Threat Weed cover		2.5

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm		
50 – 79 cm		
30 – 49 cm	11	
20 – 29 cm	1111	
10 – 19 cm	1111 1111 1111	
5 – 9 cm	1111 1111 111	No
< 5 cm	1111 1111	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	4, 1 (5m)	

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30, ..., 100, 200, 300, ...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	50	20	20	20	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average of the 5 subplots	28					0					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			
Cultivation (inc. pasture)			None
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			None
Fire damage			
Storm damage			
Weediness			
Other			Roadside vegetation

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date: 24 10 18	Yanco SF	(6)	J. GOODING

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
T	Weeping Myall Acacia pendula	N	40%	25		
S	Rhagodia spinescens	N	70%	60		
S	Echylaena tomentosa	N	5%	30		
	~~Aristida ramosa~~? Bromes?	E	05			
	Avena fatua	E	~~0.7~~	50		
	Vulpia myuros	E	0.1	~~50~~		
	Lolium sp.	E	0.2	~~100~~		
	Lactuca serriola	E	0.1	20		
F	Einadia nutans	N	0.2	10		
	Marrubium vulgare.	E	0.1	2		
	Brassica sp.	E	01	2		
F	Tar vine Boerhavia dominii	N	01	2		
G	Hairy Panic Panicum effusum	N	01	1		
	Great Brome Bromus diandrus	HTE	0.5	200		
S	Maireana (Hairy) excavata	N	0.1	20		
G	Austrostipa sp.	N	0.2	5		
	Lycium ferocissimum	HTE	2%	10		
F	Oxalis perennans	N	0.1	5		
G	Rytidosperma sp	N	0.2	20		
S	Scleolaena muricata.	N	0.1	2		
F	Sida corrugata	N	0.1	2		
	Sonchus oleraceus	E	0.1	1		
G	Tall chloris Chloris sp.	N	0.1	5		
	Echium plantagineum	E	0.1	5		
O	Grey Mistletoe	N	3%	20		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Zone 1- Derived Grassland

BAM Site – Field Survey Form

Site Sheet no:

		Survey Name	Zone ID	Recorders			
Date	25 10 18	Yanco	1	Bridgette Powlton			
Zone	Datum	Plot ID	Plot 7	Plot dimensions	20m x 50m	Photo #	
55	GDA 94						
Easting	Northing	IBRA region	SW Slopes	Midline bearing from 0 m	320°		
444963 / 444627	6171127 / 6171210						
Vegetation Class		Grassland -Derived				Confidence: H M L	
Plant Community Type				EEC:		Confidence: H M L	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	0
	Shrubs	3
	Grasses etc.	5
	Forbs	7
	Ferns	0
	Other	1
Sum of Cover of native vascular plants by growth form group	Trees	0
	Shrubs	1.4
	Grasses etc.	1.6
	Forbs	1
	Ferns	0
	Other	0.3
High Threat Weed cover		15.1

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	0	
50 – 79 cm	0	
30 – 49 cm	0	
20 – 29 cm	0	
10 – 19 cm	0	
5 – 9 cm	0	
< 5 cm	0	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	Nil	

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30 ... 100, 200, 300 ...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	60	70	90	70	50	0	5	0	0	10	0	0	0	0	0	0	0	0	0	0
Average of the 5 subplots	68					3					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	Modified.	Landform Element		Landform Pattern	Modified Roadside	Microrelief	Grated drains
Lithology		Soil Surface Texture	fine loam	Soil Colour	brown	Soil Depth	deep
Slope	Flat	Aspect	0°	Site Drainage	Grated.	Distance to nearest water and type	20m Canal

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			Modified roadside between road and railline.
Cultivation (inc. pasture)			Nil
Soil erosion			Nil
Firewood / CWD removal			Completely cleared groundcover only.
Grazing (identify native/stock)			Nil
Fire damage			
Storm damage			
Weediness			Extensive.
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Grassland

