

# Modification Application

WELLINGTON SOLAR FARM



FEBRUARY 2020



## Document Verification



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## ACRONYMS AND ABBREVIATIONS

AC	Alternating Current
ACHA	Aboriginal Cultural Heritage Assessment
BAR	Biodiversity Assessment Report
BC Act	<i>Biodiversity Conservation Act 2016</i>
BCD	Biodiversity Conservation Division
BDAR	Biodiversity Development Assessment Report
BOS	Balance of System
CEEC	Commonwealth Endangered ecological community – as defined under relevant law applying to the proposal
CoC	Conditions of Consent
Cwth	Commonwealth
DC	Direct Current
DECCW	Refer to OEH
DP&E	(NSW) Department of Planning and Environment (now DPIE)
DPIE	Department of Planning, Industry and Environment (formally, DP&E)
DRC	Dubbo Regional Council
EEC	Endangered ecological community – as defined under relevant law applying to the proposal
EIS	Environmental impact Statement
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cwth)
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i> (NSW)
GCR	Ground Cover Ratio
GW	Gigawatt
ha	hectares
km	kilometres
LGA	Local Government Area
LMP	Landscape Management Plan
LS BP	Lightsource BP
m	Metres
Mod 1	First Modification Application (Substation Expansion)
MW	Megawatt
NES	Matters of National environmental significance under the EPBC Act (c.f.)
NSW	New South Wales
OEH	(NSW) Office of Environment and Heritage, formerly Department of Environment, Climate Change and Water

PAD	Potential Archaeological Deposit
PV	Photovoltaic
RMS	Roads and Maritime Service
SSD	State Significant Development
VIA	Visual Impact Assessment

# 1 INTRODUCTION

## 1.1 THE APPROVED PROJECT

Development Consent for the Wellington Solar Farm (SSD 8573) was granted by the NSW Minister for Planning on 25 May 2018 (Development Consent) under Part 4, Division 4.1 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act). Project approval permits the construction, operation and decommissioning of a 174 Megawatt (MW AC) photovoltaic (PV) solar farm and associated infrastructure including:

- Substation and transformers.
- Overhead transmission lines.
- Battery storage facility.
- Access tracks.

The Wellington Solar Farm will be located about 2 km north-east of Wellington in the Dubbo Regional Local Government Area (LGA).

The first Modification Application (Mod 1) for the substation extension was lodged with the Department of Planning Industry and Environment (DPIE) in October 2019. Mod 1 was approved on 11 December 2019.

This is the second Modification Application for Wellington Solar Farm (Mod 2).

## 1.2 THE PROPONENT

In April 2019, Lightsource BP ('The Proponent') purchased the Wellington Solar Farm from First Solar, who had obtained Development Consent for the project.

Lightsource and BP formed a strategic partnership in 2017 with the aim of combining Lightsource's solar development and management expertise and BP's global scale, relationships and trading capabilities, forming Lightsource BP (LS BP).

LS BP is a global leader in the development, acquisition and long-term management of large-scale solar projects and smart energy solutions. The company is Europe's largest developer and operator of utility-scale solar projects. LS BP has commissioned 1.3 Gigawatt (GW) of solar capacity and manages approximately 2 GW of capacity under long-term operations and maintenance contracts.

## 1.3 PURPOSE OF THIS DOCUMENT

This report has been prepared to support an application to modify Development Consent SSD 8573. It includes:

- |  |             |
|--|-------------|
| • Detailed description of the modifications being sought.                              | Section 2   |
| • Detailed justification for the modification being sought.                            | Section 3   |
| • Details of the consultation undertaken in relation to the proposed modifications.    | Section 4   |
| • An assessment of the consistency of the proposed changes with the existing approval. | Section 5.2 |
| • Legislative context for the Modification Application.                                | Section 5.3 |

- |   |           |
|---|-----------|
| <ul style="list-style-type: none"> <li>• An outline of the approach taken to identify and assess the impacts of the modifications.</li> </ul>   | Section 6 |
| <ul style="list-style-type: none"> <li>• A targeted impact assessment to demonstrate:               <ul style="list-style-type: none"> <li>○ The nature and degree of impact posed by the changes.</li> <li>○ The requirement for any additional mitigation or consultation.</li> </ul> </li> </ul> | Section 6 |
| <ul style="list-style-type: none"> <li>• An outline of the amendments sought to the conditions of consent.</li> </ul>   | Section 7 |
| <ul style="list-style-type: none"> <li>• Conclusion.</li> </ul>   | Section 8 |

This report has been prepared by NGH on behalf of the Proponent, LS BP.

The Proponent commenced construction of the Wellington Solar Farm in December 2019. The proposed modifications to the Development Consent are required to deliver an efficient, constructible and commercially viable project.

## 2 PROPOSED PROJECT CHANGES

This Modification Application seeks five (5) changes to the approved project layout. In summary, changes relate to:

1. Optimised panel layout (Section 2.1);
2. Expanded battery storage facility area (Section 2.2);
3. An additional operations and maintenance (O&M) facility and shed (Section 2.3);
4. Relocation of the temporary construction compound (Section 2.4); and
5. Relocation of specific electricity transmission and connection routes (Section 2.5).

These are detailed below and a comparison of the approved development footprint within the consolidated Development Consent (11 December 2019) and proposed development footprint (changes proposed within this Modification Application) are presented in Table 2-1 and Figure 2-2 .

In addition to seeking the modifications above, this report confirms selection of the following:

6. Panel technology (Section 2.6); and
7. Site access point relocation (Section 2.7).

Table 2-1 Summary of proposed changes to the approved project resulting from changes in Mod 2.

Parameter	Approved project	Modification Application	Extent of modification
<b>Panel layout</b>	440,000 Approximately 262* ha	500,714 280 ha	Increased by 18 ha or 7%
<b>Battery storage facility</b>	0.25 ha	1.46 ha	Increased by 1.21 ha or 484%

Parameter	Approved project	Modification Application	Extent of modification
<b>O&amp;M facility (including 2 options: Narrawa Homestead and alternative option)</b>	2 facilities (0.31) including: Narrawa Homestead: 0.17 ha Alternative option 0.14 ha	2 facilities (0.17) including: Narrawa Homestead 0.14 ha Additional facility and shed 0.03 ha	Decreased by 0.14 ha or 45%
<b>Temporary construction compound</b>	7.7 ha	1.1 ha	Decreased by 6.6 ha or 86%
<b>Electricity and connection routes</b>	100 m overhead transmission line  Underground cables** (length unspecified in EIS).	No overhead transmission line  Underground cables: 15.74 km	Decreased by 100%.  Underground cabling is within existing disturbance area associated with the internal road network. As such, there is no additional impact.
<b>Total development footprint</b>	282 ha	288 ha	Increased by 6 ha or 2%

*\*This is an estimate based on mapping as this value was not required for the SSD approval.*

*\*\*This cannot be reliably calculated due to mapping limitations.*

Generally, this Modification Application has been prepared to assess the impact of the proposed changes in relation to the General Layout provided in Appendix 1 of the consolidated Development Consent (MOD 1, 11 December 2019). The exception to this is the assessment of impacts to biodiversity. MOD 1 (with its supporting Biodiversity Assessment Development Report) assessed the additional impact of removing 0.69 ha of vegetation for substation benching and cabling. It did not excise an area of cabling no longer required, as the reasonable equivalence credit requirement was pending and so the General Layout within the consolidated Development Consent and Mod 1 together slightly overestimate impacts required at that time.

A second BDAR has been prepared to support this Modification Application (Mod 2). It now provides one updated biodiversity credit requirement for the entire project. To fully account for new areas to be impacted and areas where impacts would now be avoided, the Biodiversity Assessment Method (BAM), pursuant to the BC Act was applied to all 'additional' and 'excised' areas. The *net* impact therefore becomes the updated project credit requirement. Specifically, pursuant to the BC Act, the Mod 2 BDAR has been prepared to:

- identify, assess and derive the credit number for the additional areas now being impacted by the solar farm footprint, that were not impacted by the approved footprint.
- identify, assess and derive the credit number for the areas that will now be removed from the approved solar farm footprint (areas that *were* impacted but are now excised from the approved footprint).

- Reconcile the credit requirement of the original SSD approvals, MOD 1 and this proposed MOD 2 to give one updated credit requirement for the Wellington Solar Farm project.

Areas outlined in blue in the vicinity of the substation (refer Figure 6-5) do not form part of the consolidated Development Consent from Mod 1 which has resulted in the mapping inconsistencies between the Mod 2 and the BDAR provided in Appendix C.2

Further assessment has been undertaken in relation to the proposed changes for Heritage, Biodiversity, Visual Amenity, Noise and Vibration, Flooding and Soil Disturbance. These are discussed further in Section 6.





Figure 2-1 Approved Project Layout as shown in Appendix 1 of consolidated Development Consent (11 December 2019)



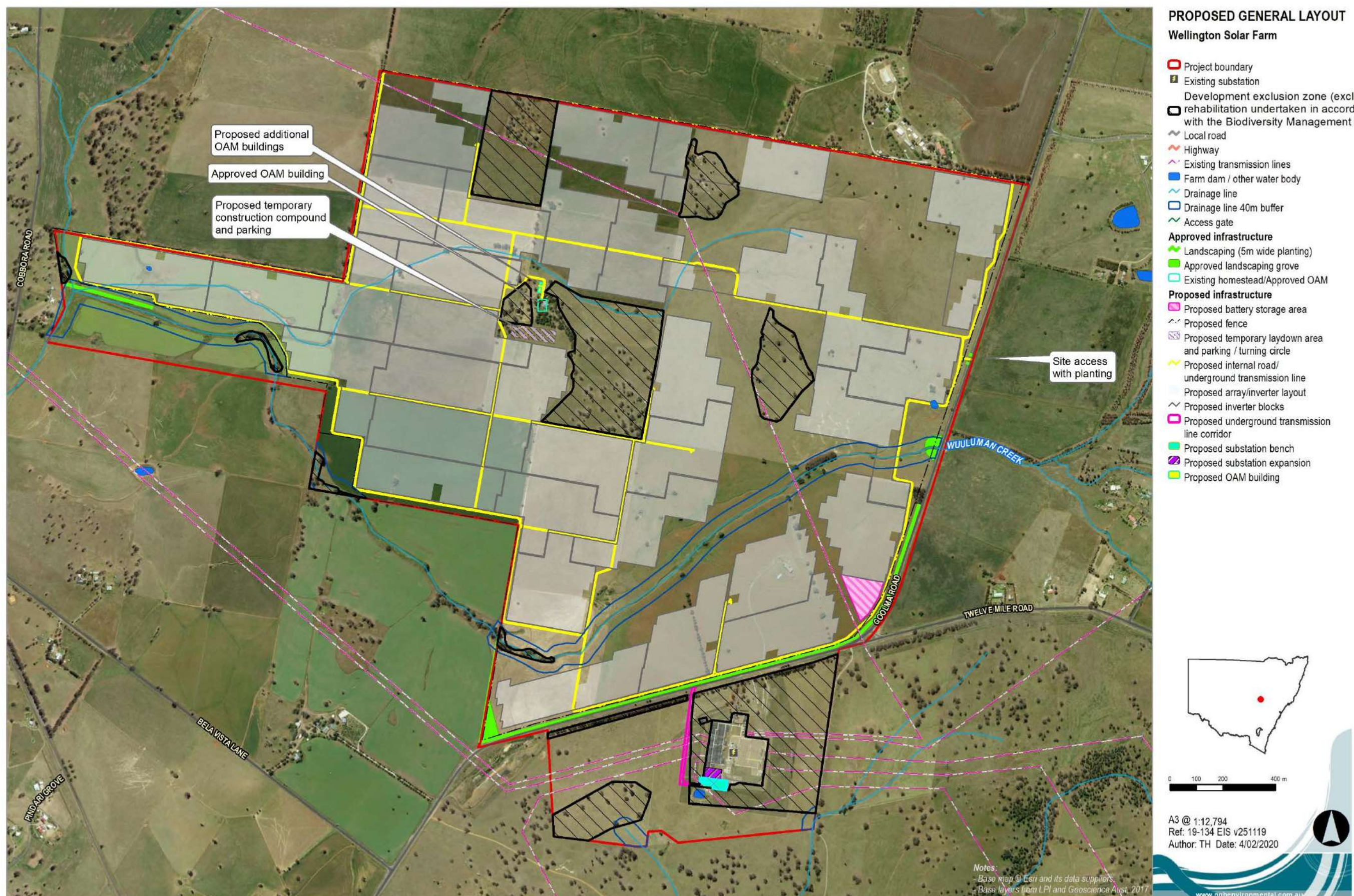


Figure 2-2 Proposed project layout including changes described in this Modification Application



## **2.1 OPTIMISED PANEL LAYOUT**

As a result of the modified layout:

- The number of panels has increased from the estimated 440,000 in the EIS to 500,714.
- The number of inverter stations has decreased from 50 to 33.

Panels would be placed in additional areas within the project site boundary but would avoid all exclusion zones stipulated in the Development Consent. The total development footprint area under the indicative layout presented in the first Modification Application was 283 ha. The changes proposed add approximately 6 ha to this; the development footprint area would now total 288 ha under the modified layout in this second Modification Application (a 2% increase in total developed area).

The Ground Cover Ratio (GCR) for the new panel arrangement has been calculated to be 42.64%, which equates to approximately 112 ha of actual panel area.

The increased panel area does not necessarily equate to increased environmental impact. The additional areas where panels would now be placed are shown in Appendix A.2.

## **2.2 EXPANDED BATTERY STORAGE**

The proposed expanded battery storage facility area would be located in generally the same location, but would require an area of 1.46 ha; 1.21 ha more than the approved layout. The proposed area allocated for the battery storage facility is a worst-case scenario and it is unlikely that the area would be used in its entirety. The expansion to the battery storage facility is not associated with any change to the storage capacity of the facility, which would remain approximately 25MW/100MWH as outlined in the Wellington Solar Farm EIS.

## **2.3 ADDITIONAL OPERATIONS AND MAINTENANCE FACILITY AND SHED**

An additional O&M facility and shed is proposed that would comprise an area of 0.03 ha and would be located in part within the approved alternative O&M facility location. Approximately 0.013 ha of the additional O&M facility is located outside of the approved alternative O&M facility location.

The O&M facility site plans are included in Appendix B.

## **2.4 RELOCATION OF THE TEMPORARY CONSTRUCTION COMPOUND**

The temporary construction compound is proposed to be relocated south of Narrawa Homestead. The construction compound would comprise an area of approximately 1.1 ha, 0.5 ha of which is located outside of the approved development footprint.

## **2.5 RELOCATION OF SUBSTATION CABLE CORRIDOR AND REMOVAL OF OVERHEAD TRANSMISSION LINES**

Wellington Solar Farm Mod 1 extended the footprint of TransGrid's Wellington Substation beyond the existing fence line and re-located the approved point of connection of the transmission line into the Substation. Additionally, the overhead transmission cable was changed to underground. The underground cabling approved in Mod 1 travels west from the battery storage facility in parallel with Goolma Road, then

south across Goolma Road, running parallel to the western boundary of the Substation before turning east to connect to the Substation's south western corner. The underground cable corridor is approximately 403 m in length from its connection with the Substation to its intersection with Goolma Road.

This Modification Application (Mod 2) proposes to extend the cable corridor parallel to the Substation for a distance of approximately 39 m further south, before intersecting with the approved substation bench in the Substation's south western corner see . The modified cable corridor is approximately 459 m in length from its connection with the substation to its intersection with Goolma Road, resulting in an overall increase of 56 m in length.

The EIS noted that overhead or underground electrical conduits and cabling to connect the panels on the array site would be required. Appendix 1 of the modified Development Consent identified approximately 15 km of overhead transmission lines connecting the panel areas to the battery storage facility. This Modification Application (Mod 2) seeks to remove all overhead transmission lines and replace them with underground conduits located within the alignments of the site's access tracks.

Installing underground cables requires trenching which does create slightly more ground disturbance however the ground is then restored to its original state. However, as the underground cables are wholly located within the access tracks, the ground would be disturbed as a result of access track construction. Additionally, the visual impact that would have arisen as a result of overhead transmission lines would be removed. The additional area of trenching is not likely to be significant and would not result in any material change to impacts.

As a result of this modification, no overhead transmission lines would be required for the project, reducing visual impacts and providing additional space for solar panels.

## **2.6 PANEL TECHNOLOGY**

The Environmental Impact Statement (EIS) for the Wellington Solar Farm proposed the use of silicon solar panels but did not specify whether they would be monofacial or bifacial.

LS BP will use utility grade silicon bifacial solar panels, which offer increased total energy generation as both sides of the panels can be used to produce energy. The bifacial modules are double glass framed and would have a glass underside as opposed to the plastic backing used on monofacial solar panels. The glass allows any daylight, direct or reflected, that falls on to either side of the module to be converted into electricity. This option further optimises the Balance of System (BOS) as productivity of the development footprint is increased. The use of bifacial solar panels does not result in any material change in impact compared with monofacial solar panels; particularly in relation to visual impacts. Appendix A.2 provides a detailed description of bifacial panel technology.

## **2.7 RELOCATION OF THE SITE ACCESS POINT**

The indicative location of the project's approved site access point was approximately 810 m south of the entrance to the Wellington Correction Centre. The as built location of the site access point is located 100 m south of the indicative location. The as built location is shown in Figure 2-2.

The constructed site access does not impact on biodiversity or Aboriginal heritage areas of constraint (Appendix A.1), and the landscaping planting has been relocated to align with the constructed site access point to manage visual impacts. The Landscaping Management Plan will be updated to reflect the revised location of the landscaping planting around the constructed site access point.

## **3 JUSTIFICATION**

LS BP undertook further site investigations and additional geotechnical studies to inform the development of the final project layout for the Wellington Solar Farm. This resulted in the proposed changes identified in Section 2 above. The proposed modified layout protects the constrained areas within the site, including watercourses and Aboriginal heritage sites. Areas mapped as exclusion zones within Appendix 1 of the Development Consent will not be impacted by the changes proposed in this Modification Application (Mod 2). There will be a net reduction in impact to native vegetation.

The modification proposed in this report are required to deliver an efficient, constructible and commercially viable project, minimising environmental impact to the extent practically and reasonably achievable. Expected generation has increased from approximately 384 GWh/yr to 428 GWh/yr. This is a result of both the increased solar panel area used and technology improvements such as bifacial modules.

### **3.1 OPTIMISED PANEL LAYOUT**

Bifacial panels operate most efficiently when there is greater spacing between rows compared with monofacial panels. As a result, the design of the panel layout needs to maximise the available area within the site boundary.

The LS BP design optimisation process also investigated the feasibility of panel rows being rotated, to take full advantage of the available area. This means that previously unused land at the edges of the proposed infrastructure (as detailed in the Submissions Report layout) is now being utilised.

### **3.2 EXPANDED BATTERY STORAGE**

Due to technology improvements and lower costs, a larger battery is likely to be installed than was originally expected. This will help shift more of the peak solar generation into peak consumption periods in the evening. It is considered unlikely that the revised area will be used in its entirety, however the expanded battery facility area (now totalling 1.46 ha) will allow greater flexibility.

### **3.3 ADDITIONAL OPERATIONS AND MAINTENANCE FACILITY AND SHED**

Condition 8, Schedule 2 of the Wellington Solar Farm development consent requires that the Narrawa Homestead be repurposed as an O&M Facility. Condition 18 of Schedule 3 of the Development Consent states that impacts on the Homestead must be minimised during the works. A Statement of Heritage Impact has been prepared for the Narrawa Homestead and is included in Appendix C.3. The assessment concluded that the impact of the proposed adaptive reuse of the Narrawa Homestead as the site office for the O&M facility would be low.

However, a further O&M facility building and shed is required in addition to using the Narrawa Homestead as the site office, as the Narrawa Homestead would not be able to house the majority of electrical equipment required for the O&M facility including batteries, low voltage equipment and SCADA without substantial alterations to the building. The additional O&M facility and shed would not impact on the exclusion zones.

### **3.4 RELOCATION OF THE TEMPORARY CONSTRUCTION COMPOUND**

The temporary construction compound is required to be relocated. The new location for this has been selected to fit within the updated project layout, and the topography of the site. As the Narrawa Homestead will be used as the project site office during both construction and operation, it will be most efficient to have the temporary construction compound centrally located near the Homestead. Additionally, due to the nature of the project layout (size) and the variable nature of the site itself (topography), it is more efficient to store the construction materials centrally within the site upon their delivery.

### **3.5 RELOCATION OF SUBSTATION CABLE CORRIDOR AND REMOVAL OF OVERHEAD TRANSMISSION LINES**

The Wellington Solar Farm Submissions Report (NGH 2018) proposed new overhead lines to connect parts of the site to the battery storage facility and the substation to the south of the site. LS BP will now be using underground cabling instead of overhead cabling. These 33 kV underground cables are required to connect the inverters located across the project site to the project's substation, located within TransGrid's Wellington Substation. These cables would be located within the project's internal access tracks, gathering just north of the approved Goolma Road crossing before crossing Goolma Road to enter the Wellington Substation in its south-western corner. The reason for locating these cables underground within the access tracks is to both minimise the impacts of the cables on the solar panel layout and minimise their visual impacts.

### **3.6 PANEL TECHNOLOGY**

Bifacial panels have been selected because initial research conducted by LS BP suggests that bifacial panel technology could increase the amount of renewable energy generated by approximately 5%. Increases in energy generation of up to 30% have been predicted by Khan et al. (2017) and Sun et al. (2018) depending on row spacing and module elevation.

The use of bifacial solar panels does not change the nature or extent of environmental impacts associated with this project. As such, this clarification will not be discussed within the Impact Assessment of this Modification Report.

### **3.7 RELOCATION OF THE SITE ACCESS POINT**

The location of the site access point was of interest to Dubbo Regional Council (DRC) and Roads and Maritime Services (RMS) and was a key issue identified in consultation with these agencies post-approval of the project.

The as-built location of the site access point, now constructed 100 m south of the indicative location, was selected in consultation with DRC and RMS and was based on a Road Safety Audit (Constructive Solutions, 2018). The movement of the site access point is in line with the agreement between DRC, RMS and First Solar that the most suitable site access could be selected within 100 m north or south of the approved site access point.

The movement of the site access to a location 100 m south of the approved project site access location has no effect on the environmental impact of the project. The inclusion of the site access point within the modified project layout brings the consented project layout into alignment with the site access as it has

now been constructed. As such, this clarification will not be discussed within the Impact Assessment of this Modification Report.

## 4 CONSULTATION

### 4.1 AGENCIES

Consultation has been undertaken with stakeholders who have the potential to be affected by the proposed modification including:

#### **Department of Planning, Industry and Environment (DPIE)**

- 29 March 2019: LS BP (Tiffany Gullan, Charlotte Kitchen and Nick Robb) and NGH (Brooke Marshall, Senior Environmental Consultant) met with DPIE (Iwan Davies, Energy and Resources, Planning and Assessments and Leesa Johnston, Post Approvals, Energy and Resource Assessments, Planning Services). During the meeting, the following issues were discussed:
  - Extension of panel area with no material environmental impact.
  - Revision of management plans.
  - Narrawa homestead, Schedule 2 Condition 8.
  - Extension of panel area with environmental impact.
  - Consideration of commencing construction of approved layout while Modification Application (if required) is being processed.
  - Consistency Review prepared by NGH.
- 10 April 2019: LSBP provided a letter to DPIE summarising the items discussed in the meeting, the Consistency Review and the updated project layout.
- 3 April 2019: NGH met with DPIE via telephone and confirmed the following:
  - DPIE will confirm if a Modification Application is required but note that the onus is on the proponent to confirm whether the proposed modifications are consistent with the Development Approval.
  - The intention of Schedule 2 condition 8 is to preserve the homestead by using it as the operations and maintenance facility.
  - LS BP can commence construction of the approved layout during the Modification Application process. In the event that the Modification Application is approved prior to commencement of construction, advice would be needed in relation to the management plans.
- 27 November 2019: The proponent lodged a Scoping Meeting Request with DPIE via the Major Projects portal, including the updated project layout and a letter of intent outlining the proposed changes.

#### **Biodiversity Conservation Trust (BCD)**

- 13 November 2019: An application for an assessment of 'reasonable equivalence' of biodiversity credits was sent via email. This is required as the offset obligation for the project as initially calculated under the 'Framework for Biodiversity Assessment' and must now be modified and retired under the 'Biodiversity Assessment Method'.

## **4.2 NEAR NEIGHBOURS**

The proposed modifications to the approved project are not expected to affect near neighbours in relation to visual amenity, noise and vibration or flood impact levels. Visual amenity is discussed in detail in Section 6.2, noise and vibration is discussed in detail in Section 6.3 and flooding is discussed in detail in Section 6.5

Notwithstanding, LS BP has undertaken on-going consultation with near neighbours since acquiring the project from First Solar. They have been informed via both letterbox drops and telephone conversations and meetings of the proposed modifications to the project and have been notified about the pre-construction minor works undertaken and commencement of construction. Meetings and telephone conversations to date include:

- 13<sup>th</sup> November 2019: Meeting with landowner at north west boundary (R5)
- 28<sup>th</sup> November 2019: Meeting with landowner on western boundary (R4)
- 7<sup>th</sup> January 2020: Telephone call with Soil Conservation Service
- 11<sup>th</sup> and 16<sup>th</sup> January 2020; and 5<sup>th</sup> February: Meeting with landowner on south western boundary (R3)

No issues have been raised to date in relation to the proposed changes within this modification. LS BP will continue to undertake consultation with near neighbours during assessment of Mod 2, during construction of the project and throughout the project's operation.