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 25 10 18	Yanco	7	J GOODING

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
F	Vittadinia gracilis	N	0.1	10		
F	Sida corrugata	N	0.1	10		
	Great Brome Bromus diandrus	HTE	5%	1000+		
	Silver leaf nightshade Solanum elaeagnifolium	HTE	10%	200		
	~~Et~~ Avena fatua		5%	1000+		
	Marrubium Vulgare, Horehound		0.2	5		
	Salvia verbenaceae		1%	40		
F	Oxalis perennans	N	0.1	10		
S	Maireana - excavata ~~large white flowers~~	N	0.2	20		
G	Rytidosperma (straw) setaceum	N	0.2	10		
	Bromus molliformis		1%	100		
S	Sclerolaena muricata	N	0.2	2		
	Vicia ~~sp~~ sativa		0.1	5		
F	Atriplex (no fruit) - Lagoon Saltbush, suberecta	N	0.3	5		
F	Tarvine Boerhavia dominii	N	0.1	1		
S	Ruby Saltbush Enchylaena tomentosa	N	1%	20		
O	Convolvulus sp	N	0.3	5		
	~~[illegible]~~					
	Rumex sp (no fruit)		0.1	1		
	Spear thistle (dead) Cirsium vulgare		0.1	1		
G	Austrostipa blakeii	N	0.1	2		
	Lucerne Medicago sativa		0.1	1		
	Lolium sp.		1%	800		
G	Panicum effusum	N	1%	30		
F	Einadia nutans	N	0.1	1		
G	Cynodon dactylon	N	0.2	5		
G	Wanego summer grass (dead) Pospalidium (constrictum?)	N	0.1	1		
F	willow herb Epilobium billardierium	N	0.1	1		
	Very Dry Conditions (~~Dead~~ Most grasses dead)					
	Incidentals.					
	Wahlenbergia Prickly Pear Bridal creeper					
	Briar Rose Iris - Moraea setifolia					

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, …, 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, …, 10, 20, 30, … 100, 200, …, 1000, …

Zone 1 - Derived Grassland

BAM Site – Field Survey Form

Site Sheet no:

Survey Name	Zone ID	Recorders
Yanco	1	Bridgette Poulton

Date	25 10 18	Plot ID	P1 (8)	Plot dimensions	20M x 50M	Photo #	
Zone 55	Datum GDA 94						
Easting 446469	Northing 6171149	IBRA region	SW Slopes	Midline bearing from 0 m	315°		

Vegetation Class			Confidence: H M L
Plant Community Type	Grassland / weeds	EEC:	Confidence: H M L

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	0
	Shrubs	2
	Grasses etc.	5
	Forbs	4
	Ferns	0
	Other	1
Sum of Cover of native vascular plants by growth form group	Trees	0
	Shrubs	0.2
	Grasses etc.	16.3
	Forbs	0.5
	Ferns	0
	Other	0.5
High Threat Weed cover		25%

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	0	
50 – 79 cm	0	
30 – 49 cm	0	
20 – 29 cm	0	
10 – 19 cm	0	
5 – 9 cm	0	
< 5 cm	0	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	NIL	

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30 ... 100, 200, 300 ...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	60	50	60	90	30	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0
Average of the 5 subplots	56					1					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern	Modified Verge	Microrelief	Gradual Banks
Lithology	Soil / No Rocks	Soil Surface Texture	fine loam	Soil Colour	Brown	Soil Depth	75cm
Slope	flat	Aspect	0	Site Drainage		Distance to nearest water and type	40m (Canal)

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			Cleared.
Cultivation (inc. pasture)			–
Soil erosion			–
Firewood / CWD removal			Completely devoid of trees
Grazing (identify native/stock)			–
Fire damage			–
Storm damage			–
Weediness			Heavy burden
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	25 10 18	YANCO	(8)	J. GOODING

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	Silverleaf Nightshade *Solanum elaeagnifolium*	HTE	5%	100		
	Great Brome - ~~Red Brome~~ *Bromus diandrus*	HTE	20%	1000+		
	Avena fatua		15%	1000+		
	Salvia verbenaca		0.3	30		
G	Curly Windmill Grass *Enteropogon ramosus*	N	15%	200		
G	Couch *Cynodon dactylon*	N	0.1	2		
F	*Dicia conjugata*	N	0.2	20		
	Lolium sp.		1%	100		
G	*Rytidosperma setaceum*	N	0.1	10		
G	Warrego summer grass (dead) *Paspalidium*	N	1%	30		
S	*Alternanthera nodiflora*	N	0.1	1		1
F	Hogweed *Zaleya galericulata*	N	0.1	2		N
	Common heliotrope *Heliotropium europaeum*		0.1	1		
	Lactuca serriola		0.1	2		
S	Maireana ~~enchylaenoides~~ *excavata*	N	0.1	3		1
O	*Convolvulus*	N	0.5	10		
	Echium plantagineum		0.2	30		
G	*Juncus* sp.	N	0.1	3		
F	Tarvine *Brachyscia dominii*	N	0.1	1		
	Spear thistle *Cirsium vulgare*		0.1	1		
	Marrubium vulgare		0.1	1		
F	*Oxalis perennans*	N	0.1	1		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

…AM Site – Field Survey Form

Site Sheet no:

		Survey Name	Zone ID	Recorders	
Date	26 11 18	Yanco		B. Poulton	
Zone 55	Datum	Plot ID	Plot 9	Plot dimensions: 10 x 100	Photo #
Easting 644028	Northing 6171291	IBRA region	SWS	Midline bearing from 0 m	290°

Vegetation Class	Derived grassland	Confidence: H M L
Plant Community Type	EEC: 44	Confidence: (H) M L

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	0
	Shrubs	5
	Grasses etc.	4
	Forbs	7
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	0
	Shrubs	15
	Grasses etc.	13
	Forbs	84
	Ferns	0
	Other	0
High Threat Weed cover		20 /

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	0	
50 – 79 cm	0	
30 – 49 cm	0	
20 – 29 cm	0	
10 – 19 cm	0	0
5 – 9 cm	0	
< 5 cm	0	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	NIL	

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30…, 100, 200, 300…). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living.

For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	40, 0, 40, 5, 60	60, 90, 60, 90, 60	0, 0, 0, 0, 0	0, 0, 0, 0, 0
Average of the 5 subplots	21	62	0	0

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	Sed. mentary	Landform Element	Floodplain	Landform Pattern	Valley	Microrelief	Canal bank
Lithology	Alluvial	Soil Surface Texture	Fine	Soil Colour	Brown	Soil Depth	>10 m
Slope	Flat 0°	Aspect	Nil	Site Drainage	roadside	Distance to nearest water and type	1m Canal

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)	3	NR	
Cultivation (inc. pasture)	0	–	
Soil erosion	0	–	
Firewood / CWD removal	0	–	
Grazing (identify native/stock)	0	–	
Fire damage	0	–	
Storm damage	0	–	
Weediness	2	R	
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

PCT44 10x30m

plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
1	Yanco SF	(9)	J. GOODING

de	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable		N, E or HTE	Cover	Abund	stratum	voucher
	Silverleaf Nightshade	Solanum elaeagnifolium	HTE	20%	200		
S	Ruby saltbush	Enchylaena tomentosa	N	5%	50		
	Verbain	Salvia verbenacea		4%	200		
	Wild Oats	Avena fatua		5%	1000		
	Pattersons curse	Echium plantagineum		1%	50		
G	Enteropogon acicularis		N	1%	20		
S	Salsola Australis		N	2%	200		
G	Austrostipa scabra		N	0.1	2		
	Lolium sp.			0.5	200		
	Malva parviflora			0.1	1		
	Spear thistle	Cirsium Vulgare		0.1	1		
	prickly lettuce	Lactuca serriola		0.1	30		
	Plantago lanceolata			0.1	10		
F	Tarvine	Boehavia dominii	N	3%	50		
S	Sclerolaena muricata		N	5%	30		
F	Atriplex (suberecta)		N	2%	100		
F	Cudweed	Pseudognaphalium luteo-album	N	0.1	1		
G	Bothriochloa macra		N	0.1	2		
F	Einadia nutans		N	1%	50		
F	Caustic weed	Euphorbia ~~prostrata~~ drummondii	N	0.1	20		
	Salsify	Tragopogon porrifolius		0.1	30		
S	~~Maireana~~ Maireana brevifolia		N	4%	30		
	Forb ? (Unid. Forb)			0.1	10		
G	~~Wal Panicum~~ - Walwhayella proluta		N	0.1	10		
S	Atriplex semibarrata		N	2%	5		
	Skeleton weed	Chondrilla juncea		0.1	2		
	Polygonum aviculare			0.1	5		
	Lepidium sp.			0.1	2		
F	Zaleya galericulata		N	0.1	2		
	Paspalum distichum		HTE	0.1	1		
	Sow thistle	Sonchus oleraceus		0.1	10		
F	Oxalis perennans		N	0.1	1		
	Horehound	Marrubium vulgare		0.1	2		
	Disturbed along length of irrigation canal						
	2 Quad						