## **5 PERMISSIBILITY**

### **5.1 APPROVAL STATUS**

Approval for the Wellington Solar Farm (SSD 8573) was granted on 25 May 2018 under Part 4, Division 4.1 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act). Project approval permits the construction, operation and decommissioning of a 174 Megawatt (MW) photovoltaic (PV) solar farm and associated infrastructure.

Mod 1 (submitted for the substation extension (NGH 2019)) was approved by the Department of Planning Industry and Environment (DPIE) on 11 December 2019. Mod 2 is the second modification for Wellington Solar Farm.

### **5.2 CONSISTENCY WITH EXISTING APPROVAL**

Changes which are consistent with the Conditions of Consent do not require a Modification and can be constructed under the existing approval. A Consistency Review was undertaken in April 2019 to determine:

- Whether the changes proposed would be substantive changes to the project's nature or description.
- Whether the changes proposed would impact on the ability to meet any Conditions of Consent.
- Whether the changes proposed would have a material change to predicted environmental impacts.
- Whether additional management strategies (or changes to the required management plans) would be required as a consequence of the changes.

Key aspects of the review are included in Appendix D and have directed the scope of this Mod 2 Application assessment. Key findings of the review were that:

- The changes proposed would not substantively change the project. The project would still involve the construction, operation and decommissioning of a solar farm with a generating capacity of 170 MW(AC)/200 MW(DC).
- Five environmental aspects were identified for closer investigation:
  - Aboriginal heritage;
  - Visual amenity;
  - Noise and vibration;
  - Soil disturbance;
  - Flooding; and
  - Biodiversity.
- Regarding the ability to meet the Conditions of Consent, no conditions were identified that could not be met. Clauses relating to the ‘development footprint’ and requirement to ‘minimise harm to the environment’ were identified for further consideration.

### 5.3 MODIFICATION APPLICATION

This Modification Application (Mod 2) has been lodged under Section 4.55(1A) of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Under Section 4.55 of the EP&A Act, a SSD Development Consent can be modified where the “*development to which the consent as modified relates is substantially the same development as the development for which the consent was originally granted*”.

In determining an application for a modification under section 4.55 of the EP&A Act, the consent authority must consider such matters referred to in section 4.40 as are relevant to the development. These matters include the likely impacts of the proposed amendments to the Development Consent, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality.

Modifications are allowed that are ‘substantially the same development’. Section 1(A) and Section 2 of Clause 4.55 differ regarding whether the proposed modification is of minimal environmental impact or not.

#### ***Environmental Planning and Assessment Act 1979 extract***

##### ***4.55 Modification of consents—generally***

##### ***(1A) Modifications involving minimal environmental impact***

*A consent authority may, on application being made by the applicant or any other person entitled to act on a consent granted by the consent authority and subject to and in accordance with the regulations, modify the consent if:*

- (a) it is satisfied that the proposed modification is of minimal environmental impact, and*
- (b) it is satisfied that the development to which the consent as modified relates is substantially the same development as the development for which the consent was originally granted and before that consent as originally granted was modified (if at all), and*
- (c) it has notified the application in accordance with:*
  - (i) the regulations, if the regulations so require, or*



*(ii) a development control plan, if the consent authority is a council that has made a development control plan that requires the notification or advertising of applications for modification of a Development Consent, and*

*(d) it has considered any submissions made concerning the proposed modification within any period prescribed by the regulations or provided by the development control plan, as the case may be.*

*Subsections (1), (2) and (5) do not apply to such a modification.*

**(2) Other modifications**

*A consent authority may, on application being made by the applicant or any other person entitled to act on a consent granted by the consent authority and subject to and in accordance with the regulations, modify the consent if:*

*(a) it is satisfied that the development to which the consent as modified relates is substantially the same development as the development for which consent was originally granted and before that consent as originally granted was modified (if at all), and*

*(b) it has consulted with the relevant Minister, public authority or approval body (within the meaning of Division 4.8) in respect of a condition imposed as a requirement of a concurrence to the consent or in accordance with the general terms of an approval proposed to be granted by the approval body and that Minister, authority or body has not, within 21 days after being consulted, objected to the modification of that consent, and*

*(c) it has notified the application in accordance with:*

*(i) the regulations, if the regulations so require, or*

*(ii) a development control plan, if the consent authority is a council that has made a development control plan that requires the notification or advertising of applications for modification of a Development Consent, and*

*(d) it has considered any submissions made concerning the proposed modification within the period prescribed by the regulations or provided by the development control plan, as the case may be.*

*Subsections (1) and (1A) do not apply to such a modification.*

The proposed changes within this Mod 2 Application would involve minimal environmental impact. As such, this Mod 2 Application is being lodged under Section 4.55(1A) of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Additional impacts that may result from the changes in this Mod 2 Application are assessed, in Section 6, below.

## 6 IMPACT ASSESSMENT

A Consistency Review, provided in Appendix D, identified areas where there was potential for material changes to the project's predicted environmental impacts that could result from any proposed modifications to the project layout. In consultation with specialists, these areas were investigated in greater detail and the modified project layout was designed to avoid these areas where possible. The assessment has been developed further in this Mod 2 Application and is presented below.



## **6.1 ABORIGINAL HERITAGE**

### **6.1.1 Approach**

A desktop study was undertaken to assess if the additional impacts being considered would have a significant impact on the heritage values previously assessed for the project.

### **6.1.2 EIS assessment**

An Aboriginal Cultural Heritage Assessment Report (ACHAR) (NGH 2018) was previously undertaken to provide an assessment of the Aboriginal cultural values associated with the proposal site for the Wellington Solar Farm and to assess the cultural and scientific significance of any Aboriginal heritage sites recorded.

There were 61 stone artefacts identified across the proposal area that were recorded as 25 site occurrences. These archaeological features were recorded as ten artefact scatters and 15 isolated finds. A single scarred tree and a possible hearth were also recorded. Two areas of Potential Archaeological Deposit (PAD) were also noted as having potential for subsurface finds within the proposal area. Refer to Figure 6-1.

Given the time that has lapsed since the ACHAR was undertaken an extensive search of the Aboriginal Heritage Information Management System (AHIMS) (Client Service Number: 435832) was undertaken on the 17 July 2019 over an area approximately 5 km east-west x 5 km north-south which covered the Wellington Solar Farm. A total of 39 registered sites were identified within the search area, but no Aboriginal Places have been declared. The sites listed within the Wellington Solar Farm were all those recorded and assessed in the ACHAR (NGH 2018).





Figure 6-1 Aboriginal Cultural Heritage survey results in context of approved layout and modified layout (NGH, 2019).



### **6.1.3 Modification assessment**

NGH senior archaeologist Kirsten Bradley, co-author of the Wellington Solar Farm ACHAR and co-author of the Wellington Solar Farm Cultural Heritage Management Plan (CHMP) (Version 1.3), investigated whether the proposed increase in panel area could result in a material change to the predicted impacts on heritage values within the Wellington Solar Farm.

The ACHAR field survey and impact assessment for the Wellington Solar Farm development footprint was broader than the final infrastructure footprint outlined in the Approval (Appendix A.1). In relation to the additional areas of panels now proposed, a portion of this, specifically the area south of Wuuluman Creek, was originally assessed to be impacted in the ACHAR.

The additional areas of panels now proposed that are outside the areas identified for impact in the ACHAR total approximately 14.9 ha; which equates to 4.9% of the 316 ha assessed in the ACHAR. With the current proposed modification (Mod 2), the Wellington Solar Farm footprint would impact approximately 288 ha of the 316 ha assessed in the ACHAR. The site Wellington Solar Farm ST1, which is a scarred tree, will also continue to be avoided. No additional impacts to the areas of potential archaeological deposit (PAD), beyond those areas recently tested as per the Conditions of Consent, will be impacted. A single isolated find, Wellington Solar Farm IF 1, was originally assessed to have low scientific value and to be located outside the development footprint, and would not be impacted by the modified design. No other previously recorded sites beyond those previously approved for salvage as shown in the Approval (Appendix A.1) would be impacted by the proposed modification design.

It is therefore considered that the additional impacts being considered would not have a significant impact on heritage, nor significantly change the impact on heritage from the project as originally assessed by NGH (NGH 2018) and subsequently approved by DPIE.

### **Recommendations**

Aboriginal heritage impacts generated as a result of this modification (Mod 2) will be mitigated by implementing the existing conditions of consent. However, it is recommended that:

- The Registered Aboriginal Parties (RAPs) for this project are informed of the change.
- The Conditions of Consent (CoC) Appendix 1 should be updated to include the figure of the modified layout.
- The Cultural Heritage Management Plan Appendix B should be updated to include the figure of the modified layout.
- If, once the modified layout is approved and Wellington Solar IF 1 cannot be avoided, the site must be salvaged and reburied in line with the CHMP and CoC. The site should only be subject to salvage if works cannot avoid impacting the site. If, however, this site can be avoided by the proposed fencing or other works it should be demarcated and a 5 m buffer maintained around the site to ensure no inadvertent impact occurs in line with the CHMP.

The environmental safeguards proposed as part of the approved project are considered sufficient.

## **6.2 VISUAL AMENITY**

### **6.2.1 EIS assessment**

A Visual Impact Assessment of the Wellington Solar Farm was undertaken as part of the EIS and provided a full assessment of the visual impacts associated with the landscape character and scenic vistas in the locality, stakeholder values regarding visual amenity and potential impacts on representative viewpoints including residences and road corridors.

The potential visual impact levels were defined as high, medium and low impact. Of the 12 viewpoints assessed, no high impact view locations were identified. Seven viewpoints were defined as medium impact and the remaining five locations were defined as low impact.

Five residents were identified that could not be adequately assessed by the roadside VIA and required additional consultation. As a result, photo montages were undertaken at two residences (R1/R2 and R4) and additional mitigation was agreed upon for both R1/R2 and R4 (Figure 6-2).



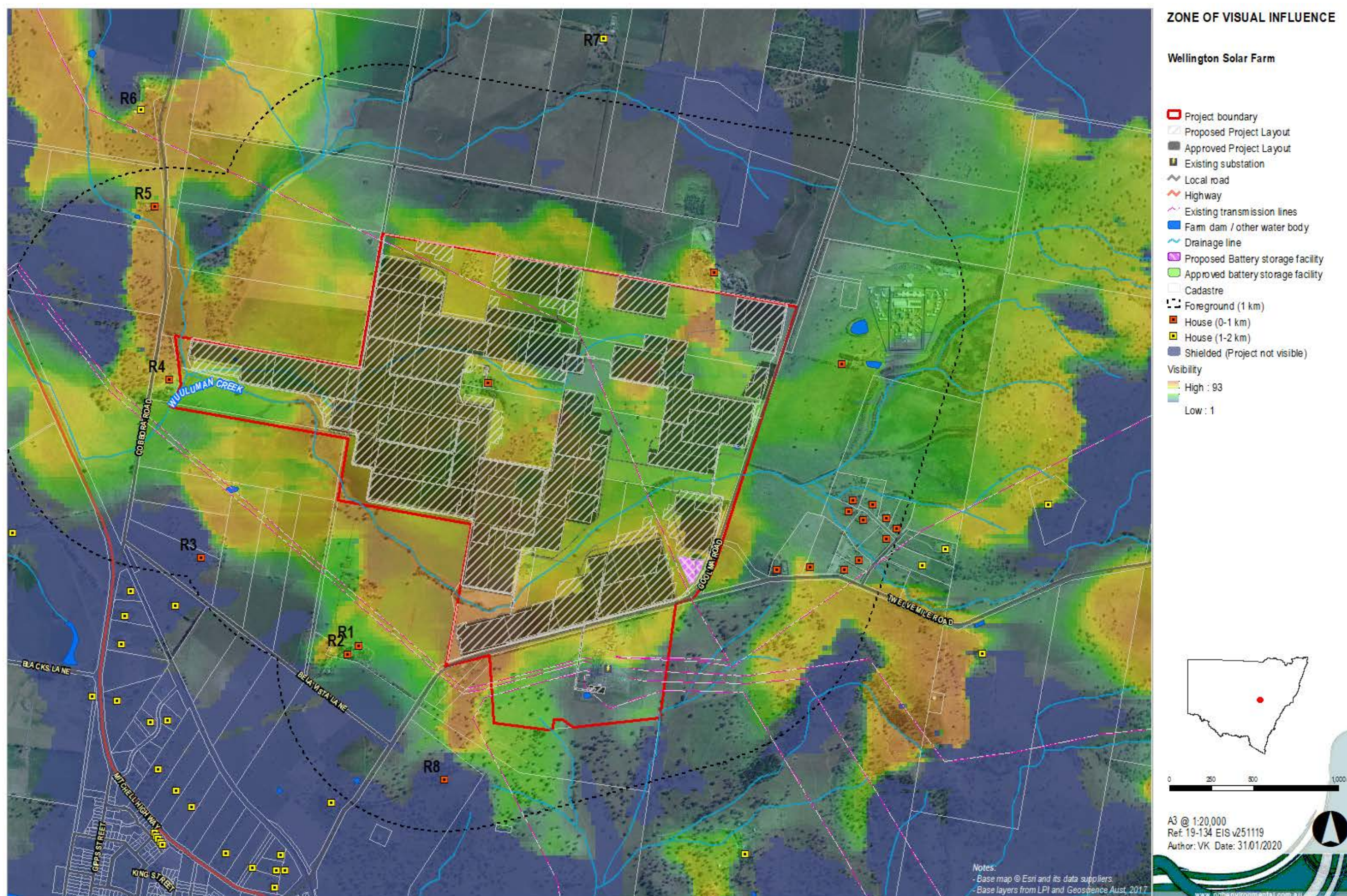


Figure 6-2 Location of residences in context of foreground of Zone of Visual Influence comparing the approved project layout to the proposed modified project layout (NGH, 2019).



### 6.2.2 Modification assessment

Senior consultant for NGH, Brooke Marshall, author of the Wellington Solar Farm VIA, investigated whether the proposed increase in panel area and expansion of the battery storage facility could result in a material environmental impact on landscape character and visual amenity.

Generally speaking, the expanded panel area and battery storage facility will not affect the view shed of the solar farm. Specifically, additional panels along Wuuluman Creek are in the lower landscape and would have limited additional impacts on receivers. Minor increases in the panel area around the central area of the site are unlikely to be perceived, when viewed in the context of existing approved layout. The remaining additional panel areas fill in the corners of the approved layout, rather than provide new areas of panels. The expansion of the battery storage facility is located within the same location as the approved battery storage facility and would not exceed 4 m in height (compared with solar panel height of 4.5 m). As such, expansion of the battery storage facility is unlikely to be perceived by sensitive receivers when compared with the approved layout. There is landscape planting (as detailed in the Landscape Management Plan) that would provide screening of views for road users of Goolma Road. The planned copse plantings identified in the Landscape Management Plan around the site access would be moved to the new location, 100m south.

Minor increases to the western edge of the site bring visual considerations closer to R4. There is a waterway and proposed landscape screening in this area, which will provide a visual buffer (as detailed in the Landscape Management Plan) to R4. Landscape screening within the Landscape Management Plan includes a requirement to establish one to two rows of sparse, native plantings, in keeping with the local native vegetation community including along the southern boundary of the site and north of R4 along Wuuluman Creek (refer Appendix A.2). As such, the expanded panel area is unlikely to have a dominant impact on the views from R4.

The visual impact resulting from the expanded panel area and battery storage area, with respect to R4 and vehicles travelling on Goolma Road, are summarised in Table 6-1 and Table 6-2 below.

Table 6-1 Visual impact at viewpoint representing vehicles travelling along Goolma Road.

VIEWPOINT ID 1		
Summary of Viewpoint		Viewpoint Description / Impact
LCU	Agricultural	The array infrastructure would be located immediately adjacent to Goolma Road for approximately 1.3 km. While a vegetation screen is located on the south of Goolma Road, little overstorey vegetation is present on the northern solar farm boundary. The solar infrastructure would be a new type of structure and contrast with the existing agricultural landscape character while adding some cumulative industrial visual impacts to the locality.
Scenic Quality	Moderate	
Proximity	Foreground <1 km	
Sensitivity	Low	
LMZ Objective	B	
Contrast	Indistinct	
Residual Visual Impact (after establishment of landscape planting required within LMP)	LOW	

Table 6-2 Visual impact at viewpoint representing R4.

VIEWPOINT ID 4		
Summary of Viewpoint		Viewpoint Description / Impact
LCU	Agricultural and rural residence	The Solar Farm is visible when travelling north on Cobbora Road. This view is considered indicative of two closest receivers to it, R3 and R4. Existing riparian screening will soften views from the road. Given the low lying infrastructure proposed and distance from the road (in excess of 400m), the contrast and impact would not be high for road corridor views.
Scenic Quality	Moderate	
Proximity	Foreground <1 km	
Sensitivity	Low	
LMZ Objective	B	
Contrast	Indistinct	
Residual Visual Impact (after establishment of landscape planting required within LMP)	LOW	

Replacement of overhead transmission line with underground transmission lines will reduce the visual impact on road users of Goolma Road and this is therefore an improvement in terms of visual amenity.

No additional impact relating to dust generation and light pollution would be associated with the modified layout. These are important considerations, as the Siding Spring Observatory is located approximately 130km south of the proposed Wellington Solar Farm.

No additional impact relating to dust generation and light pollution would be associated with the modified layout (Mod 2). These are important considerations, as the Siding Spring Observatory is located approximately 130km south of the proposed Wellington Solar Farm. The Dark Sky Region in NSW is centred upon the site of this observatory which is considered Australia's most important visible-light observatory. The Dark Sky Region Guidelines have been prepared to ensure the night sky is free of light pollution and increased levels of atmospheric dust which may impact on the observatory<sup>1</sup>. Impacts of dust and lighting, if any, as a consequence of the increased areas of panels and associated lesser number of piles per hectare would be negligible. No additional mitigation would be required.

Considering the currently proposed onsite perimeter vegetation screening, no additional areas of screening would be required for the modifications (this report, Mod 2) to the panel layout. The proposed perimeter screening is sufficient to break up views for motorists. Considering planting on private properties, the EIS commitments require mitigation of the 'as built layout' for R2 and R8, in consultation with landowners. R4 will also be consulted in this manner if panels remain in areas that bring the development closer to R4.

Given the factors above, it is considered that no significant changes to visual impact would result from the modified layout.

<sup>1</sup> Dust tends to scatter light and increase light pollution.

### **6.2.3 Recommendations**

In terms of managing impacts of the expanded footprint, the recommendations of the EIS and Conditions of Consent do not require alteration. However, it is recommended that:

- In consideration of screen planting on private properties, R4 should also be consulted regarding mitigation of the 'as built layout' if panels remain in areas that bring the development closer to R4.

The environmental safeguards proposed as part of the approved project are considered sufficient. Visual impacts generated as a result of this modification (Mod 2) will be mitigated by implementing the existing conditions of consent.

The environmental safeguards proposed as part of the approved project are considered sufficient.

## **6.3 NOISE AND VIBRATION**

### **6.3.1 EIS assessment**

A Construction and Operational Noise and Vibration Assessment for the Wellington Solar Farm was undertaken by Renzo Tonin and Associates. It included consideration of noise and vibration impacts from the construction and operation phases of the proposal.

Noise monitoring was undertaken at the closest residence (R1, monitored at L1 on Figure 6-3). Long term (unattended) noise monitoring was carried out at M1 to determine the existing background and ambient noise levels.

Based on the construction noise levels presented in the noise assessment, the construction management levels at receivers R1 and R7 were assessed as being exceeded when the construction works are conducted at closest proximity to the receivers. It was noted that there would be minimal construction occurring near R1 and that construction noise levels at all receivers are predicted to be less than the highly noise affected level of 75dB(A).

The assessment of operation noise levels predicted that noise levels at all nearby receivers would comply with the nominated criteria under all scenarios and meteorological conditions. The predicted operational noise levels were additionally assessed as being well below the sleep disturbance criteria of 45 dB(A).



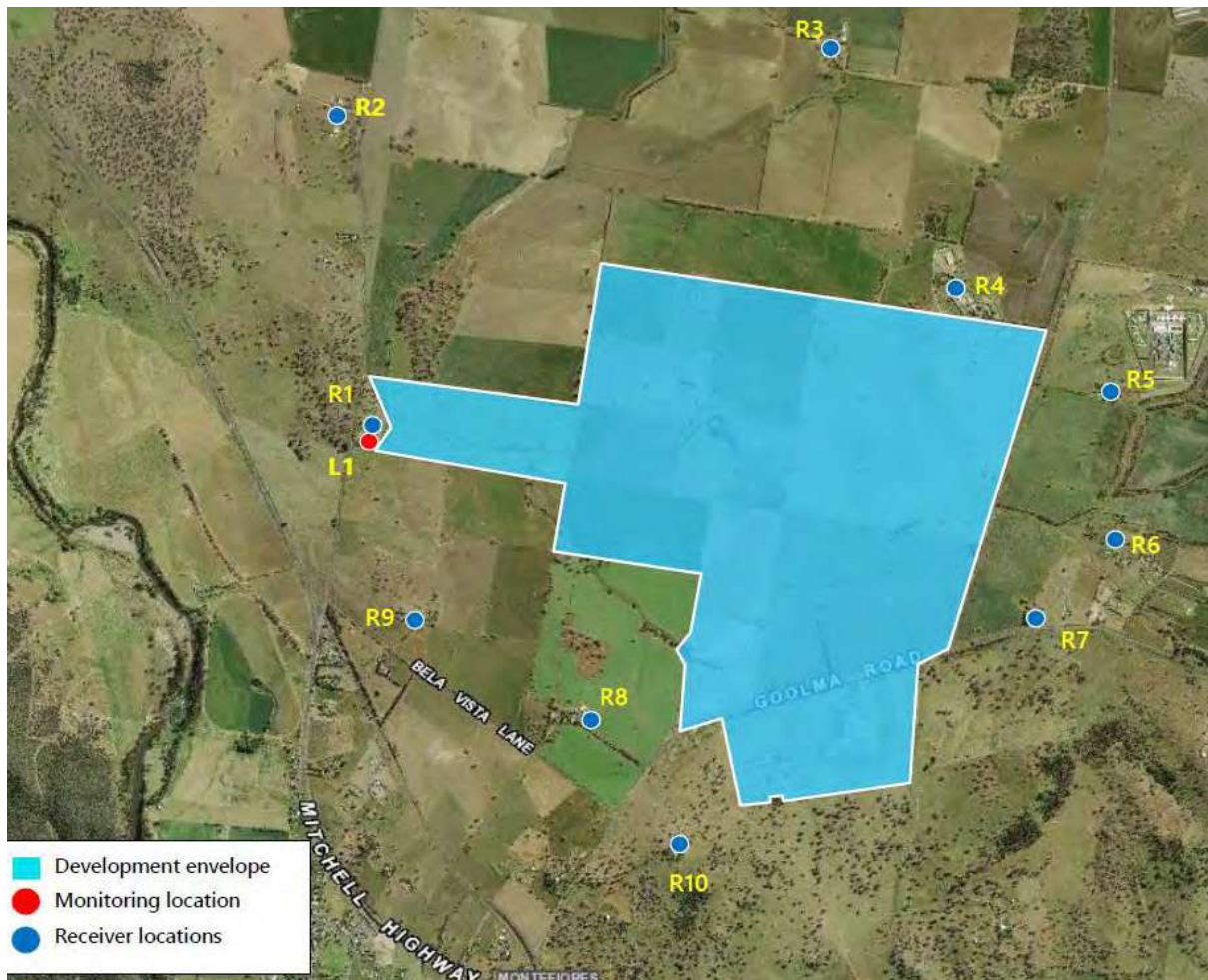


Figure 6-3 Residential receivers and noise monitoring locations (Renzo Tonin, 2017).

### 6.3.2 Modification assessment

Senior consultant for Renzo Tonin, William Chan, author of the Wellington Solar Farm Noise Impact Assessment, investigated whether the proposed increase in panel area could result in changes to the predicted environmental impact from noise and vibration. An additional investigation was undertaken by Michael Chung, Director of Renzo Tonin to clarify noise impacts relating to the proposed expanded battery storage facility, temporary construction compound, replacement of overhead transmission lines with underground cabling and relocated site access.

Given the reduced number of inverters associated with the expanded panel area (Mod 2), Renzo Tonin stated the operational noise would be lower than, or the same as, the previous predictions for all receiver locations. Operational noise was predicted to be compliant for the original layout so it is expected that the new design (Mod 2) will also be compliant.

Construction noise may vary slightly depending of the final footprint of the construction works, however, given the previous assessment already predicted exceedances when works are at close proximity to certain receivers. Given that the works will generally not be at the closest proximity the construction noise would comply for the majority of the construction phase.

In consideration of this advice, it is considered no changes to noise and vibration impacts will result from the modified layout (Mod 2).

### **6.3.3 Recommendations**

Noise impacts generated as a result of this modification (Mod 2) will be mitigated by implementing the existing conditions of consent.

The environmental safeguards proposed as part of the approved project are considered sufficient.

## **6.4 SOIL DISTURBANCE**

### **6.4.1 EIS assessment**

The EIS considered the solar panels would be comprised of approximately 440,000 First Solar thin film solar modules installed on a single-axis tracker in rows aligned in north south arrangement. Approximately 66,600 piles would be driven or screwed into the ground in order to support the solar array's mounting system and solar modules. The total footprint assumed was 282 ha of the 493 ha project site. This equates to around 236 piles per ha, resulting in a ground disturbance of 1.4% of the total development footprint (approximately 4 ha).

Underground cabling was proposed within the EIS at a depth of at least 500mm with the electrical reticulation buried to either 600mm (low voltage) or 800mm (high voltage) depth.

A soil survey was undertaken by DM McMahon Pty Ltd to verify soil and land capability. The report noted that the risk of erosion on site due to construction activities was considered low due to the very low relief and generally low salinity and sodicity of topsoils and subsoils. Limited excavation of subsoils, where possible, was recommended along with maintenance of ground cover around infrastructure to aid in the prevention of topsoil losses from wind erosion.

### **6.4.2 Modification assessment**

Under the Mod 2 layout, approximately 89,000 piles would be driven or screwed into the ground. The total footprint would now be 288 ha of the 493 ha project site. The updated layout of Mod 2 will result in approximately 306 piles per ha, a higher incidence of soil disturbance per ha. The ground disturbance from the piles equates to 1.8% of the total development footprint (approximately 5 ha). As such, the additional impact as a result of additional piles is considered manageable with the environmental safeguards of the approved project.

Ground disturbance relating to trenches for the installation of cables were also considered in the EIS. As part of this modification, LS BP proposes to replace the overhead transmission lines with underground cables. Additional ground disturbance due to trench excavation would occur to a depth between 500 mm and 800 mm. The underground cabling would be located within the road corridor, which would already be subjected to vegetation and topsoil removal, thus resulting in no additional impact.

Panels would now be placed in closer proximity to waterways in some locations. This is considered more specifically in Section 6.5.

### **6.4.3 Recommendations**

Soil impacts generated as a result of this modification will be mitigated by implementing the existing conditions of consent.

The environmental safeguards proposed as part of the approved project are considered sufficient.

## 6.5 FLOODING

### 6.5.1 EIS assessment

A Hydrological and Hydraulic Analysis Report was prepared by Footprint NSW Pty Ltd and included in the EIS to assess potential impacts of the proposal on existing hydrological conditions of the Wellington Solar Farm site. Additional modelling by Footprint NSW Pty Ltd was also undertaken as part of the Submissions Report (NGH 2018) in response to queries regarding flood behaviour.

Footprint NSW Pty Ltd noted that construction of the solar farm would not substantially affect landforms or watercourses at the site and existing flood patterns are unlikely to be affected. Parts of the site were assessed as being at risk of temporary minor flooding during high rainfall events and high flows through Wuuluman Creek, particularly within the low relief areas of the site.

During operation, the report noted that the solar farm would slightly increase flood levels at the site due to the installation of the solar frame piles. The addition of the solar frame piles and their associated infrastructure would result in an increase in surface roughness over the proposal site, from grazed/cropped pasture to a regular grid of steel piles. The hydrology report indicated that an increase in surface roughness would produce localised increases in flood levels in the vicinity of the panels.

While the report recommended that in some areas, increased mounting spans should be considered, the overall assessment concluded no significant impact on flood behaviour within the floodplain as a result of the infrastructure proposed. Flood levels and depths are predicted to remain relatively unchanged. Further, the proposed works and infrastructure installation were not anticipated to adversely increase the velocity in any of the watercourses or their associated overbanks, therefore ensuring the stability of their bed and banks and minimising erosion potential.

### 6.5.2 Modification assessment

Senior consultant for Footprint Pty Ltd, Ashley Bond, author of the Wellington Solar Farm Hydrological and Hydraulic Analysis, investigated whether the proposed increase in panel area could result in changes to the predicted environmental impact on flood behaviour. The investigation included remodelling of the Mod 2 layout and comparing this to the approved layout (modelling results provided in full, Attachment B.1).

The results of the proposed solar array layout were compared to those of the approved layout and the change in maximum flood levels between the two sets of results are included in Figure 6-4.

The results generally show a slight reduction in maximum flood levels over the site and particularly within the Wuuluman Creek overflow channel due to the slight reduction in encroachment of the proposed array field into this area.

Some minor increases in maximum flood level (up to about 20 mm) are shown to occur elsewhere on the site due to the proposed solar array field encroaching slightly further into flood affected area compared with the approved layout.

Overall the results demonstrate that the proposed modification (Mod 2) to the solar array field are not anticipated to result in any greater flood impact than the previous layout.



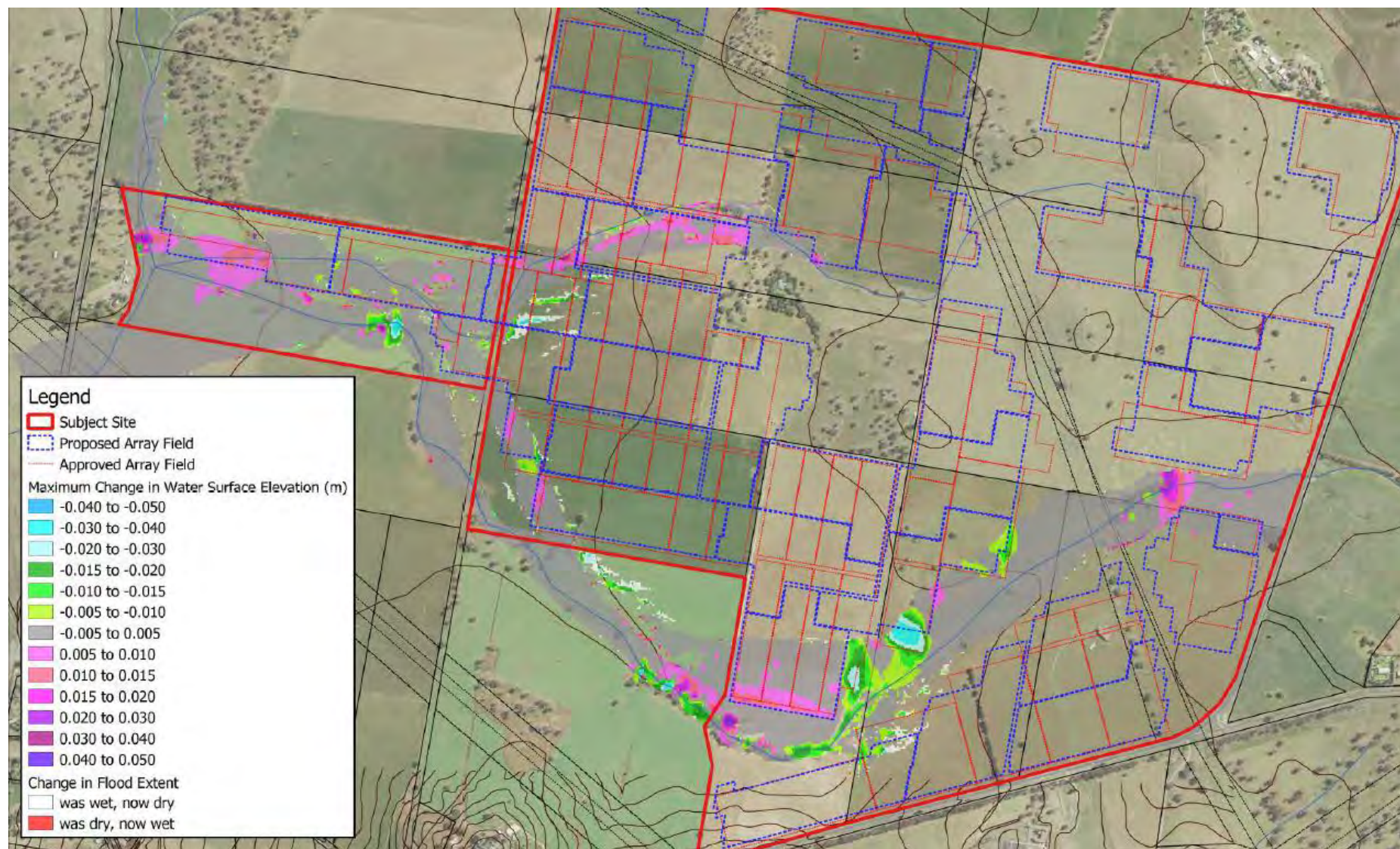


Figure 6-4 Figure 6 4 Comparison to approved layout 1% Annual Exceedance Probability, post development results (Footprint 2019).

### 6.5.3 Recommendations

Flooding impacts generated as a result of this modification will be mitigated by implementing the existing conditions of consent.

The environmental safeguards proposed as part of the approved project are considered sufficient.

## 6.6 BIODIVERSITY

### 6.6.1 EIS assessment

In 2017, a specialist Biodiversity Assessment Report (BAR) was prepared by NGH as part of the EIS to investigate and assess the potential impacts of the Wellington Solar Farm on biodiversity. The BAR was originally assessed under the now repealed NSW Framework for Biodiversity Assessment (FBA) transitional arrangement under the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*. An application for 'reasonable equivalence' was made to convert the credits approved to the new *Biodiversity Conservation Act* (BC Act) scheme.

This Modification (Mod 2) layout changes, biodiversity considerations and subsequent offsets are shown in Figure 6-4. Figure 6.4 outlines the comparison of the impact area approved as part of Mod 1 and the current proposed impact area (Mod 2).

### 6.6.2 Modification assessment – MOD 1

At the time of MOD 1, as this legislation was repealed, the Biodiversity Assessment Methodology (BAM), NSW Biodiversity Offsets Scheme prescribed by the NSW *Biodiversity Conservation Act 2016* applied and a BDAR was prepared to assess a small area of additional clearing. MOD 1 was approved on December 11, 2019 to extend TransGrid's Wellington Substation.

The currently approved SSD project therefore has a credit requirement calculated under the 'Framework for Biodiversity Assessment' and subsequently converted using an application for reasonable equivalence to credits under the BC Act as well as a supplementary credit requirement calculated under the BC Act for an expansion to the existing Wellington substation under MOD 1.

### 6.6.3 Modification assessment – MOD 2

A second Modification Application (MOD 2), was prepared to alter the indicative solar panel layout presented in the EIS. However, the entire project has *not* been reassessed under the BC Act, as this would have led to unnecessary duplication of assessment for areas that remain impacted in the new layout. These areas are already included in the reasonable equivalence credit profile. To account for new areas to be impacted and areas where impacts would now be avoided, the Biodiversity Assessment Method (BAM), pursuant to the BC Act, was applied to these 'additional' and 'excised' areas only. The *net* impact therefore becomes the updated project credit requirement.

The aim of the MOD 2 BDAR is to:

- identify, assess and derive the credit number for the additional areas now being impacted by the solar farm footprint, that were not impacted by the approved footprint (shown in red in Figure 6-5)
- identify, assess and derive the credit number for the areas that will now be removed from the approved solar farm footprint (areas that *were* impacted but are now excised from the approved footprint; shown in blue in Figure 6-5).
- Reconcile the credit requirement of the original SSD approvals, MOD 1 and this proposed MOD 2 to give one updated credit requirement for the Wellington Solar Farm project.

This BDAR has been prepared to support the MOD 2 for submission to Department of Planning Infrastructure and Environment.

### **Ecosystem credits**

In terms of the impacts on vegetation and the generation of ecosystem credits, the changes proposed in MOD 2 compared with the approved footprint are summarised as follows:

- An overall additional impact of 0.02 ha of PCT 277 White Box Yellow Box Blakely's Red Gum woodland. This generates no credits;
- An overall reduced impact of 6.90 ha of mapped Plant Community Type (PCT) 266 – White Box grassy woodland in the upper slopes sub-region of NSW South Western Slopes. Zones 2 and 4, together now generate 3 credits for the project. For Zones 3, 5 and 6, the net effect is zero credits;
- An overall additional impact of 15.43 ha of exotic vegetation. This generates no credits.



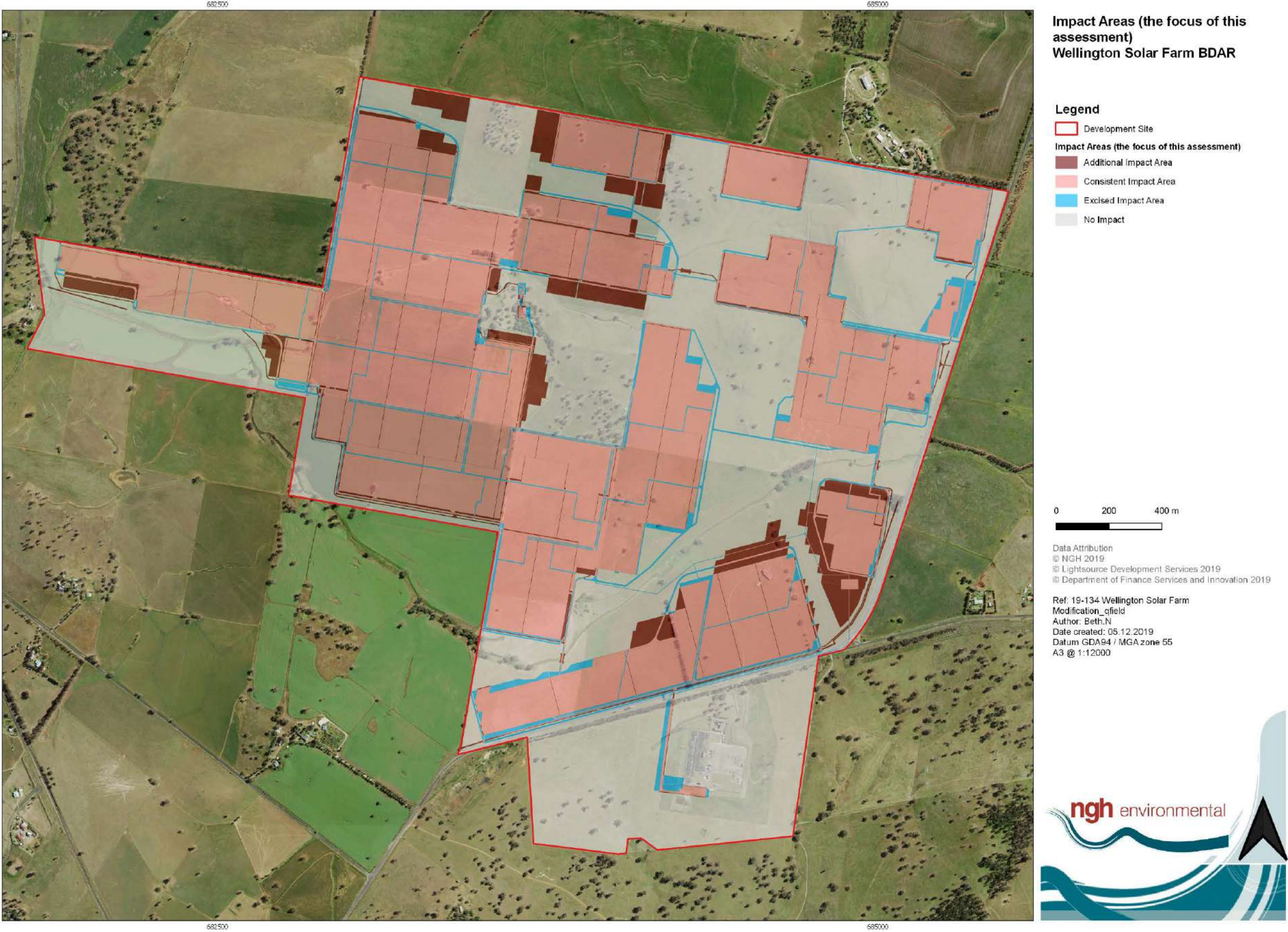


Figure 6-5 Final project development footprint, showing areas added and excised (the focus of this assessment for MOD 2)



The changes to the development footprint have resulted in an overall reduction in native vegetation being impacted and therefore a reduced credit requirement. Even though there is an overall increase in clearing, the impacts to exotic/planted areas did not generate credits. This has resulted in the footprint increasing in size but the biodiversity impacts and offset requirement being reduced.

The following details the ecosystem credits generated for the additional and excised areas for each vegetation zone for MOD 2. The net credit requirement that now applies the project is summarised in the righthand column. Note: as the areas that are now being excised in Zones 3, 5 and 6 represent more credits than the areas now being added, the net result is that there will be no credits required to be retired in these zones.

Table 6-3 Net ecosystem credits generated from SSD, Mod 1 and Mod 2

Zone	PCT and structure	Condition	Approved Credit Requirements		Credits Requirements Mod 2 (this report)		Updated credit requirement
			Original Approval SSD8573 (converted via reasonable equivalence)	Mod 1	Additional area credits	Excised area credits	Net
PCT 277							
Zone 1	PCT 277 woodland	low condition	0	0	0	0	0
PCT 266							
Zone 2	PCT 266 planted woodland	moderate to good condition	0	1	0	0	1
Zone 3	PCT 266 woodland	low condition	1	0	+1	-2	0
Zone 4	PCT 266 woodland	moderate to good condition (hollow bearing trees present)	1	0	+1	0	2
Zone 5	PCT 266 derived grassland	moderate to good condition	0	0	+1	-5	0 (-4)
Zone 6	PCT 266 derived grassland	low condition	0	0	+64	-129	0 (-65)

### Species credits

Targeted flora surveys were undertaken for candidate flora species where habitat elements were known to exist onsite. Of the flora species surveyed, none were found during targeted surveys.



The majority of fauna candidate species identified in the BAM calculator were excluded from further assessment due to a lack of suitable habitat available onsite. For the remainder, due to time constraints, fauna surveys were not conducted for species that had not been previously assessed such as the Stone-curlew, Gang-gang Cockatoo, White-bellied Sea-eagle, Square-tailed Kite, Little Eagle and Superb Parrot. These were all assumed to be present and appropriate credits generated. Other fauna surveyed in 2016 and 2017 had sufficient data to exclude them.

In regard to Species Credit Species for MOD 2, there is one additional credit required for the Gang-gang Cockatoo and one additional credit required for the Superb Parrot, otherwise there are no additional impacts to species credit species due to less impacted areas than excised areas. Note: as the areas that are now being excised represent more species credits than the areas now being added for the White-bellied Sea-Eagle, Square-tailed Kite and Little Eagle, the net result is that there will be no credits required to be retired for these species.

Table 6-4 Updated (and net) species credit species generated for the project.

Species	Approved Credit Requirements		Change in credits Mod 2 (this report)		
	Original Approval	Mod 1	Additional areas	Excised areas	Updated project requirement (net)
Gang-gang Cockatoo	0	0	+1	0	1
White-bellied Sea-Eagle	0	0	+1	-2	0 (-2)
Square-tailed Kite	0	0	0	-2	0 (-2)
Little Eagle	0	0	0	-2	0 (-2)
Superb Parrot	0	0	+1	0	1
Pink-tailed Legless Lizard	0	2	0	0	2

#### 6.6.4 Offsets required under the EPBC Act

Assessment against EPBC was conducted in relation to the Corben's Long-eared Bat, and Superb Parrot to determine whether a referral to the Commonwealth was necessary. No referral or offsets are required under the EPBC Act. Further information about EPBC matters are summarised in Appendix B of the BDAR report NGH 2019).

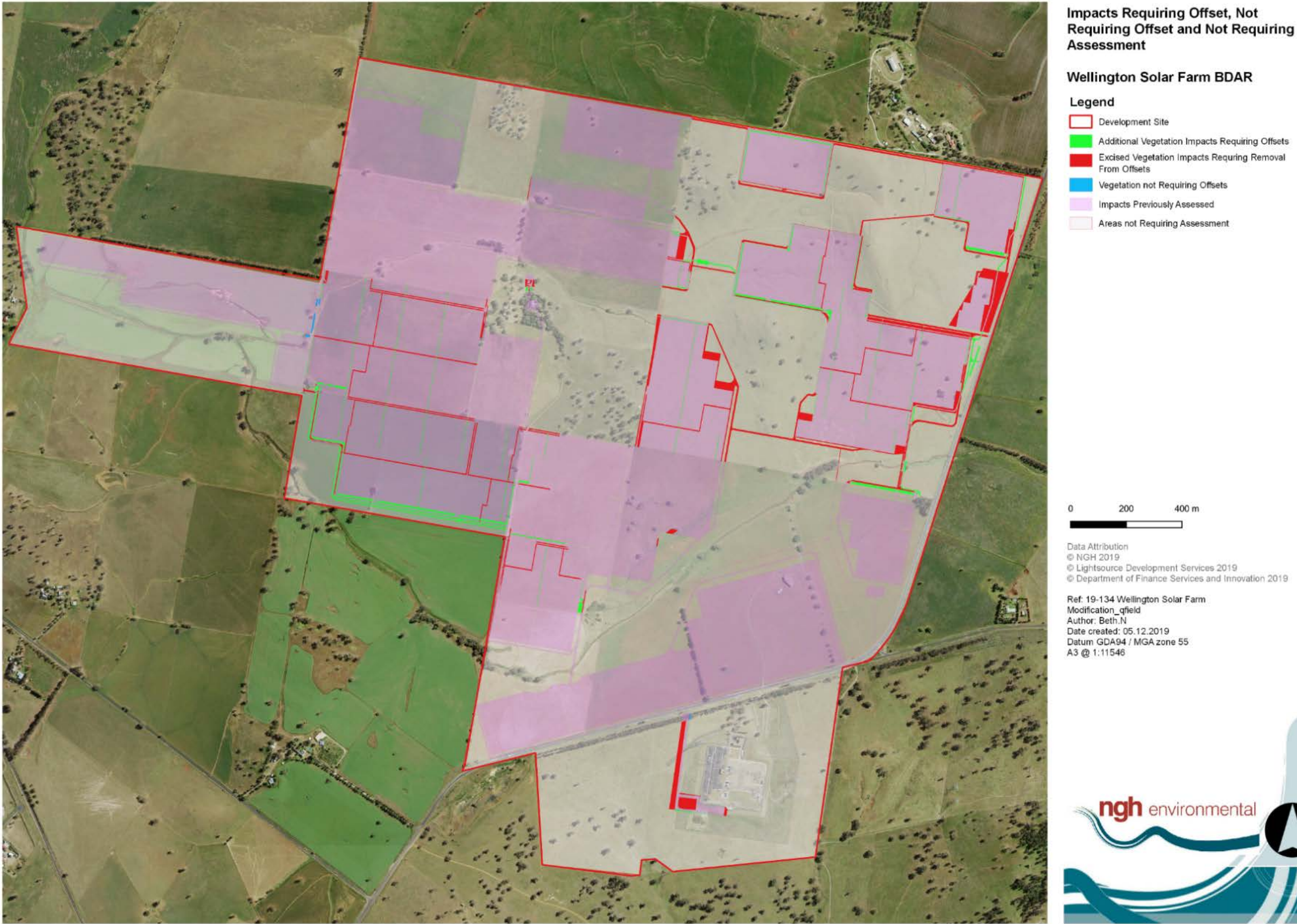


Figure 6-6 Impacts requiring offset, not requiring offset and not requiring assessment (NGH, 2019).



### 6.6.5 Recommendations

The net credit requirement for the Wellington Solar Farm is:

- 1 ecosystem credit for PCT 266 planted woodland
- 2 ecosystem credits for PCT 266 woodland moderate to good (with hollow bearing trees)
- 1 species credit for Gang Gang
- 1 species credit for Superb Parrot
- 2 species credit for Pink-tailed Legless Lizard

Mitigation and management measures are proposed to adequately address impacts associated with the proposal, both directly and indirectly. The retirement of the updated credit requirement is proposed to be carried out in accordance with the NSW Biodiversity Offsets Scheme and will be achieved by either:

- a) Retiring credits under the Biodiversity Offsets Scheme, or
- b) Making payments into the Biodiversity Conservation Fund using the offset payments calculator, or
- c) Funding a biodiversity action that benefits the threatened entity impacted by the development.

## 7 CONDITIONS OF CONSENT

With reference to the conditions of consent for the project, (Development Consent, 25 May 2018), no conditions were identified that could not be met, should the modified layout presented in Appendix A.2 be adopted. However, two items were identified for further discussion.

In the Definitions section of the consent, 'Development footprint' is defined as:

*The area within the project site on which the components of the project will be constructed.*

A map of the project boundary, indicative infrastructure layout and specific exclusion zones is contained in Appendix A.1 of the Conditions of Consent. However, the development footprint is not shown here.

That the final constructed layout would be different from that shown in the EIS and subsequent approval is implicit in the EIS however, the modified layout is now approximately 29 ha greater (9% greater) than that shown.

The Administrative conditions required that:

*The Applicant must carry out the development:*

*Generally in accordance with the EIS; and*

*In accordance with the conditions of this consent.*

*Note: The general layout of the development is shown in Appendix 1.*

The modified layout is within the project boundary and still avoids the specific exclusion zones mapped on the approval. The impacts of the panel area increase have been assessed in Section 6 and found to be negligible. As such, we have demonstrated that the project remains generally in accordance with the EIS. No change to any part of the approval is requested.

## 8 CONCLUSION

This assessment outlines the Proponent's proposed modification (Mod 2) for the development of the approved Wellington Solar Farm. The modifications to the Development Consent proposed in this report are required to deliver an efficient, constructible and commercially viable project, minimising environmental impacts to the extent practically and reasonably feasible.