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

	COUNT	COVER
T	0	T 0
S	5	S 15%
G	4	G 2.3%
F	7	F 6.4%

HTE
- 20 1%

APPENDIX H BAM CALCULATOR CREDIT REPORT

NSW GOVERNMENT

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00011569/BAAS18074/19/00011570	Yanco Solar Farm	04/01/2019
Assessor Name	Report Created	BAM Data version *
Julie Gooding	03/06/2019	6
Assessor Number	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.	
BAAS18074		

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Candidate SAII	Ecosystem credits
Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion								
1	44_Low	36.4	0.5	0.25	High Sensitivity to Potential Gain	2.00		9
							Subtotal	**9**

NSW GOVERNMENT

BAM Credit Summary Report

Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion							
2	26_Mod	86.5	0.1	0.25	High Sensitivity to Potential Gain	2.00	2
						Subtotal	**2**
						Total	**11**

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Candidate SAII	Species credits
Cullen parvum / Small Scurf-pea (Flora)						
44_Low	36.4	0.49	0.25	2	False	9
26_Mod	86.5	0.05	0.25	2	False	2
					Subtotal	**11**

NSW GOVERNMENT

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00011569/BAAS18074/19/00011570

Proposal Name
Yanco Solar Farm

BAM data last updated *
04/01/2019

Assessor Name
Julie Gooding

Assessor Number
BAAS18074

BAM Data version *
6

Proponent Names
Jenny Walsh ,

Report Created
03/06/2019

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Candidate Serious and Irreversible Impacts

Nil

Nil

Additional Information for Approval

PCTs With Customized Benchmarks
No Changes

Predicted Threatened Species Not On Site

BAM Biodiversity Credit Report (Like for like)

No Changes

Ecosystem Credit Summary

PCT	TEC	Area	Credits
44-Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion	Not a TEC	0.5	9.00
26-Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	0.1	2.00

Credit classes for 26

Like-for-like options

Any PCT with the below TEC	Containing HBT	In the below IBRA subregions
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (including PCT's 26, 27, 37, 43, 49, 55, 145, 159, 1766)	Yes	Murrumbidgee,Darling Depression, Lachlan, Lachlan Plains, Lower Slopes, Murray Fans, Robinvale Plains and South Olary Plain. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

NSW GOVERNMENT

BAM Biodiversity Credit Report (Like for like)

Credit classes for 26				
Credit classes for 44	**Like-for-like options**			
	Any PCT in the below Class	And in any of below trading groups	Containing HBT	In the below IBRA subregions
	Riverine Plain Grasslands (including PCT's 44)	Riverine Plain Grasslands - ≥ 70% - <90% cleared group (including Tier 4 or higher).	No	Murrumbidgee,Darling Depression, Lachlan, Lachlan Plains, Lower Slopes, Murray Fans, Robinvale Plains and South Olary Plain. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Area	Credits
Cullen parvum / Small Scurf-pea	0.5	11.00

Cullen parvum/ Small Scurf-pea	26_Mod	**Like-for-like options**		
		Only the below Spp	In the below IBRA subregions	

NSW GOVERNMENT

BAM Biodiversity Credit Report (Like for like)

		Cullen parvum/Small Scurf-pea	Any in NSW
	44_Low	**Like-for-like options**	
		Only the below Spp	In the below IBRA subregions
		Cullen parvum/Small Scurf-pea	Any in NSW

APPENDIX I KEY PERSONNEL

Name	Title	Qualifications	Roles
Mitch Palmer	Senior Ecologist	• BAM Accredited Assessor (BAAS17051) • B. Science	Review of BDAR
Julie Gooding	Environmental Consultant - Ecologist	• BAM Accredited Assessor (BAAS18074) • B. Science (Biology)	Field Work Co-author of BDAR
Jess Murphy	Environmental Consultant - Ecologist	• B. Science • Master Environmental Science and Management	Field Work Co-author of BDAR
Bridgette Poulton	Environmental Consultant	• B. Science (Biology & Environmental science) • Master Environmental Science	Field Work