The key benefits of the modifications to Development Consent would be:

- Increased energy generation through the use of bifacial solar panels.
- Reduced native vegetation impact including 6.90 ha of PCT 266 – White Box grassy woodland in the upper slopes sub-region of NSW South Western Slopes.
- Maximised use of previously unused areas.
- A slight overall reduction in maximum flood levels across the site.
- Reduced visual impact through removal of proposed overhead powerlines and of use of underground cabling instead.

This Modification Application (Mod 2) demonstrates that there will be an equivalent environmental impact to that assessed and that the modification is justifiable and able to be approved.

## 9 REFERENCES

NGH, 2019, *Modification Application – substation extension*, Wellington Solar Farm. Report prepared for Lightsource BP in October 2019.

NGH, 2019, *Biodiversity Management Plan*, Wellington Solar Farm. Report prepared for Lightsource BP in April 2019.

NGH, 2018, *Submission Report*, Wellington Solar Farm. Report prepared for First Solar in March 2018.

NGH, 2017, *Environmental Impact Statement*, Wellington Solar Farm. Report prepared for First Solar in November 2017.

Ryvan Khan, M., Hanna, A., Xingshu, S., and Ashraful Alam, M., 2017, *Vertical bifacial solar farms: Physics, design, and global optimisation*, accessed April 2018, from

<https://www.sciencedirect.com/science/article/pii/S0306261917310589?via%3Dihub#!>

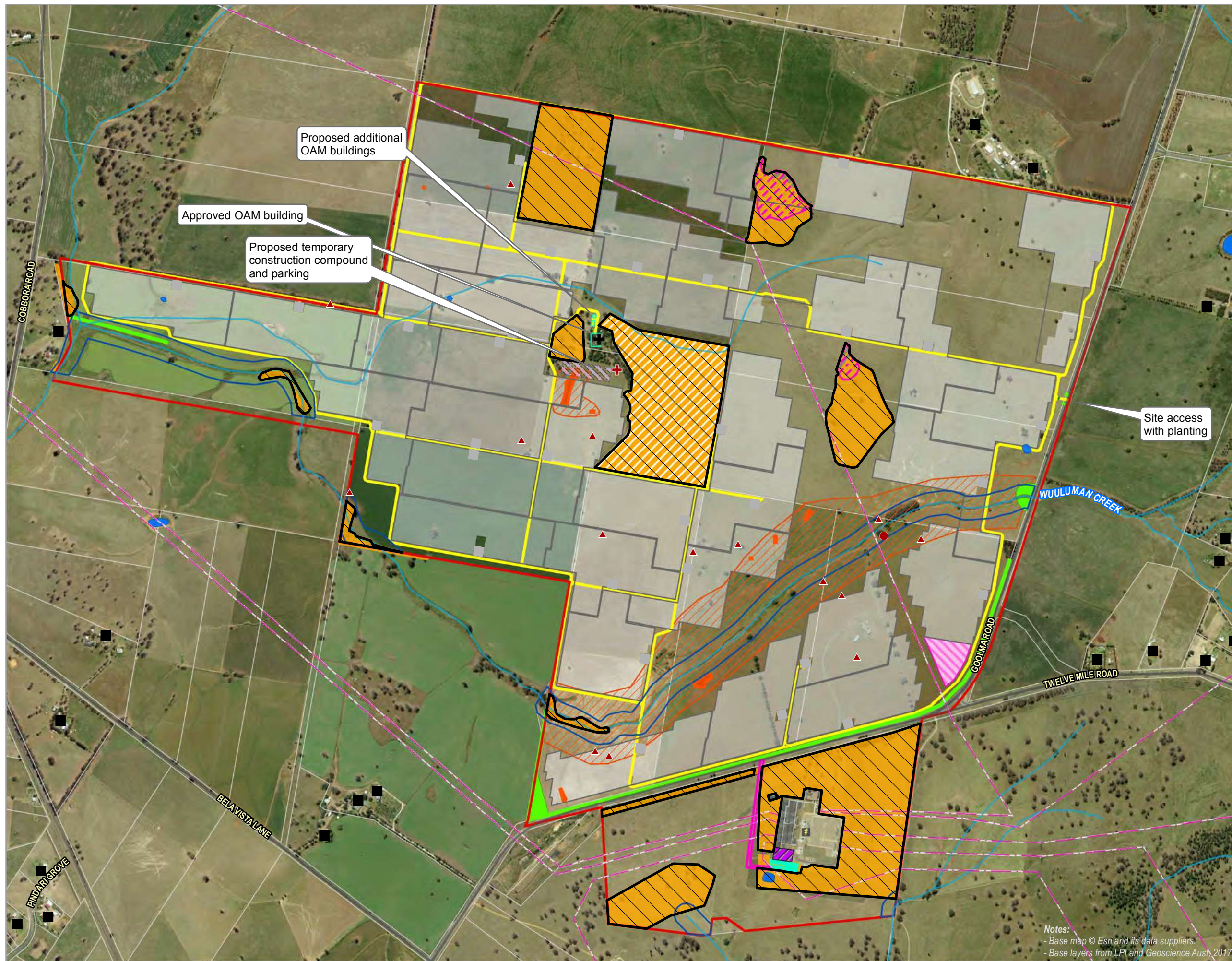
Xingshu, S., Ryvan Khan, M., Deline, C and Ashraful Alam, M., 2018, *Optimisation and performance of bifacial solar modules: A global perspective*, accessed April 2018, from

<https://www.sciencedirect.com/science/article/pii/S0306261917317567?via%3Dihub>

## **APPENDIX A PROJECT LAYOUT AND TECHNOLOGY**

### **A.1 MODIFIED LAYOUT (MOD 2)**

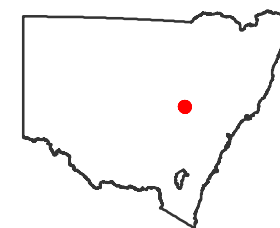




## GENERAL LAYOUT OF DEVELOPMENT

### Wellington Solar Farm

- Development exclusion zone (excluding rehabilitation undertaken in accordance with the Biodiversity Management Plan)
- Project boundary
  - Existing substation
  - Local road
  - Highway
  - Existing transmission lines
  - Farm dam / other water body
  - Drainage line
  - Drainage line 40m buffer
  - Access gate
- Approved infrastructure**
- Landscaping (5m wide planting)
  - Approved landscaping grove
  - Existing homestead/Approved OAM
- Proposed infrastructure**
- Proposed battery storage area
  - Proposed temporary laydown area and parking / turning circle
  - Proposed internal road/underground transmission line
  - Proposed array/inverter layout
  - Inverter
  - Proposed inverter blocks
  - Proposed underground transmission line corridor
  - Proposed substation bench
  - Proposed substation expansion
  - Proposed OAM building
- Constraints**
- Aboriginal heritage item (isolated find)
  - Aboriginal heritage item (artefact scatter)
  - Hearth site
  - Potential archaeological deposit (PAD)
  - Scarred tree
  - Historic heritage site (OAM building)
  - Sensitive receiver
  - Potential rocky outcrops
- Vegetation exclusion zones**
- Vegetation constraint (CEEC)
  - Vegetation constraint (EEC moderate to good condition)
  - Cadastre



0 100 200 400 m

A3 @ 1:12,500  
Ref: 19-134 EIS v251119  
Author: VK Date: 26/11/2019

Notes:  
- Base map © Esri and its data suppliers.  
- Base layers from LPI and Geoscience Aust. 2017.

[www.nghenvironmental.com.au](http://www.nghenvironmental.com.au)

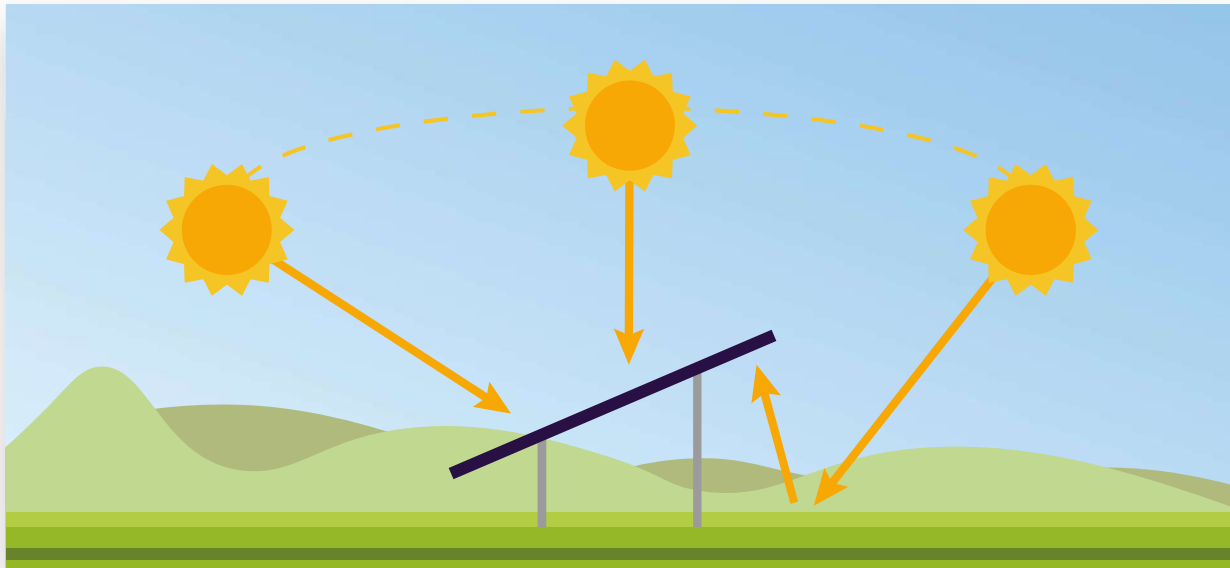


## **A.2 BIFACIAL EXPLAINER**



# BIFACIAL PANELS: A NEW STAR IN THE SOLAR SYSTEM

Lightsource BP, along with many other solar developers across the world, are now building sites with cutting-edge bifacial panel technology, designed to increase the amount of electricity produced.



*How bifacial solar panels work*

## What are bifacial panels?

These new panels work in essentially the same way as the standard, widely-used monofacial solar modules. However, instead of being backed with plastic, the rear surface of the modules is a sheet of clear glass. This allows any daylight, direct or reflected, that falls on to either the front or the back of the module, to be converted into electricity.

## Will solar installations using bifacial panels look different?

From a visual perspective, bifacial panels look largely the same as standard panels. New bifacial solar installations will be almost indistinguishable from existing ones using monofacial panels.

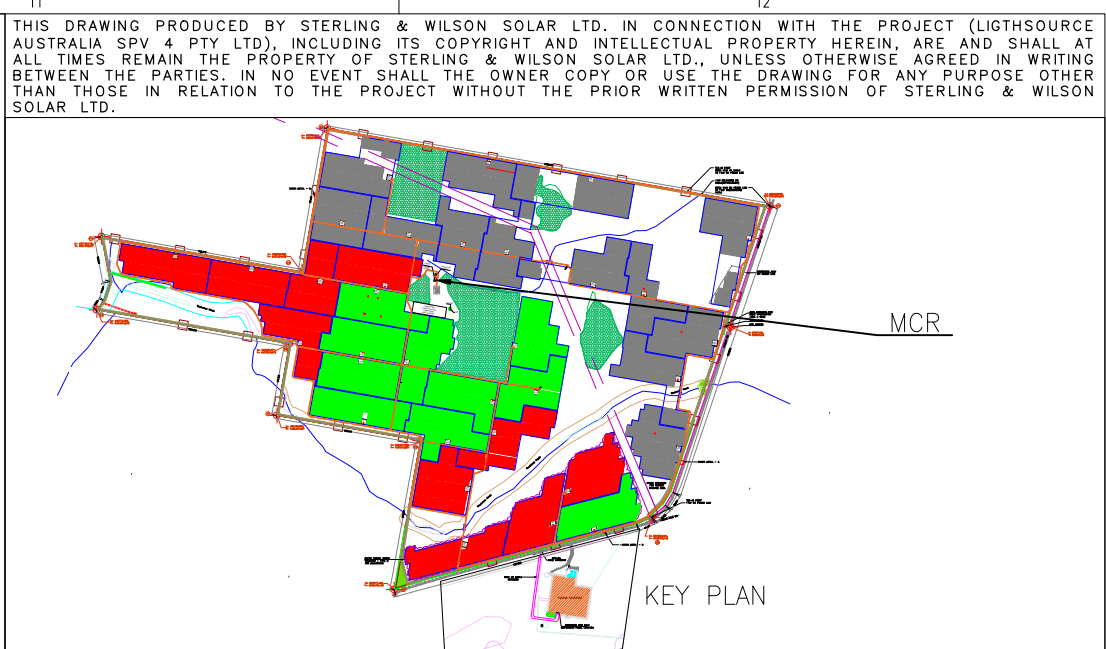
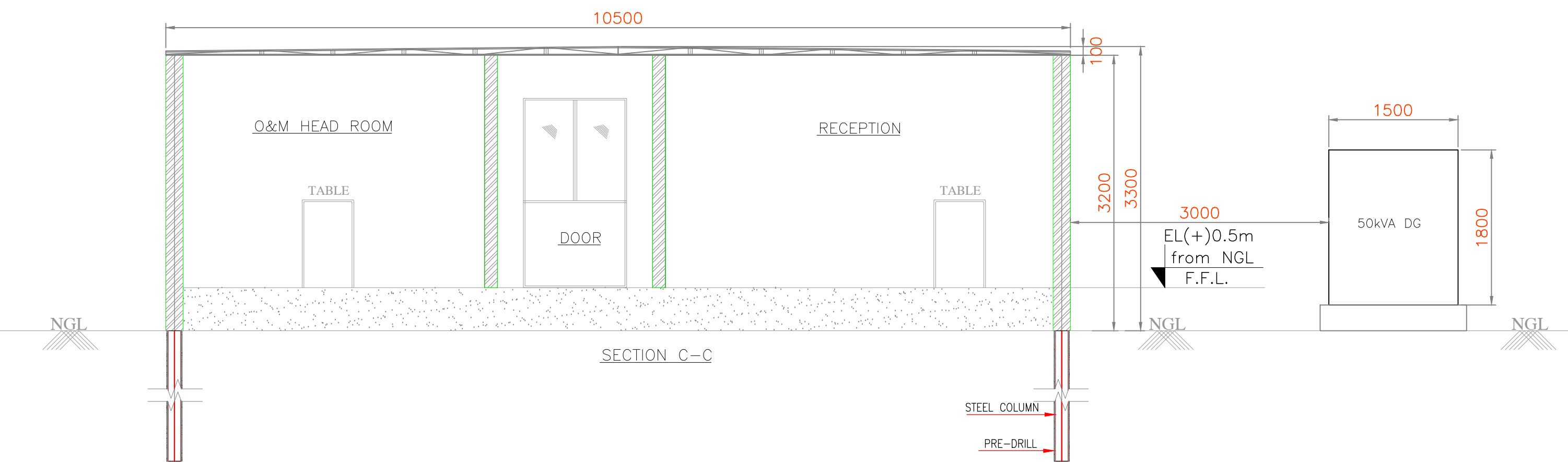
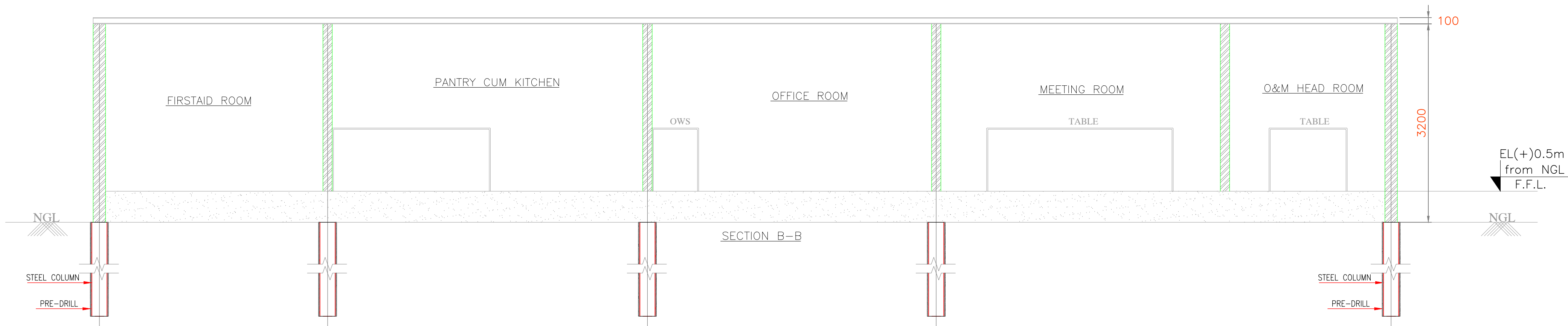
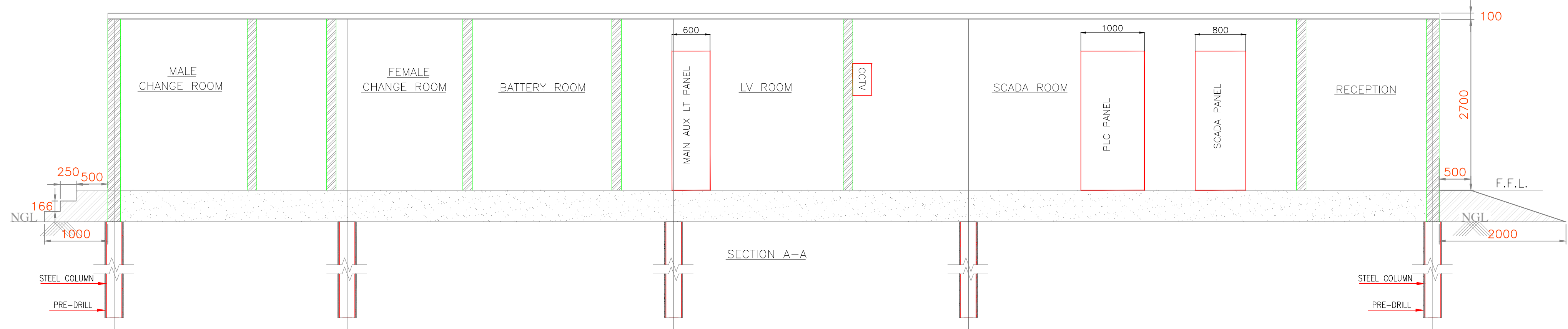
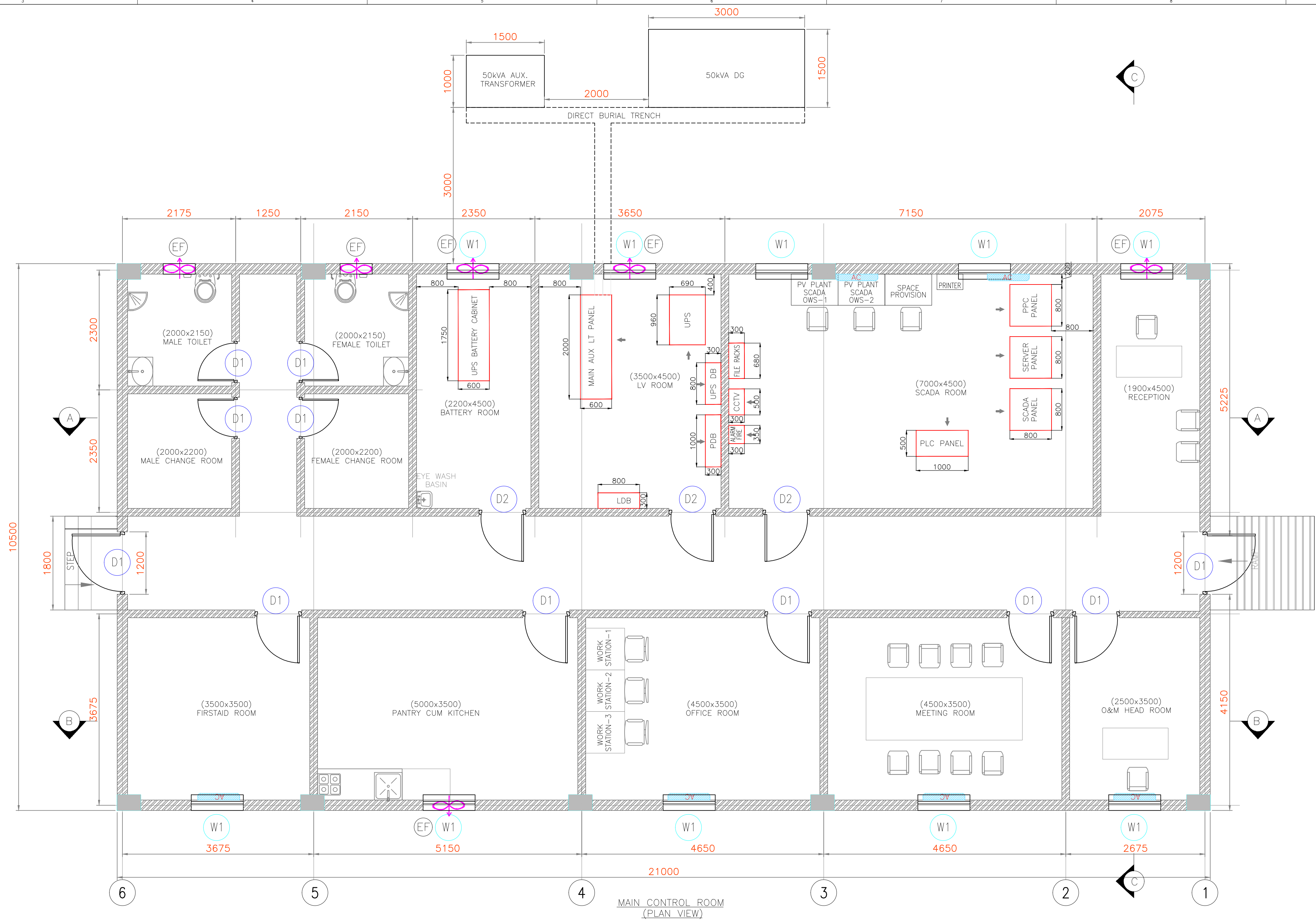
## Why not just use normal panels?

Because bifacial panels can generate electricity on both sides, they are an excellent way to increase the productivity of a site. Our initial research suggests that this new technology could increase the amount of renewable energy generated by at least 8%, but figures from researchers worldwide have been as high as 15%!

## Will this affect the design of our solar installations?

One of the many advantages of bifacial panels is that they don't require any additional infrastructure or other significant changes to standard design or operation of a solar installation – they're more effective and produce more electricity than standard monofacial panels.

## **APPENDIX B OPERATIONS AND MAINTENANCE FACILITY PLANS**



LEGENDS:-				
SL NO.	SYMBOL	DESCRIPTION	QTY	UNIT
01	AC	AIR CONDITIONER (1T)	06	NO'S
02	EF	EXHAUST FAN	06	NO'S
03	D1	DOOR	11	NO'S
04	D2	FIRE RESISTANCE DOOR (FRD)	03	NO'S
05	W1	WINDOW	10	NO'S

EQUIPMENT DETAILS:-				
SL NO.	DESCRIPTION	DIMENSIONS (LxWxH In mm)	WEIGHT (kg)	QTY (Nos)
01	PPC PANEL	800x800x600	-	01
02	SERVER PANEL	800x800x2100	-	01
03	SCADA PANEL	800x800x2100	-	01
04	PLC PANEL	800x800x2100	-	01
05	FIRE ALARM PANEL	500x300x500	-	01
06	CCTV PANEL	500x300x500	-	01
07	POWER DB	1000x300x900	-	01
08	LIGHTING DB	800x300x900	-	01
09	UPS DB	800x300x900	-	01
10	UPS	690x960x600	-	01
11	MAIN AUX LT PANEL	2000x600x2100	-	01
12	UPS BATTERY CABINET	1750x600x600	-	01

NOTE: EQUIPMENT FINAL DIMENSIONS SHALL BE UPDATED AS PER MANUFACTURER'S APPROVED DRAWINGS.

ABBREVIATIONS:-  
EF - EXHAUST FAN  
PPC - POWER PLANT CONTROLLER  
PLC - PROGRAMMABLE LOGIC CONTROLLER  
PDB - POWER DISTRIBUTION BOARD  
LDB - LIGHTING DISTRIBUTION BOARD  
AC - AIR CONDITIONER  
UPS - UNINTERRUPTED POWER SUPPLY  
FPL - FINISHED FLOOR LEVEL  
NGL - NATURAL GROUND LEVEL  
SCADA - SUPERVISORY CONTROL AND DATA ACQUISITION

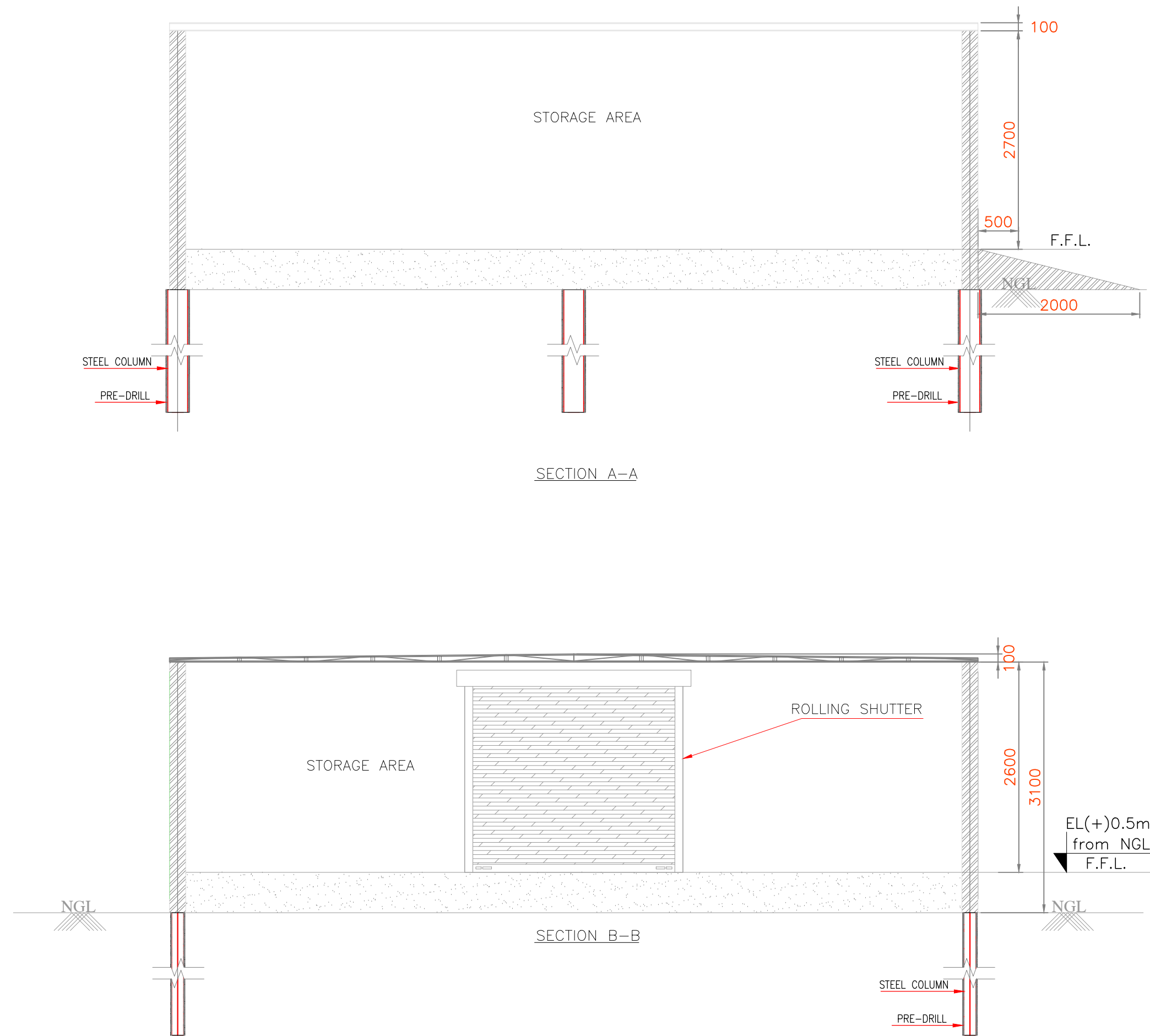
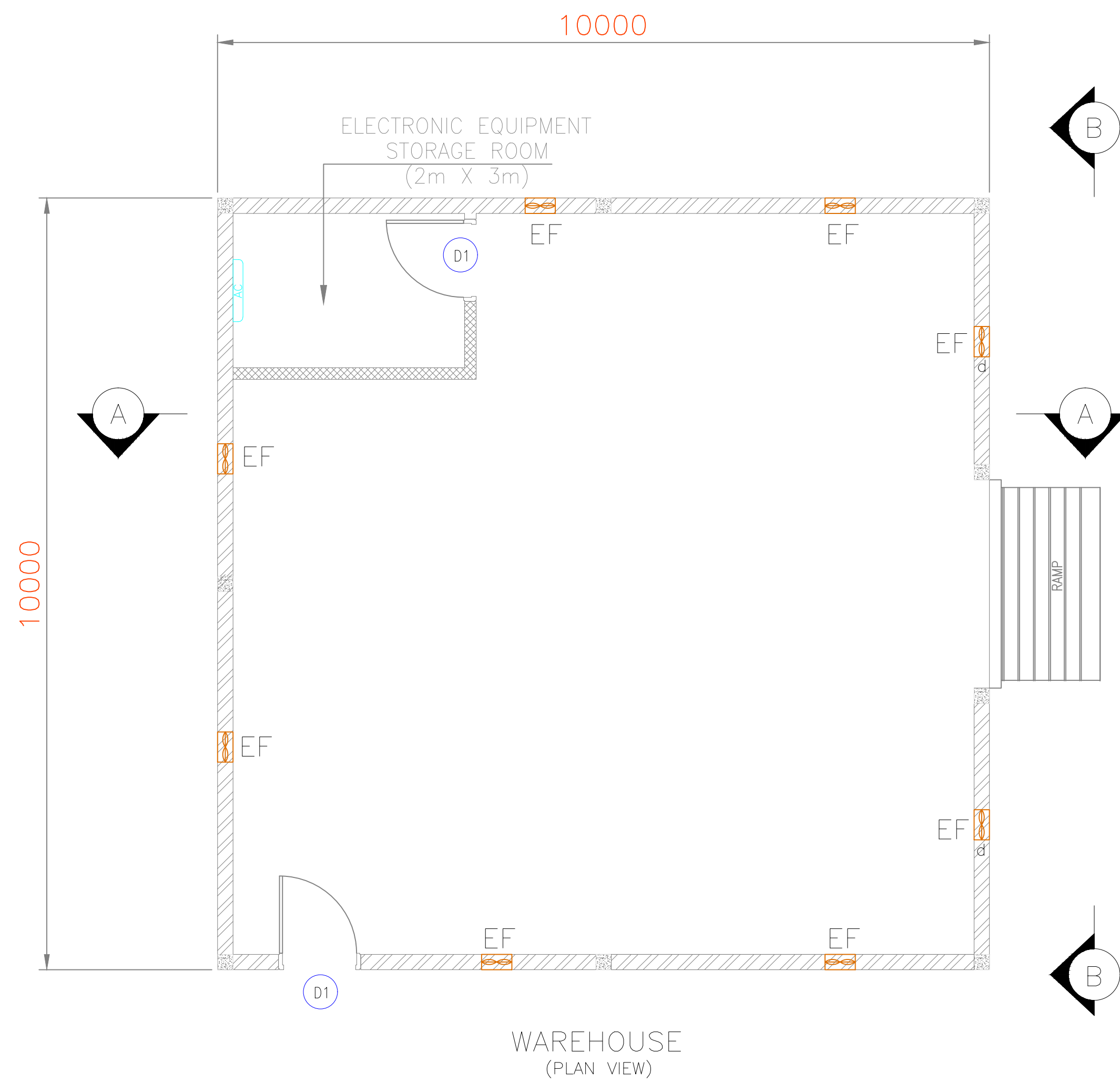
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2. FOR CIVIL DETAILS, REFER RELEVANT CIVIL ARCHITECTURAL DRAWINGS.  
3. FOR FIRE ALARM DETAILS, REFER RELEVANT FIRE ALARM DRAWINGS.  
4. CLEARANCES MARKED ARE THE "MINIMUM ELECTRICAL CLEARANCES REQUIRED".  
5. HEIGHT OF THE DOORS SHALL BE 2.2m FOR ALL PANELS/EQUIPMENT ROOMS.  
6. 300MM MINIMUM CLEARANCE SHALL BE MAINTAINED FROM TOP OF THE PANELS TO BOTTOM OF THE ROOF BEAM.  
7. ALL DOOR IN IN THE SWITCHGEAR ROOM SHALL BE OF FIRE PROOF AND RATED FOR A PERIOD OF ONE HOUR.  
8. THIS DRAWING IS ONLY FOR EQUIPMENT ARRANGEMENT & SEPARATE DRAWING SHALL BE REFERRED FOR CABLE ROUTING, EARTHING, LIGHTNING PROTECTION AND ROOM ARCHITECTURE.  
9. BUILDING SHALL BE PRE-ENGINEERED AND PORTABLE TYPE AS PER STANDARD LOCAL PRACTICE.  
10. DETAILS MENTIONED IN THIS DRAWING ARE SUBJECT TO CHANGE AS PER FINAL VENDOR DRAWING.

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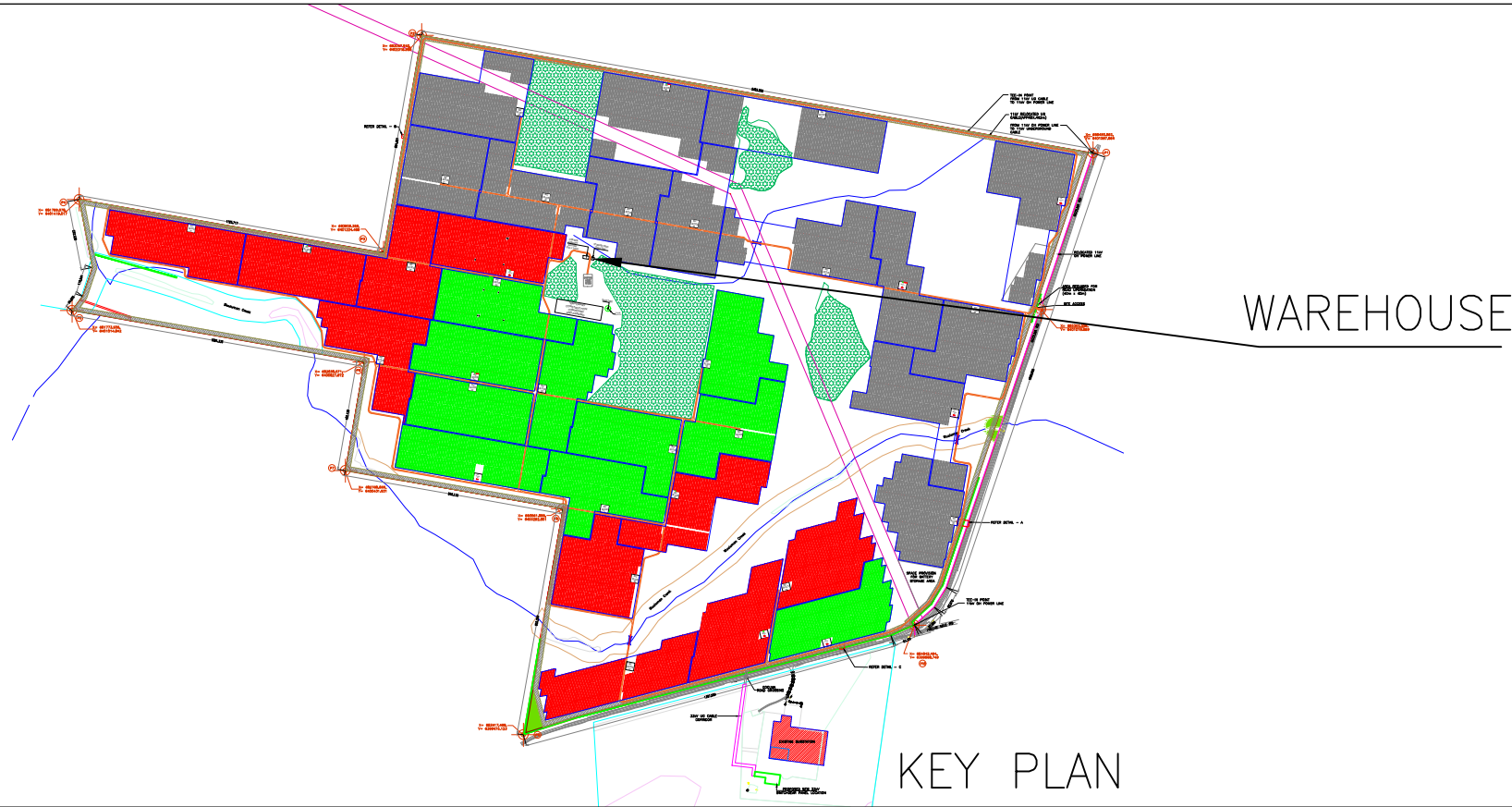
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B 21.10.2019	FOR APPROVAL		HST SDD
A 04.10.2019	FOR APPROVAL		HST SDD
NO.	DATE	REMARKS	DRN CKED
REVISIONS HISTORY			

PROJECT TITLE:- 170MWac/200MWp WELLINGTON SOLAR FARM (WSF), NEW SOUTH WALES, AUSTRALIA			
CLIENT:- LIGHTSOURCE AUSTRALIA SPV 4 PTY LTD			
EPC CONTRACTOR :- STERLING & WILSON			
DRAWING TITLE:- MCR EQUIPMENT LAYOUT			
DRAWING NO:- SWLB-LSBP-AUS-170MW-E-DWG-MCREL-213			
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DRAWN	HST	PAPER SIZE	A0
CHECKED	SDD	REV NO.	C
APPROVED	SKK	DATE	18.11.2019





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LEGENDS:-

SL NO.	SYMBOL	DESCRIPTION	QTY	UNIT
01		AIR CONDITIONER (1T)	01	NO.
02		EXHAUST FAN (EF)	08	NO'S
03		DOOR	02	NO'S

NOTE: FINAL DIMENSIONS SHALL BE UPDATED AS PER MANUFACTURER'S APPROVED DRAWINGS.

NOTES:-

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3. FOR FIRE ALARM DETAILS, REFER RELEVANT FIRE ALARM DRAWINGS.
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7. DETAILS MENTIONED IN THE DRAWING ARE SUBJECT TO CHANGE AS PER FINAL VENDOR DRAWING.

REFERENCE DRAWING:-

1. SWLB-LSBP-AUS-170MW-E-DWG-OAARL-201 [OVERALL ARRAY LAYOUT]

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RB	21.10.2019	FOR APPROVAL	PAN	SDD
RA	16.09.2019	FOR APPROVAL	PAN	SDD
No.	DATE	REMARKS	DRN	CKED

REVISIONS HISTORY

PROJECT TITLE:-

170MWac/200MWp WELLINGTON SOLAR FARM (WSF),  
NEW SOUTH WALES, AUSTRALIA

CLIENT:-

  LIGTHSOURCE AUSTRALIA SPV 4 PTY LTD

EPC CONTRACTOR :-

**STERLING & WILSON** 

STERLING AND WILSON SOLAR LIMITED,  
ASSOCIATES OF: SHAPORJI PALLONJI & COMPANY PVT. LTD.  
4A/14, 6TH MAIN, CHIKKA ADUGODI NEW EXTENSION,  
THAVAREKERE MAIN ROAD, BENGALURU-560029  
WEBSITE : [www.sterlingandwilsonsolar.com](http://www.sterlingandwilsonsolar.com)

DRAWING TITLE:-

WAREHOUSE EQUIPMENT LAYOUT

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CHECKED	SDD	REV NO.	RB
APPROVED	SKK	DATE	21.10.2019

## **APPENDIX C INPUT FROM SPECIALISTS**

### **C.1 UPDATED HYDRAULIC AND HYDROLOGICAL ANALYSIS**

# **Proposed Solar Farm, Wellington New South Wales**

## **Hydrological and Hydraulic Analysis**

---

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Project No. 1724

Date: 02 November 2019


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Prepared for: Lightsource BP

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# APPENDICES

## **APPENDIX A**

BOM ARR 2016 Hub Data

## **APPENDIX B**

ARR 2016 IFD Data

## **APPENDIX C**

RFFE Method Results

## **APPENDIX D**

Inflow Hydrographs

## **APPENDIX E**

Flood Mapping



# 1.0 INTRODUCTION

Footprint (NSW) Pty. Ltd. (*Footprint*) has been engaged by Lightsource BP to undertake a hydrological and hydraulic analysis in support of a proposed solar farm located north-east of Wellington, New South Wales.

The purpose of the analysis is to define the flood behaviour, including depth of inundation, over three ephemeral watercourses/overland flow paths that traverse the subject site, in order to guide the design with respect to the extent and elevation of proposed solar array infrastructure and to determine the potential impact of this infrastructure on the existing flood behaviour.

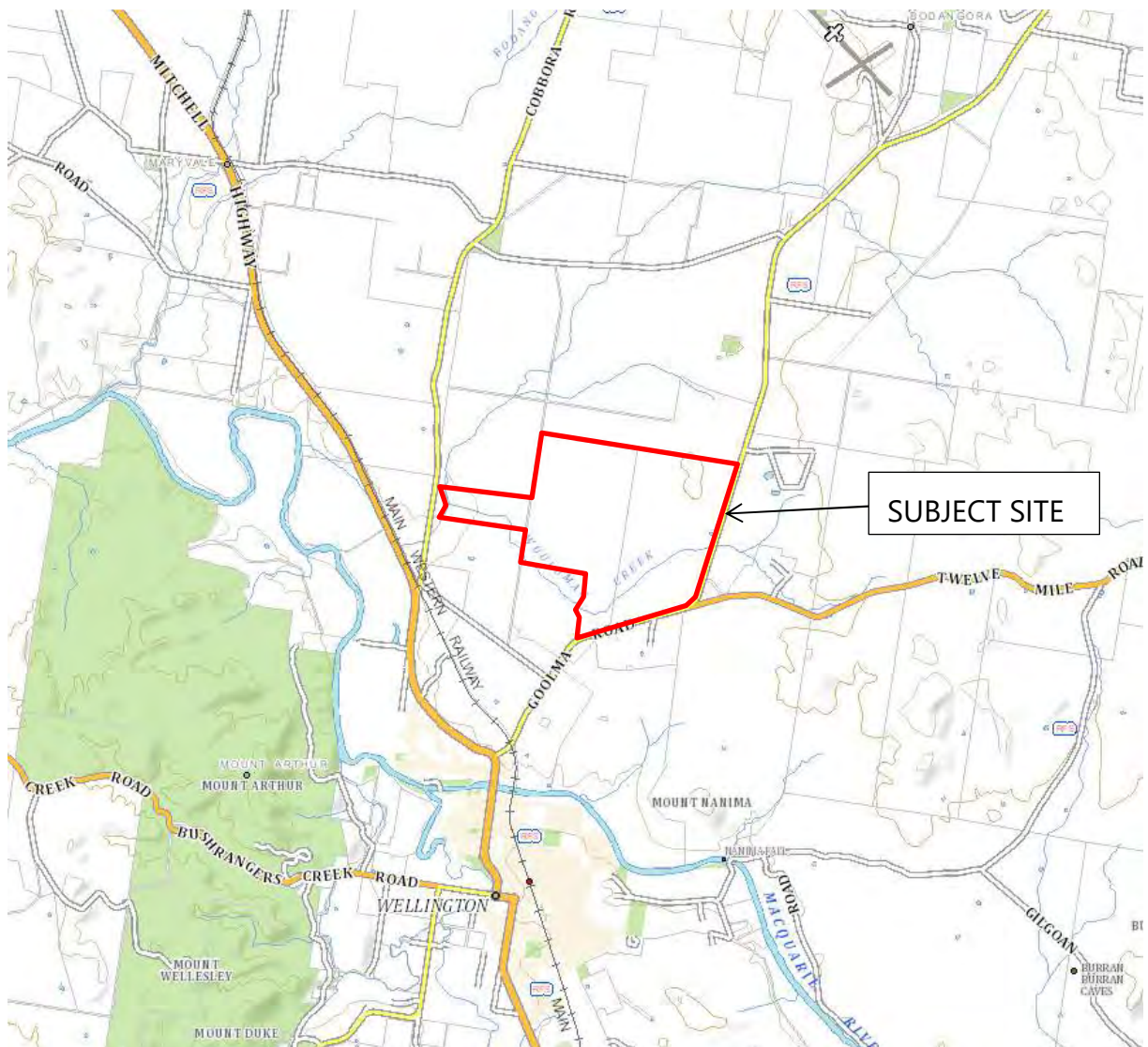
## 1.1. Scope of Works

The scope of works for the project includes:

1. Review available background information including site survey, topographic maps, proposed development plans.
2. Undertake hydrologic calculations to determine peak flows arriving at the site for each watercourse for the 20%, 10%, 5%, 2% and 1% AEP events.
3. Undertake hydraulic modelling (using HEC-RAS) to determine the depth and extent of flooding over the each of the three watercourses for each of the above rainfall events.
4. Preparation of a concise hydrological and hydraulic report defining the methodology and result of the above investigation.

## 2.0 SUBJECT SITE

The subject site is described as Lots 89, 90, 91, 92 , 99, 102, 103 and 104/DP2987; Lot1/DP34690; Lot 1/DP520396 and Lot 2/DP807187 and is located approximately 2 kilometers north-east of the township of Wellington. The site location in relation to Wellington is shown in Figure 1.



*Figure 1: Location of Subject Site*



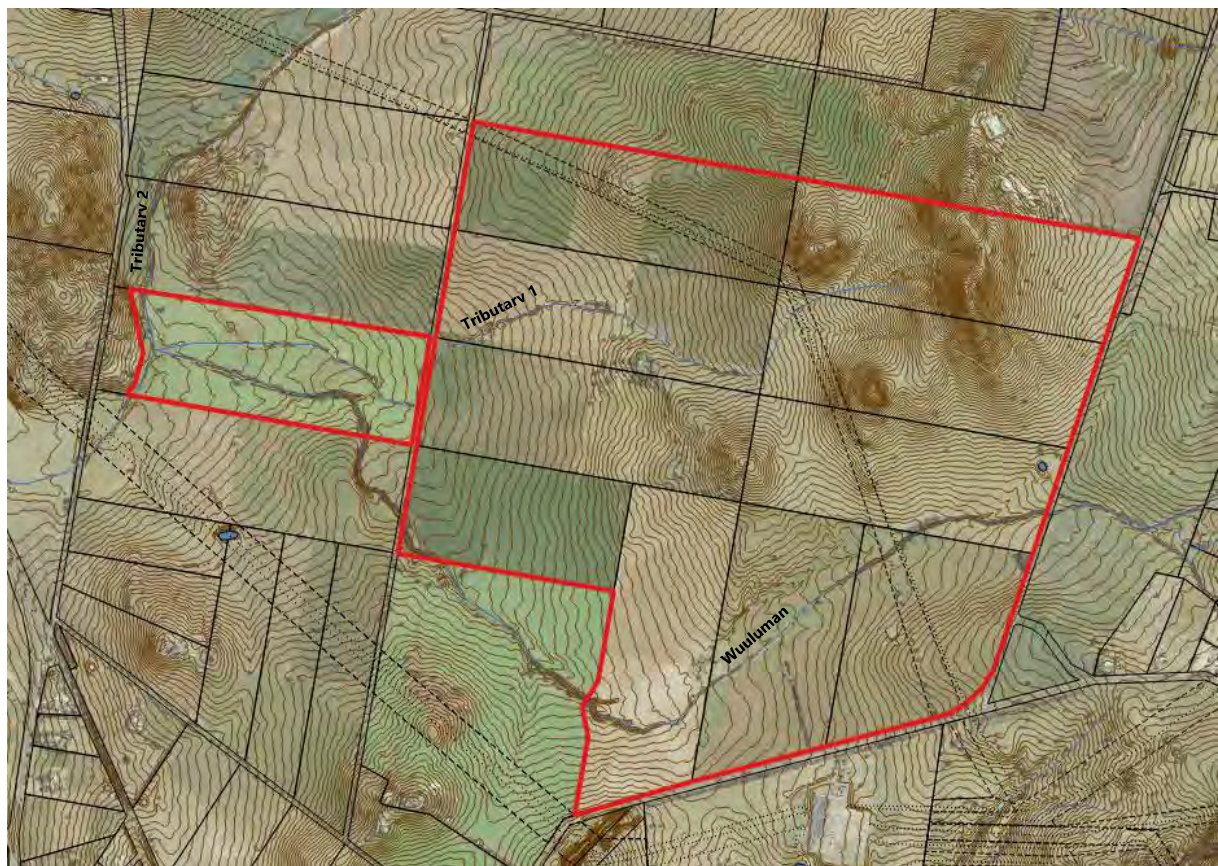
The site consists of an area of approximately 490 hectares and is traversed by three watercourses including Wuuluman Creek and two tributaries. Wuuluman Creek traverses east to west along the southern portion of the site. One of the tributaries (Tributary 1), an overland flow path, traverses east to west in the northern and central areas of the site. The third tributary (Tributary 2), traverses north to south across the extreme western edge of the subject site.

All watercourses are described as ephemeral and only contain flowing water during rainfall.

Wuuluman Creek is a tributary of the Macquarie River, which is located approximately 1.3km west of the subject site.

The dominant land use on the subject site is agriculture with the steeper landforms mainly used for grazing activities whilst the flatter landforms are mostly cropped. Native vegetation remnants are present across some of the site, particularly on the knolls and along Wuuluman Creek.

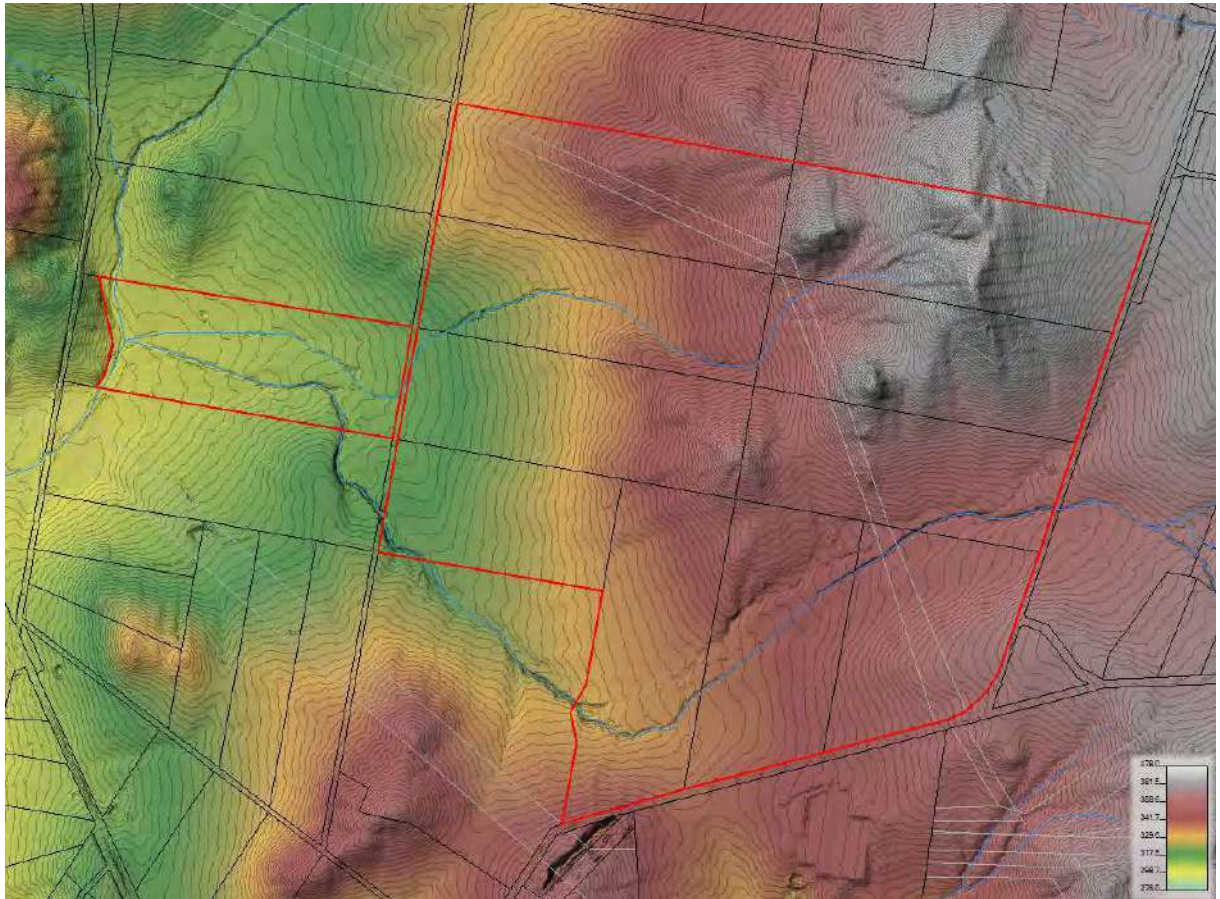
An aerial view of the subject site showing the ephemeral watercourses described above is depicted in Figure 2.



*Figure 2: Aerial View of Subject Site*

Elevations over the site range from RL299 m AHD to RL424m AHD as depicted in Figure 3.





*Figure 3: Terrain Analysis over Subject Site (1m contour interval)*

## 3.0 HYDROLOGICAL MODELLING

### 3.1. Model Adoption

XP-RAFTS was chosen to develop the hydrological model for this study. XP-RAFTS is a non-linear runoff routing model used extensively throughout Australia and South East Asia. XP-RAFTS has been shown to work well on catchments ranging in size from a few square metres to 1000's of square kilometres of both urban and rural nature. XP-RAFTS can model up to 2000 different nodes and each node can have any size sub-catchment as well as a storage basin.

XP-RAFTS uses the Laurenson non-linear runoff routing procedure to develop a stormwater runoff hydrograph from either an actual event (recorded rainfall time series) or a design storm utilising Intensity-Frequency-Duration (IFD) data together with dimensionless storm temporal patterns as well as standard AR&R data.

### 3.2. Catchment Area

The catchment area contributing to Wuuluman Creek just downstream of the subject site and including the two tributaries was estimated to be 60.45km<sup>2</sup> and was determined using 10m contour data obtained through NSW Government Spatial Services.

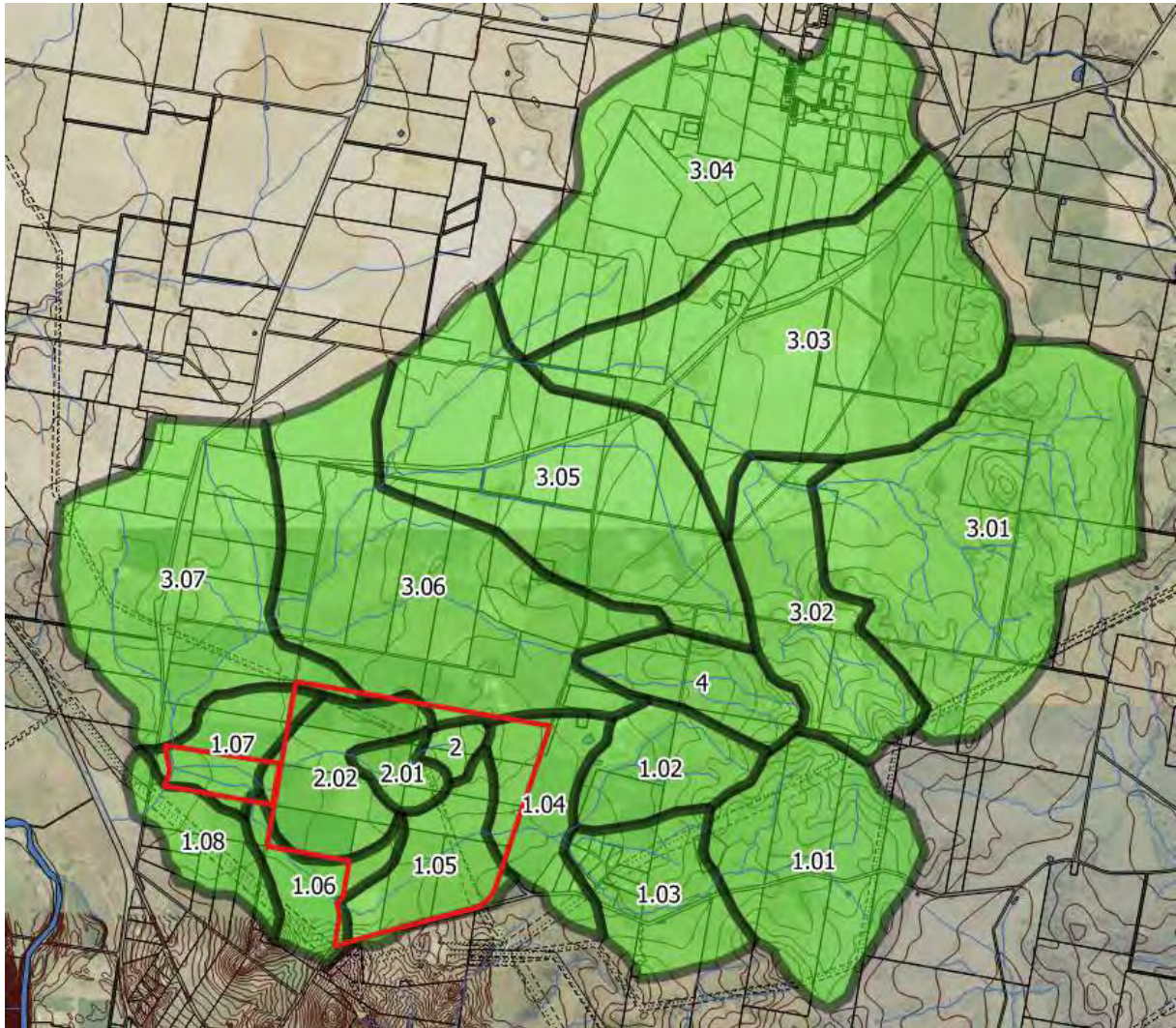
The overall catchment was discretised into 19 sub-catchments ranging in size from 27 – 780 hectares as shown in Figure 4.

The approximate catchment area draining to each of the three watercourses is shown in Table 1.

Table 1: Summary of Catchment Areas by Tributary

<b>Watercourse</b>	<b>Sub-Catchments</b>	<b>Approx Catchment Area (ha)</b>
Wuuluman Creek	1.01 – 1.08	1300
Tributary 1	2 – 2.02	235
Tributary 2	3.01 – 3.07 & 4	4510
Total		6045





*Figure 4: Sub-catchment Plan*

### 3.3. Modelling Input Parameters

The parameters adopted for hydrological modelling are shown in Table 2.



Table 2: Hydrological Parameters Adopted

Parameter	Value Adopted	Justification/Source
Pervious Area Initial Loss (mm)	25	Recommended value for Central NSW obtained through ARR 2016 data hub (refer Appendix A)
Pervious Area Continuing Loss (mm/h)	2.0	Recommended value for Central NSW obtained through ARR 2016 data hub (refer Appendix A)
BX	1	RAFTS Default
Sub-catchment Area (ha)	Varies	As per Figure 4
Impervious Area (%)	5	Value considered representative of rural lands on the urban fringe
Sub-catchment Slope (%)	Varies	Varies based on site topography.
Manning's n	0.025	Typical value for rural pasture lands

## 3.4. Rainfall Data

IFD design rainfall depth data was derived in accordance with Australian Rainfall and Runoff (2016) using the Bureau of Meteorology's 2016 Rainfall IFD on-line Data System.

A copy of the Rainfall depth for Durations, Exceedance per Year (EY) and Annual Exceedance Probabilities (AEP) table is included in Appendix B.

## 3.5. Results

The RAFTS Model was run for storm durations ranging from 30 minutes to 24 hours and hydrographs at the outlet for the median storm for the range of events modelled are shown in Figure 5.

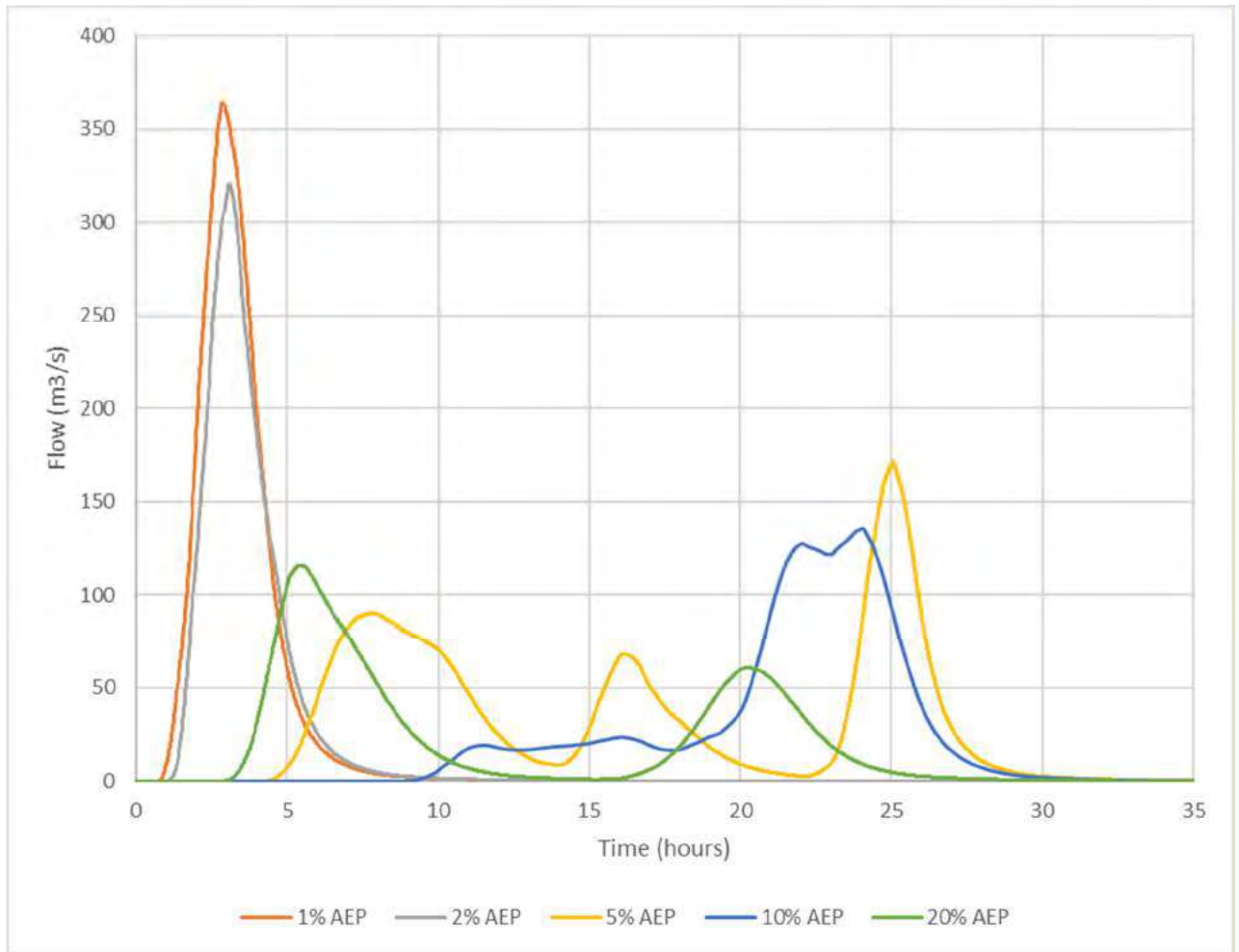
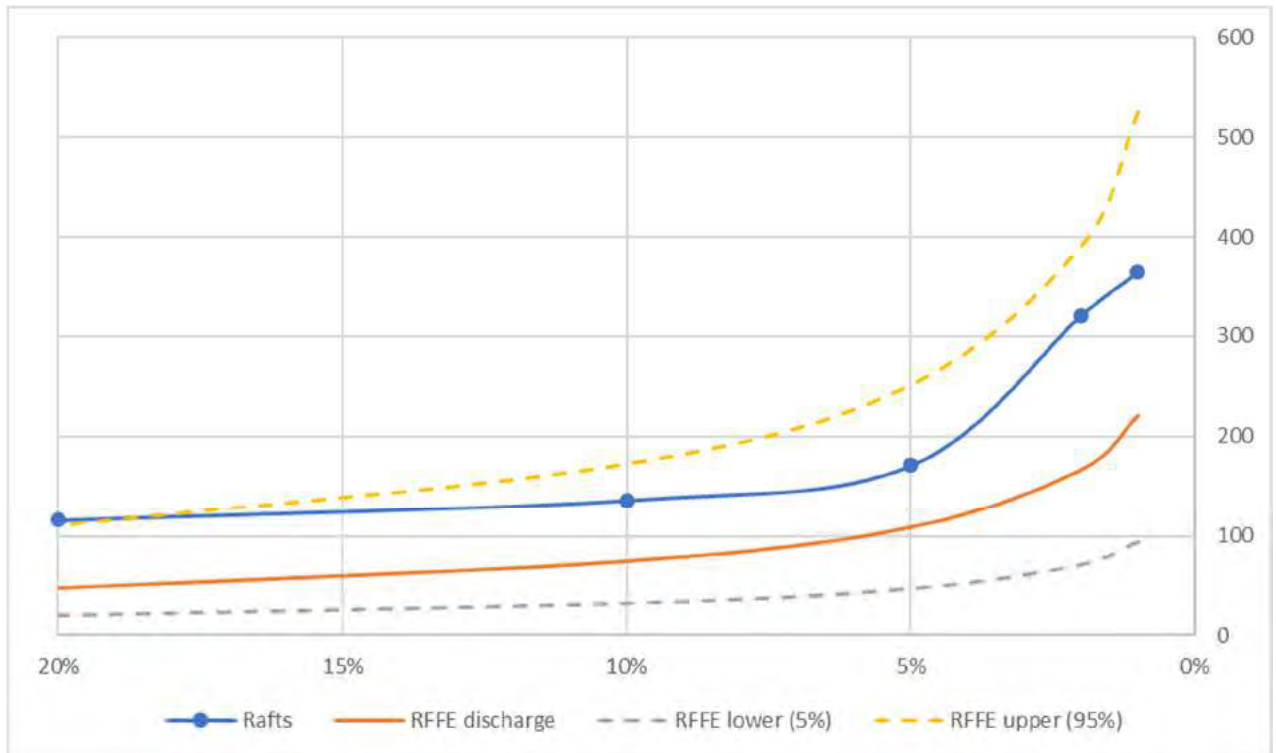


Figure 5: Median Flood Hydrographs Derived from Hydrological Model

The peak flows derived in RAFTS at the outlet were compared to those derived using the Australian Rainfall and Runoff Regional Flood Frequency Estimation (RFFE) Model and the results are shown in Table 3 and Figure 6.

Table 3: Comparison of Peak Flows to Regional Flood Frequency Estimation Model

AEP	Peak Flow Rate (cumecs)			
	RAFTS	Regional Flood Frequency Estimation Model		
		Discharge	Lower (5%)	Upper (95%)
20%	116	48.0	20.6	111
10%	136	75.0	32.5	173
5%	171	109	47.1	252
2%	321	167	71.2	391
1%	364	221	93.7	526



*Figure 6: Comparison of Peak Flows to Regional Flood Frequency Estimation Model*

The comparison of results shows that the runoff routing model results tend to estimate peak flows higher than the RFFE method. Without calibration reasons for this are not able to be determined. However possible causes could be due to routing effects and/or surface roughness which may result in increased peak flows from the RAFTS model. Results are well within the confidence limits for flow estimations based on gauged events from regional catchments, apart from the 20% AEP.

Outputs from the RFFE method are included in Appendix C.



## 4.0 HYDRAULIC MODELLING

Hydraulic modelling was conducted using an unsteady two-dimensional HEC-RAS model (Version 5.0.3) run in mixed flow regime to enable both subcritical and supercritical flow regimes to be assessed.

### 4.1. Model Inputs

#### 4.1.1. Two-Dimensional Domain

A digital elevation model (DEM) of the subject site was established using a 5m gridded digital elevation model (wellington1009.tif) sourced from [www.elevation.fsdf.org.au](http://www.elevation.fsdf.org.au).

A two-dimensional flow area (i.e. active cells) was defined over the subject site over an extent considered large enough to accommodate the expected flows. The extent of the two-dimensional flow area is shown in Figure 7.

The 5m DEM grid was imported into HEC-RAS and used as the basis for development of a 10m x 10m terrain model. The DEM grid was further refined over each watercourse by applying breaklines with a maximum cell spacing of 5m. An example of the additional definition along each watercourse is shown in Figure 8.

The two-dimensional flow area was assigned a Manning's n value of 0.025 which is considered representative of the current condition of the land. The Manning's n value was increased to 0.06 in several isolated areas to represent some more densely vegetated areas along the creek corridors. The areas of increased Manning's n are shown in Figure 7.

#### 4.1.2. Boundary Conditions

The hydrographs derived using RAFTS were used to define the upstream boundary condition within each watercourse for each of the modelled events. Hydrographs for each storm event at each of the inflow locations are provided in Appendix D and were derived using total hydrographs from subcatchments outlet as defined in Table 4.

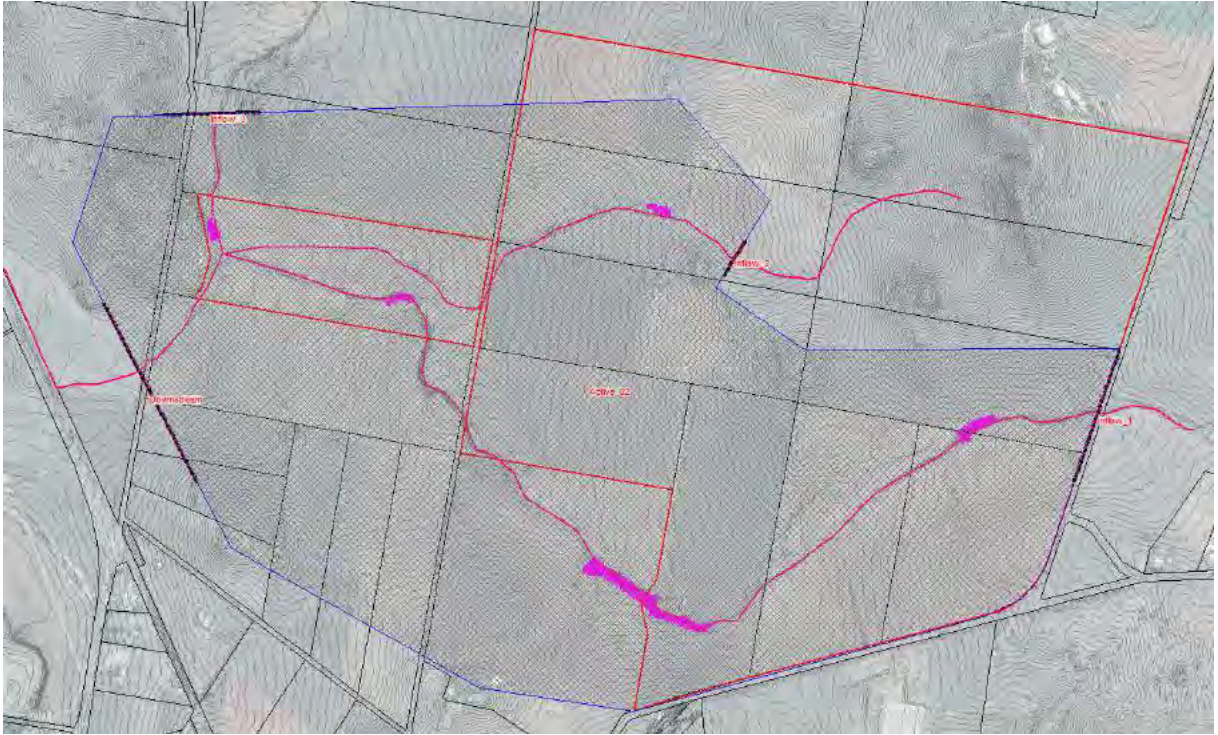
Table 4: Adopted hydrographs for inflow boundaries

<b>Inflow Boundary</b>	<b>Total Hydrograph from Subcatchment Outlet</b>
Inflow_1	1.07
Inflow_2	2.02
Inflow_3	3.07

The upstream boundaries were extended along the upstream face of the two-dimensional domain at each watercourse over a sufficient length to enable the model to appropriately distribute the flow to the cells that are wet. At any given time step, only a portion of the boundary condition line may be wet, thus only the cells in which the water surface elevation is higher than their outer boundary face terrain will receive water.

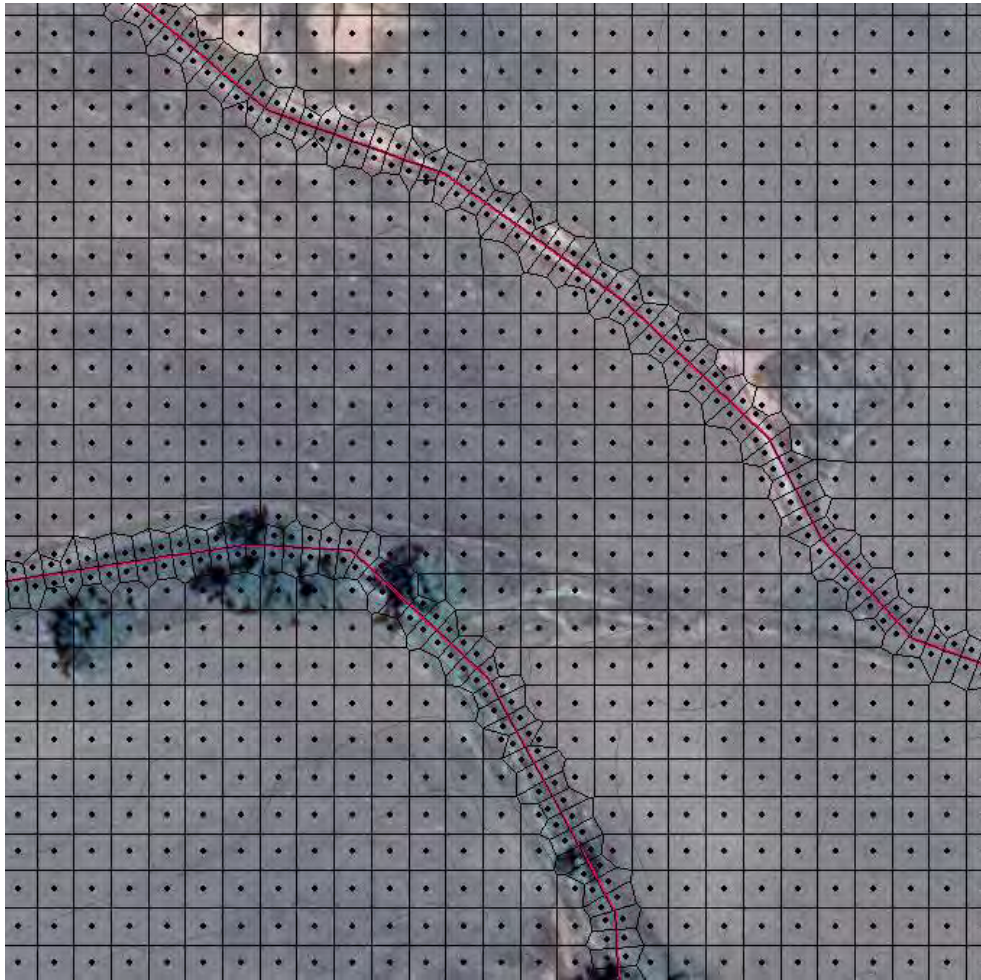
Flows leaving the two-dimensional area were defined with a normal depth downstream boundary condition with a friction slope of 0.07% which is based on the gradient of the land at the location of the boundary. The friction slope method uses the Manning's equation to compute a normal depth for each given flow, based on the cross section underneath the two-dimensional boundary condition line and is computed on a per cell basis.

The location and extent of the upstream and downstream boundary condition lines is shown in Figure 7.



*Figure 7: Two Dimensional Flow Area and Hydraulic Boundary Conditions (Mannings  $n = 0.06$  areas shown in pink)*





*Figure 8: Example of additional definition along each watercourse*

## 4.2. Results

Results of the hydraulic modelling are included in Appendix E and include the following:

Figure 1.1 – 1% AEP Flood Levels and Depths

Figure 1.2 – 1% AEP Flood Velocities

Figure 2.1 – 2% AEP Flood Levels and Depths

Figure 2.2 – 2% AEP Flood Velocities

Figure 3.1 – 5% AEP Flood Levels and Depths

Figure 3.2 – 5% AEP Flood Velocities

Figure 4.1 – 10% AEP Flood Levels and Depths

Figure 4.2 – 10% AEP Flood Velocities

Figure 5.1 – 20% AEP Flood Levels and Depths

Figure 5.2 – 20% AEP Flood Velocities

The results show that in the 1% AEP event significant overbank flows are predicted to occur within the upper reaches of Wuuluman Creek. Flow depths in excess of 1m are predicted on the right overbank, where an overflow channel exists. This overflow channel is clearly visible when analysing the terrain as shown in Figure 9.

Elsewhere, except for within Lot 2 DP807187 where the watercourses merge, flows are largely confined to the watercourses, with overbank flows limited to several hundred millimetres in depth.



*Figure 9: Wuuluman Creek Overflow Channel*

It should be noted that due to the coarse nature of the 5m DEM grid used in the analysis that the watercourse profile does not provide accurate representation of the actual channel profile. This is depicted in Figure 10 where a longitudinal section along the channel invert is shown to contain a series 'humps' and 'hollows'. The variable channel profile would likely result in an underestimation of the channel flows and a corresponding overestimation of overbank flows. Nonetheless the results are considered to provide a good estimation of the extent and depth of inundation over the site.

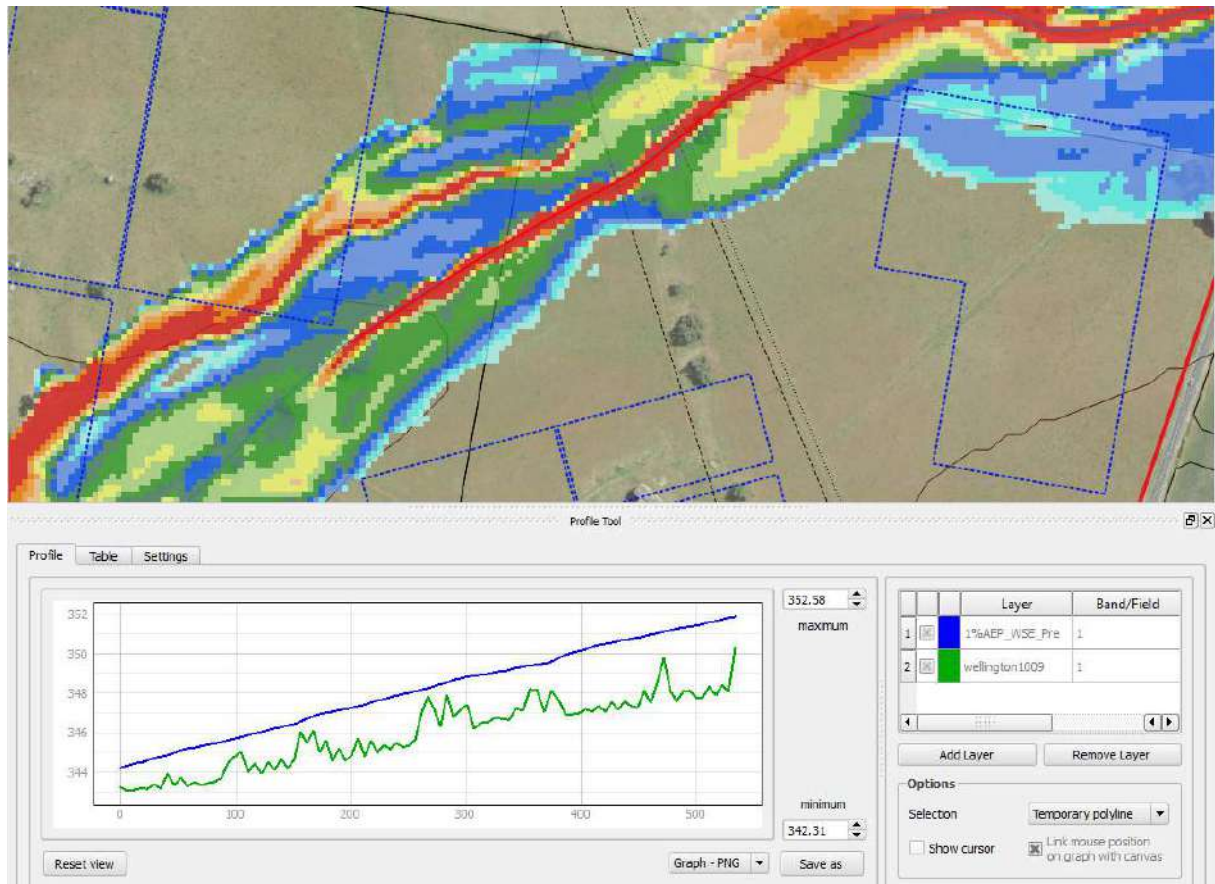


Figure 10: Analysis of Terrain within Watercourse Channel



## 5.0 IMPACT OF PROPOSED WORKS

The proposal would comprise an array of solar panels covering an area of approximately 360 hectares, a 132kV substation, and related infrastructure as follows:

- PV modules mounted on a horizontal tracking structure.
- Site office and maintenance building.
- A site access road off Goolma Road.
- Underground transmission lines for grid connection to the adjacent substation (132kV).
- Overhead or underground electrical conduits and cabling to connect the arrays on the array site.
- Internal inverter stations to allow conversion of DC module output to AC electricity.
- Internal access tracks to allow for site maintenance.
- Perimeter security fencing.
- Native vegetation screening, where required to break up views of infrastructure to specific nearby receivers.

It is understood the solar modules will be erected on a frame supported on piers at an approximate grid spacing of 6 x 6 metres.

The addition of the solar arrays and their associated infrastructure will result in an increase in surface roughness over the site, from grazed/cropped pasture to a regular grid of steel piers.

The change in floodplain roughness associated with the proposed development was assessed using the Modified Cowan Method for Floodplain Roughness and is shown in Table 5. It demonstrates that the roughness is anticipated to slightly increase as a result of the development.

Table 5: Modified Cowan Method for Estimation of Floodplain Roughness

Roughness Component	Existing (Grazed Pasture)	Proposed (Solar Array)
Floodplain Material ( $n_b$ )	0.020	0.020
Degree of Irregularity ( $n_1$ )	0.001	0.001
Variation in Floodplain Cross Section ( $n_2$ )	N/A	N/A
Effect of Obstructions ( $n_3$ )	0.000	0.003 <sup>1</sup>
Amount of Vegetation ( $n_4$ )	0.004	0.004
Total ( $n$ )	0.025	0.028

<sup>1</sup> Based on an obstruction of 2.5% of the available flow area (i.e. 150mm piers at 6m intervals)

It should be noted that the proposed network of access roads is to be constructed from dirt (gravel) and within the floodplain itself are to be constructed at the existing surface level so as not to result in adverse impact on flood behaviour.

In accordance with the Modified Cowan Method of Floodplain Roughness gravel has a floodplain roughness of 0.026, which is only marginally higher than the adopted predevelopment value. On this basis, and considering the fact these tracks are likely to be less than 5m in width and therefore not well represented by the model, the marginal increase in floodplain roughness associated with the proposed road network has not been included in the post development model.

Furthermore, watercourse crossings have not been included in the model as fords, which minimise any hydraulic impact, have been recommended (see Section 6.4).

The post development hydraulic model is therefore considered to be representative of the development as proposed and therefore reflective of the hydraulic impacts associated with the development.

The hydraulic model was re-run to assess the impact of an increase in surface roughness on flood behaviour for the 1% AEP event and the results are included in Figures 6.1, 6.2 and 6.3 in Appendix E.

The results in Figures 6.1 and 6.2 demonstrate that there is not predicted to be a significant impact on flood behaviour within the floodplain as a result of the proposed works, with flood levels, depths and velocities remaining relatively unchanged. Furthermore, the proposed works within and over Tributary 1 are not predicted to result in an adverse impact on the hydraulic function of that watercourse.

The results in Figure 6.3 show that the increase in floodplain roughness over the area of the proposed solar module arrays is anticipated to result in localised increases in flood levels near the arrays with an associated minor decrease in flood levels downstream of the arrays. They also show that there is predicted to be a very marginal increase in the extent of flooding in the 1% AEP event.

The maximum increase in flood level resulting from the increase in surface roughness is predicted to be in the order of 70mm within the overflow channel along Wuuluman Creek within Lot 99, DP2987.

Importantly the modelling demonstrates that the changes in flood levels are principally isolated to the subject site, with the exception of some minor (up to a maximum in the order of 30mm) increases with the adjacent Lot 2, DP588075.

In addition, Figure 6.4 demonstrates that the proposed works are not anticipated to adversely increase the velocity in any of the watercourses or their associated overbanks therefore ensuring the stability of their bed and banks and minimising erosion potential.

## 5.1. Comparison to Previous Solar Array Layout

The results of the proposed solar array layout were compared to those of the approved layout and the change in maximum flood levels between the two sets of results are included in Figure 6.5 in Appendix E.

The results generally show a slight reduction in maximum flood levels over the site and particularly within the Wuuluman Creek overflow channel due to the slight reduction in encroachment of the proposed array field into this area compared to the approved layout.

Some minor increases in maximum flood level (up to about 20mm) are shown to occur elsewhere on the site due to the proposed solar array field encroaching slightly further into flood affected area compared to the approved layout.

Overall the results demonstrate that the proposed modifications to the solar array field are not anticipated to result in any greater flood impact than the approved layout.



## 6.0 FLOOD MANAGEMENT RECOMMENDATIONS

### 6.1. Solar Array Field

The Wuuluman Creek overflow channel within Lot 99 DP 2987 and Lot 1 DP520396 represents an area of high flood risk. In order to both minimise the impact of the development on flood behaviour and minimise the impact of flooding on the proposed development it is recommended that, within this area;

- the solar array mounting piers are designed to withstand the forces of floodwater (including any potential debris loading) up to the 1% AEP flood event, giving regard to the depth and velocity of floodwaters;
- the layout of the solar array mounting piers are designed to minimise encroachment within the areas of highest velocity and depth. This may necessitate solar module frame spans in excess of those proposed.

Where the solar array fields encroach on Tributary 1 the layout of the mounting piers are to be designed to minimise encroachment within areas of the watercourse subject to high velocity and depth flows. Again, this may necessitate solar module frame spans more than those proposed.

Within the area of inundation, the mounting height of the solar module frames should be designed such that the lower edge of the module is clear of the predicted 1% AEP flood level so as not to impact on existing flood behaviour and to prevent the infrastructure from being damaged as a result of flooding.

In the event of a significant flood event the modules should be rotated to provide maximum clearance from the panels to the ground to keep them positioned well above the predicted flood level.

### 6.2. Electrical Infrastructure

All electrical infrastructure, including inverters, should be located above the 1% AEP flood level.

Where electrical cabling is required to be constructed below the 1% AEP flood level it should be capable of continuous submergence in water.

## 6.3. Perimeter Fencing

The proposed perimeter security fencing should be constructed in a manner which does not adversely affect the flow of floodwater and should be designed to withstand the forces of floodwater, or collapse in a controlled manner to prevent impediment to floodwater.

## 6.4. Watercourse Crossings

Any proposed crossings (vehicular or service) of existing watercourses on the subject site should be designed in accordance with the following guidelines, and should preferably consist of fords constructed flush with the bed of the watercourse to minimise any hydraulic impact:

- Guidelines for Watercourse Crossings on Waterfront land (NSW DPI, 2012)
- Guidelines for Laying Pipes and Cable in Watercourses on Waterfront Land (NSW DPI, 2012)

# APPENDIX A

## BOM ARR 2016 Hub Data



# Australian Rainfall & Runoff Data Hub - Results

## Input Data

Longitude	148.982
Latitude	-32.508
<b>Selected Regions (clear)</b>	
River Region	show
ARF Parameters	show
Temporal Patterns	show
Areal Temporal Patterns	show
Interim Climate Change Factors	show



## Region Information

Data Category	Region
River Region	Macquarie-Bogan Rivers
ARF Parameters	Central NSW
Temporal Patterns	Central Slopes

## Data

### River Region

division	Murray-Darling Basin
rivregnum	22
River Region	Macquarie-Bogan Rivers

### Layer Info

Time Accessed	21 September 2017 05:43PM
Version	2016_v1

## ARF Parameters

### Long Duration ARF

$$ARF = Min \left\{ 1, \left[ 1 - a \left( Area^b - \log_{10} Duration \right) Duration^{-d} \right. \right. \\ \left. \left. + e Area^f Duration^g (0.3 + \log_{10} AEP) \right. \right. \\ \left. \left. + h 10^{i Area^{\frac{Duration}{1440}}} (0.3 + \log_{10} AEP) \right] \right\}$$

Zone	a	b	c	d	e	f	g	h	i
Central NSW	0.265	0.241	0.505	0.321	0.00056	0.414	-0.021	0.015	-0.00033

### Short Duration ARF

$$ARF = Min \left[ 1, 1 - 0.287 \left( Area^{0.265} - 0.439 \log_{10}(Duration) \right) . Duration^{-0.36} \right. \\ \left. + 2.26 \times 10^{-3} \times Area^{0.226} . Duration^{0.125} (0.3 + \log_{10}(AEP)) \right. \\ \left. + 0.0141 \times Area^{0.213} \times 10^{-0.021 \frac{(Duration-180)^2}{1440}} (0.3 + \log_{10}(AEP)) \right]$$

### Layer Info

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Version	2016_v1

### Storm Losses

Note: Burst Loss = Storm Loss - Preburst

Note: These losses are only for rural use and are **NOT FOR USE** in urban areas

Storm Initial Losses (mm)	25.0
Storm Continuing Losses (mm/h)	2.0

### Layer Info

Time Accessed	21 September 2017 05:43PM
Version	2016_v1

### Temporal Patterns | Download (.zip) (./temporal\_patterns/tp/CS.zip)

code	CS
Label	Central Slopes

### Layer Info

Time Accessed	21 September 2017 05:43PM
Version	2016_v2

code	CS
arealabel	Central Slopes

Layer Info

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BOM IFD Depths

Click here ([http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016&coordinate\\_type=dd&latitude=-32.50781&longitude=148.981899&sadmin=true&sdhr=true&sdday=true&user\\_label=](http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016&coordinate_type=dd&latitude=-32.50781&longitude=148.981899&sadmin=true&sdhr=true&sdday=true&user_label=)) to obtain the IFD depths for catchment centroid from the BoM website

Layer Info

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Median Preburst Depths and Ratios

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	1.3 (0.058)	0.9 (0.029)	0.6 (0.017)	0.3 (0.008)	0.5 (0.009)	0.6 (0.01)
90 (1.5)	0.9 (0.037)	0.9 (0.027)	0.9 (0.022)	0.9 (0.019)	0.5 (0.009)	0.2 (0.002)
120 (2.0)	1.2 (0.044)	0.9 (0.025)	0.7 (0.016)	0.5 (0.01)	0.7 (0.012)	0.8 (0.012)
180 (3.0)	0.5 (0.015)	0.8 (0.019)	1.0 (0.021)	1.3 (0.022)	1.4 (0.021)	1.5 (0.02)
360 (6.0)	0.7 (0.017)	2.0 (0.038)	2.9 (0.047)	3.8 (0.053)	6.0 (0.073)	7.7 (0.083)
720 (12.0)	0.0 (0.001)	3.2 (0.05)	5.4 (0.071)	7.4 (0.085)	9.4 (0.091)	10.9 (0.094)
1080 (18.0)	0.0 (0.0)	0.9 (0.012)	1.5 (0.017)	2.0 (0.021)	5.7 (0.048)	8.4 (0.063)
1440 (24.0)	0.0 (0.0)	0.1 (0.001)	0.2 (0.002)	0.2 (0.002)	3.5 (0.027)	6.0 (0.041)
2160 (36.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.4 (0.003)	0.7 (0.004)
2880 (48.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
4320 (72.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)

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10% Preburst Depths

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
90 (1.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
120 (2.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
180 (3.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
360 (6.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
720 (12.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
1080 (18.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
1440 (24.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
2160 (36.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
2880 (48.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
4320 (72.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)

Layer Info

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25% Preburst Depths

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.002)	0.0 (0.001)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
90 (1.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
120 (2.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
180 (3.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
360 (6.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
720 (12.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.1 (0.001)	0.1 (0.001)
1080 (18.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
1440 (24.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
2160 (36.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
2880 (48.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
4320 (72.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)

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## 75% Preburst Depths

min (h)\AEP(%)	50	20	10	5	2	1
<b>60 (1.0)</b>	16.2 (0.707)	12.0 (0.386)	9.2 (0.251)	6.5 (0.154)	7.8 (0.158)	8.8 (0.16)
<b>90 (1.5)</b>	11.1 (0.43)	11.7 (0.335)	12.1 (0.294)	12.5 (0.263)	10.4 (0.186)	8.8 (0.142)
<b>120 (2.0)</b>	15.4 (0.545)	14.8 (0.389)	14.5 (0.322)	14.1 (0.274)	14.6 (0.241)	14.9 (0.222)
<b>180 (3.0)</b>	11.3 (0.356)	15.3 (0.357)	17.9 (0.356)	20.5 (0.354)	22.8 (0.336)	24.5 (0.325)
<b>360 (6.0)</b>	12.0 (0.307)	19.6 (0.373)	24.6 (0.399)	29.4 (0.416)	39.9 (0.48)	47.7 (0.514)
<b>720 (12.0)</b>	7.3 (0.152)	18.0 (0.28)	25.2 (0.331)	32.0 (0.366)	40.7 (0.394)	47.2 (0.407)
<b>1080 (18.0)</b>	3.3 (0.061)	10.6 (0.146)	15.5 (0.18)	20.1 (0.203)	27.2 (0.231)	32.4 (0.244)
<b>1440 (24.0)</b>	0.5 (0.009)	6.4 (0.081)	10.3 (0.11)	14.0 (0.129)	20.0 (0.155)	24.5 (0.168)
<b>2160 (36.0)</b>	0.0 (0.0)	2.7 (0.031)	4.5 (0.043)	6.2 (0.051)	8.2 (0.056)	9.8 (0.059)
<b>2880 (48.0)</b>	0.0 (0.0)	1.4 (0.015)	2.3 (0.021)	3.2 (0.025)	5.6 (0.035)	7.4 (0.041)
<b>4320 (72.0)</b>	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.4 (0.008)	2.4 (0.012)

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## 90% Preburst Depths

min (h)\AEP(%)	50	20	10	5	2	1
<b>60 (1.0)</b>	32.8 (1.43)	26.1 (0.842)	21.7 (0.593)	17.5 (0.414)	27.7 (0.558)	35.4 (0.638)
<b>90 (1.5)</b>	29.8 (1.148)	41.6 (1.188)	49.4 (1.197)	56.9 (1.198)	48.0 (0.86)	41.3 (0.664)
<b>120 (2.0)</b>	31.1 (1.102)	36.5 (0.958)	40.0 (0.892)	43.4 (0.842)	54.0 (0.893)	61.9 (0.92)
<b>180 (3.0)</b>	33.2 (1.044)	40.1 (0.935)	44.6 (0.885)	49.0 (0.847)	60.9 (0.899)	69.9 (0.927)
<b>360 (6.0)</b>	25.7 (0.658)	40.9 (0.78)	51.0 (0.827)	60.7 (0.858)	71.6 (0.861)	79.7 (0.86)
<b>720 (12.0)</b>	22.7 (0.473)	44.7 (0.692)	59.2 (0.779)	73.1 (0.836)	85.1 (0.824)	94.2 (0.812)
<b>1080 (18.0)</b>	15.8 (0.292)	32.3 (0.445)	43.2 (0.504)	53.6 (0.542)	67.3 (0.572)	77.5 (0.584)
<b>1440 (24.0)</b>	8.9 (0.152)	17.4 (0.221)	23.0 (0.247)	28.4 (0.263)	43.5 (0.338)	54.9 (0.376)
<b>2160 (36.0)</b>	4.1 (0.063)	12.5 (0.143)	18.1 (0.174)	23.4 (0.193)	35.5 (0.244)	44.6 (0.269)
<b>2880 (48.0)</b>	5.6 (0.081)	10.1 (0.108)	13.1 (0.117)	15.9 (0.122)	21.9 (0.139)	26.4 (0.147)
<b>4320 (72.0)</b>	0.5 (0.007)	3.8 (0.037)	5.9 (0.048)	8.0 (0.055)	12.3 (0.07)	15.5 (0.078)

## Layer Info

<b>Time Accessed</b>	21 September 2017 05:43PM
<b>Version</b>	2016_v2

# APPENDIX B

## ARR 2016 IFD Data



## Location

**Label:** Not provided

**Latitude:** -32.50781 [Nearest grid cell: 32.5125 (S)]

**Longitude:** 148.981899 [Nearest grid cell: 148.9875 (E)]

## IFD Design Rainfall Depth (mm)

Issued: 21 September 2017

Rainfall depth for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).

[FAQ for New ARR probability terminology](#)

Duration	Annual Exceedance Probability (AEP)						
	63.2%	50%#	20%*	10%	5%	2%	1%
1 min	1.83	2.06	2.78	3.28	3.79	4.47	5.01
2 min	3.09	3.48	4.71	5.55	6.39	7.45	8.27
3 min	4.27	4.80	6.50	7.67	8.82	10.3	11.5
4 min	5.33	5.99	8.10	9.55	11.0	12.9	14.4
5 min	6.27	7.04	9.51	11.2	12.9	15.2	17.0
10 min	9.75	10.9	14.8	17.4	20.1	23.8	26.7
15 min	12.0	13.5	18.2	21.6	24.9	29.5	33.2
20 min	13.7	15.4	20.8	24.6	28.4	33.7	37.8
30 min	16.1	18.1	24.5	29.0	33.4	39.5	44.3
45 min	18.6	20.9	28.2	33.4	38.5	45.4	50.8
1 hour	20.4	22.9	31.0	36.6	42.2	49.6	55.4
1.5 hour	23.1	25.9	35.0	41.3	47.5	55.8	62.2
2 hour	25.1	28.2	38.1	44.9	51.6	60.5	67.3
3 hour	28.3	31.8	42.8	50.4	57.9	67.8	75.4
6 hour	34.8	39.1	52.5	61.7	70.8	83.1	92.7
12 hour	43.0	48.1	64.5	76.0	87.4	103	116
24 hour	52.4	58.6	78.7	93.1	108	129	146
48 hour	62.0	69.2	93.7	112	131	158	180
72 hour	67.0	75.0	102	123	145	175	200
96 hour	70.3	78.8	108	130	154	186	213
120 hour	72.7	81.7	113	136	161	195	223
144 hour	74.6	84.1	116	140	166	201	230
168 hour	76.4	86.2	120	144	170	207	236

Note:

# The 50% AEP IFD **does not** correspond to the 2 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 1.44 ARI.

\* The 20% AEP IFD **does not** correspond to the 5 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 4.48 ARI.



## Location

**Label:** Not provided

**Latitude:** -32.50781 [Nearest grid cell: 32.5125 (S)]

**Longitude:** 148.981899 [Nearest grid cell: 148.9875 (E)]

## Rare Design Rainfall Depth (mm)

Issued: 21 September 2017

Rainfall depth for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).

[FAQ for New ARR probability terminology](#)

Duration	Annual Exceedance Probability (1 in x)				
	1 in 100	1 in 200	1 in 500	1 in 1000	1 in 2000
24 hour	146	166	193	216	240
48 hour	180	205	241	270	303
72 hour	200	227	266	299	334
96 hour	213	241	283	318	355
120 hour	223	252	296	332	371
144 hour	230	261	306	344	384
168 hour	236	269	315	354	395

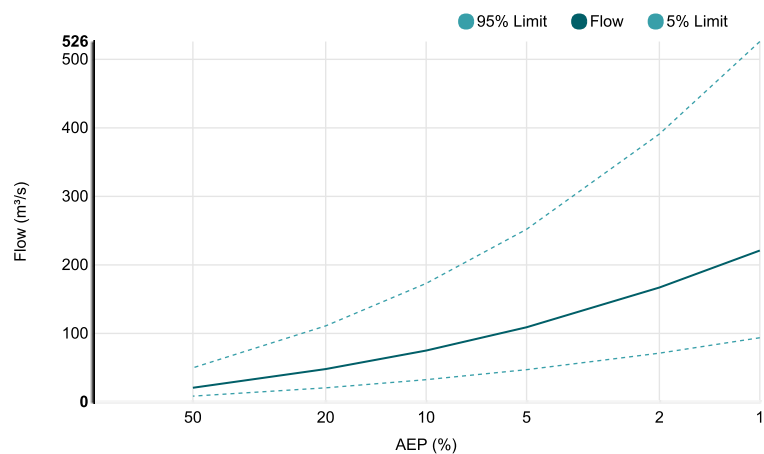
This page was created at **17:46 on Thursday 21 September 2017 (AEST)**

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# APPENDIX C

## RFFE Method Results

# Results | Regional Flood Frequency Estimation Model



AEP (%)	Discharge (m³/s)	Lower Confidence Limit (5%) (m³/s)	Upper Confidence Limit (95%) (m³/s)
50	20.7	8.50	49.8
20	48.0	20.6	111
10	75.0	32.5	173
5	109	47.1	252
2	167	71.2	391
1	221	93.7	526

## Statistics

Variable	Value	Standard Dev
Mean	3.034	0.526
Standard Dev	0.984	0.111
Skew	0.071	0.026

Note: These statistics come from the nearest gauged catchment. Details.

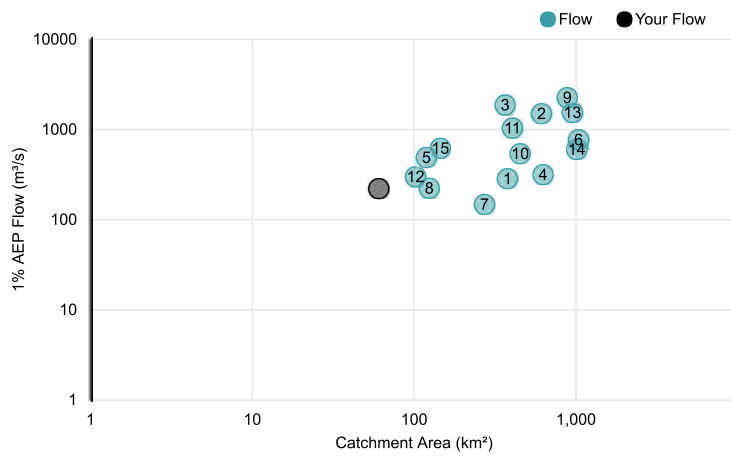
### Correlation

1.000		
-0.330	1.000	
0.170	-0.280	1.000

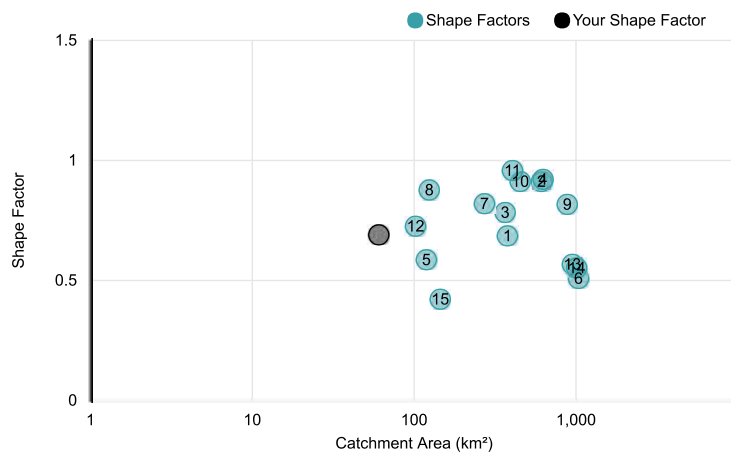
Note: These statistics are common to each region. Details.

## 1% AEP Flow vs Catchment Area

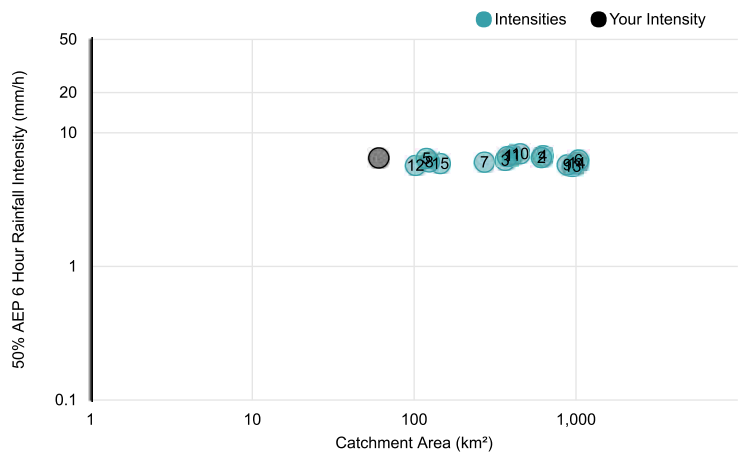




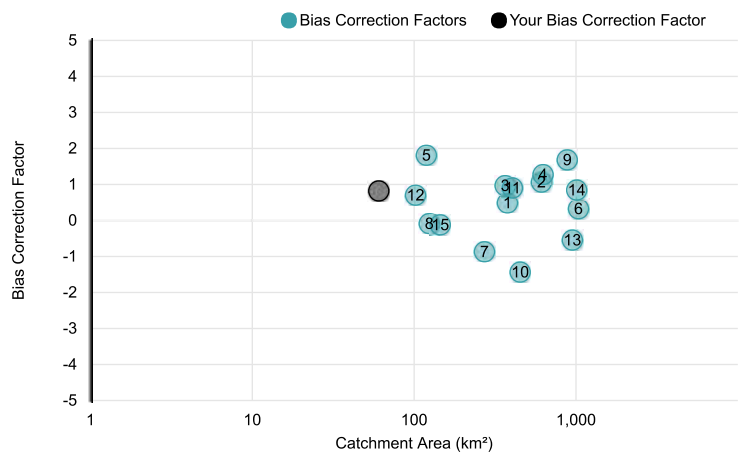
## Shape Factor vs Catchment Area



## Intensity vs Catchment Area



## Bias Correction Factor vs Catchment Area



Download

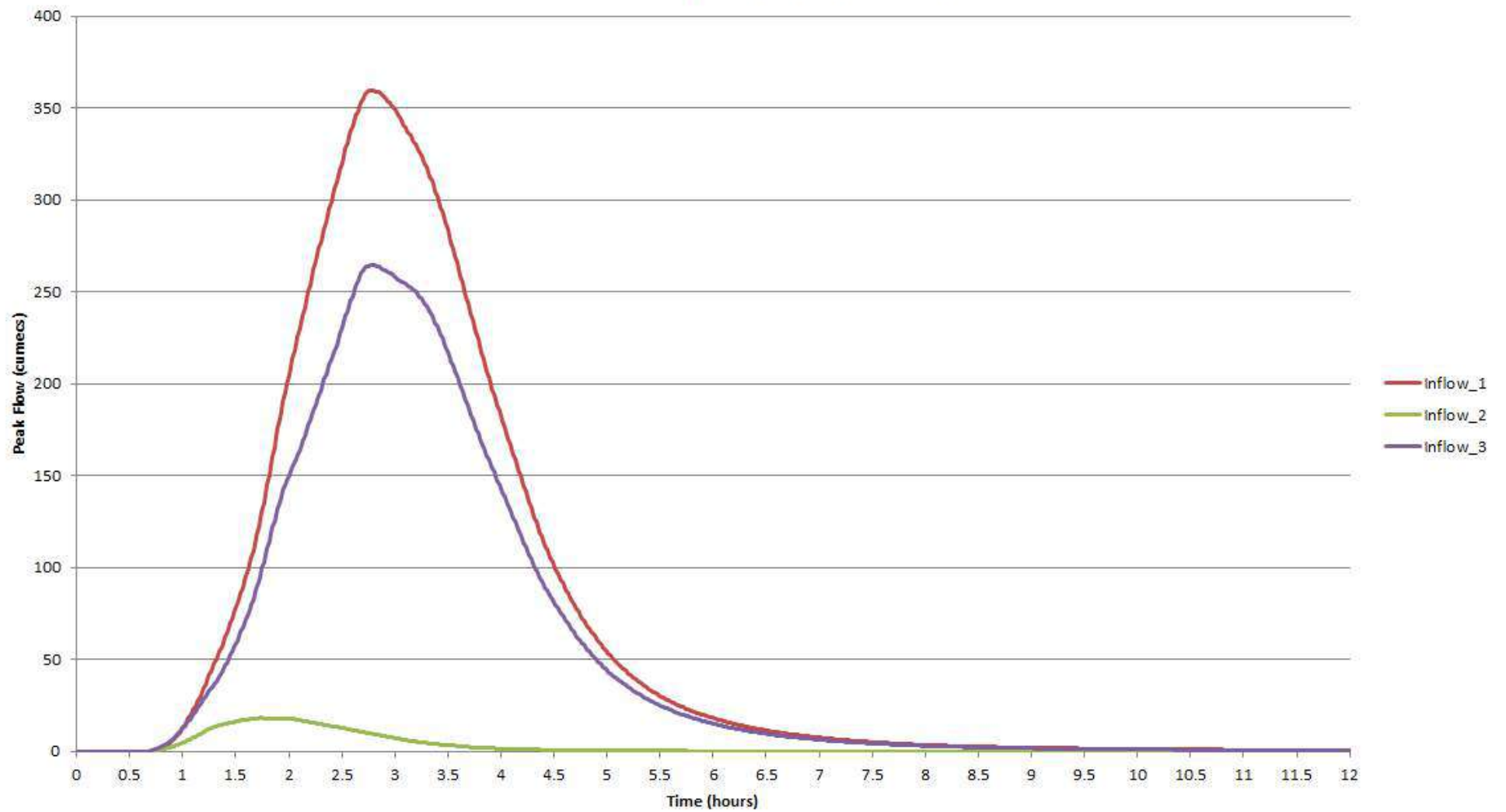
- TXT
- PDF
- Nearby
- JSON

Input Data

# APPENDIX D

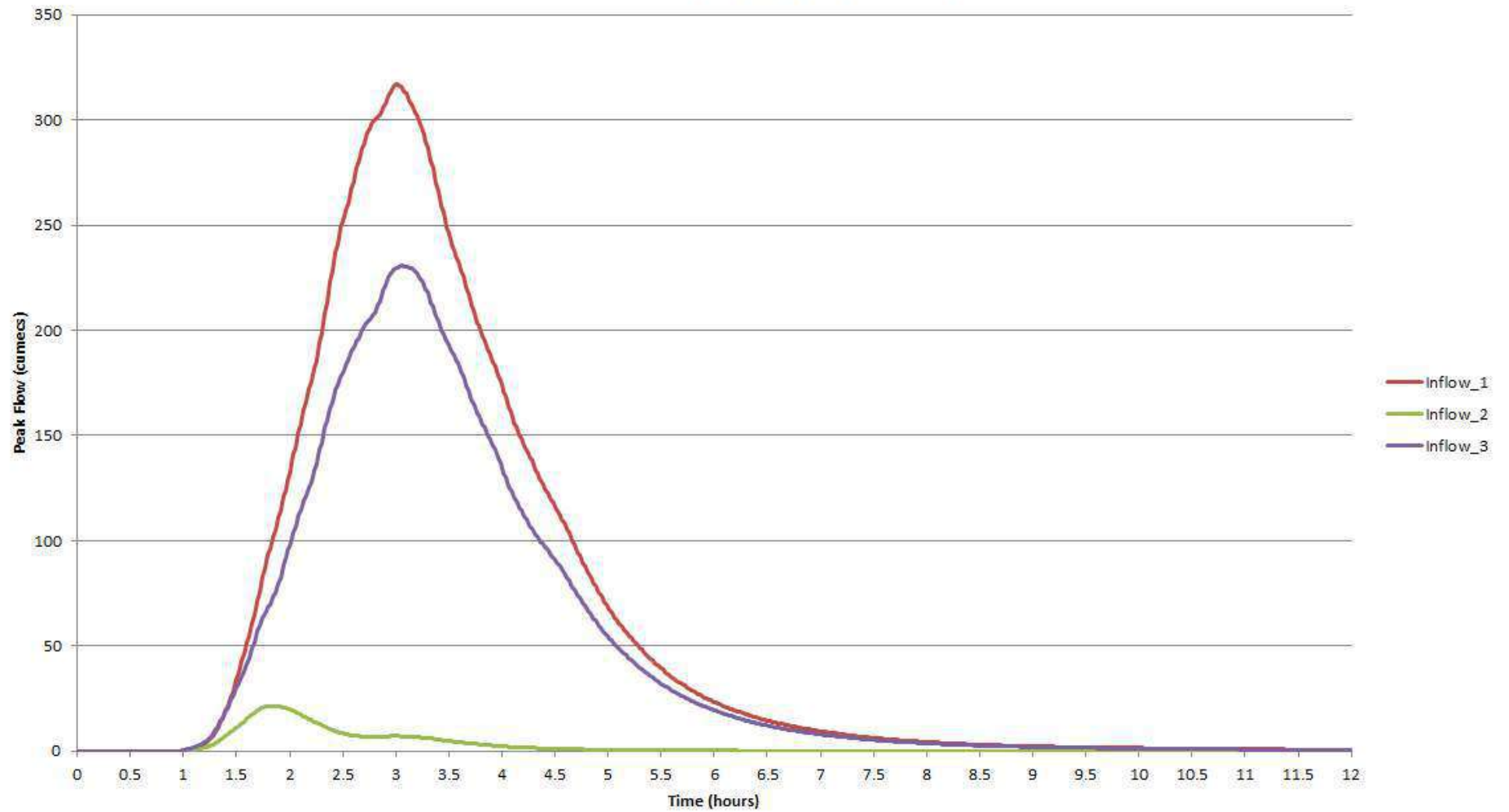
## Inflow Hydrographs

Peak Flow Hydrographs (1% AEP)

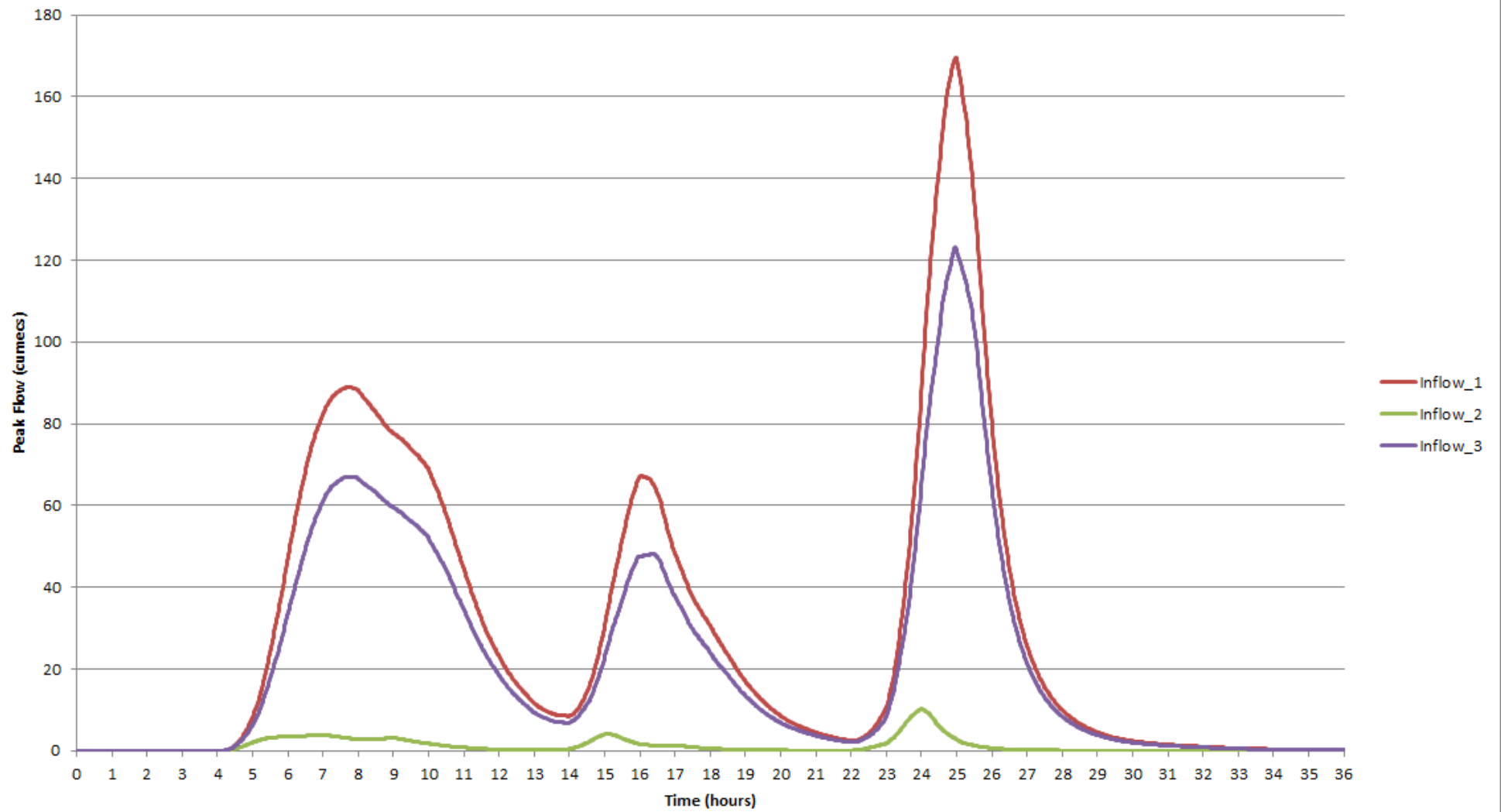




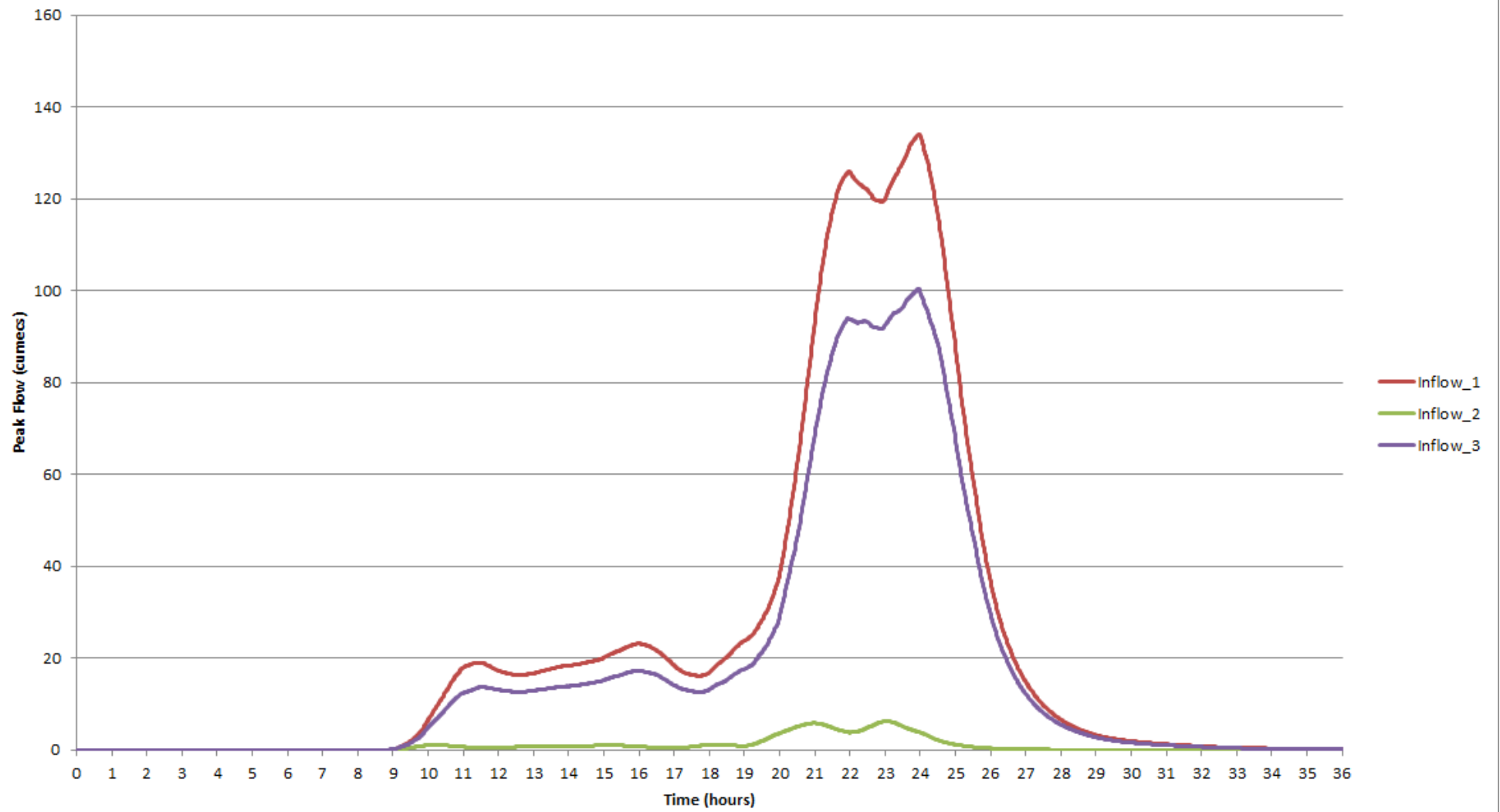
Peak Flow Hydrographs (2% AEP)



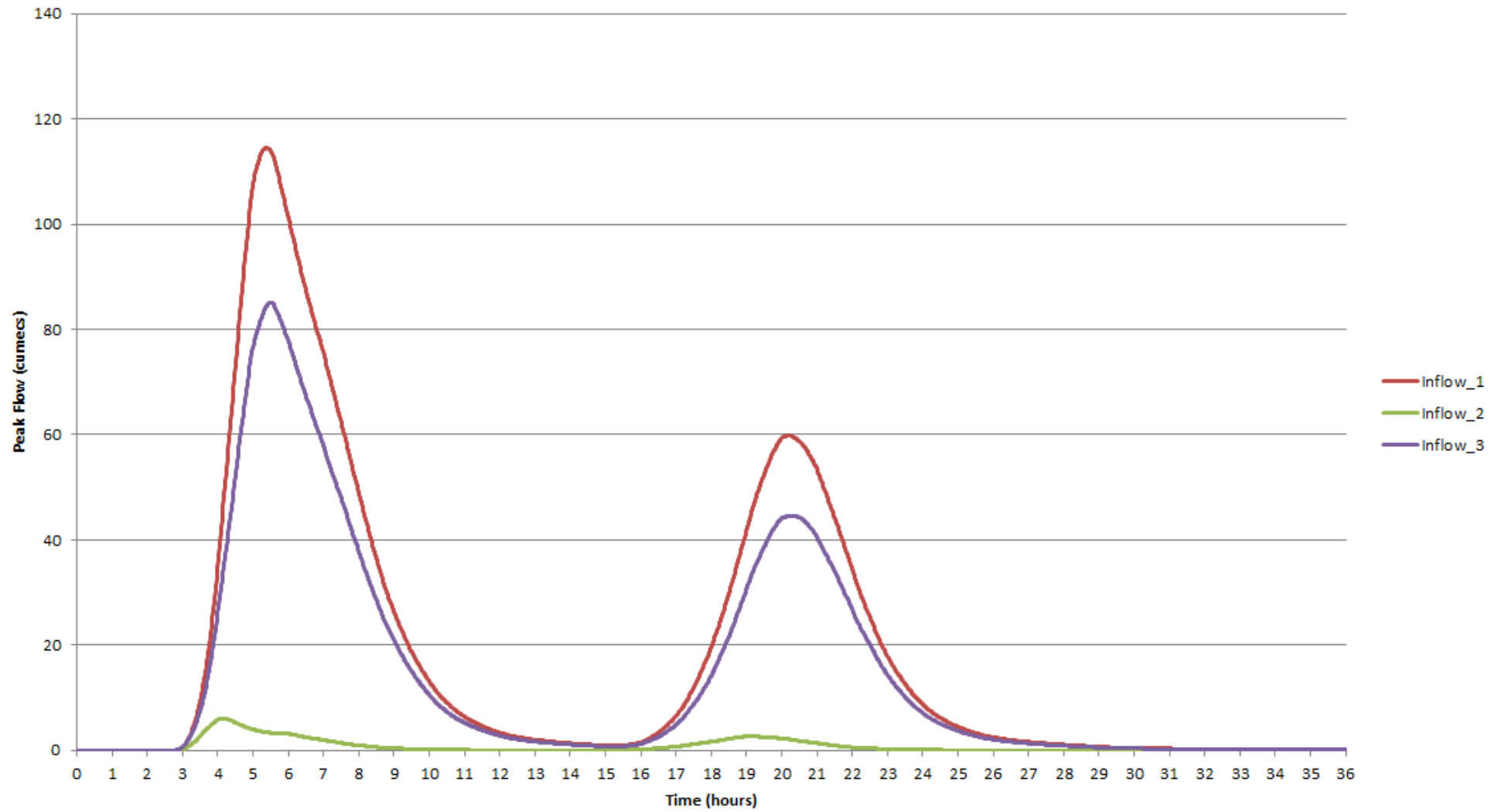
Peak Flow Hydrographs (5% AEP)



Peak Flow Hydrographs (10% AEP)



Peak Flow Hydrographs (20% AEP)

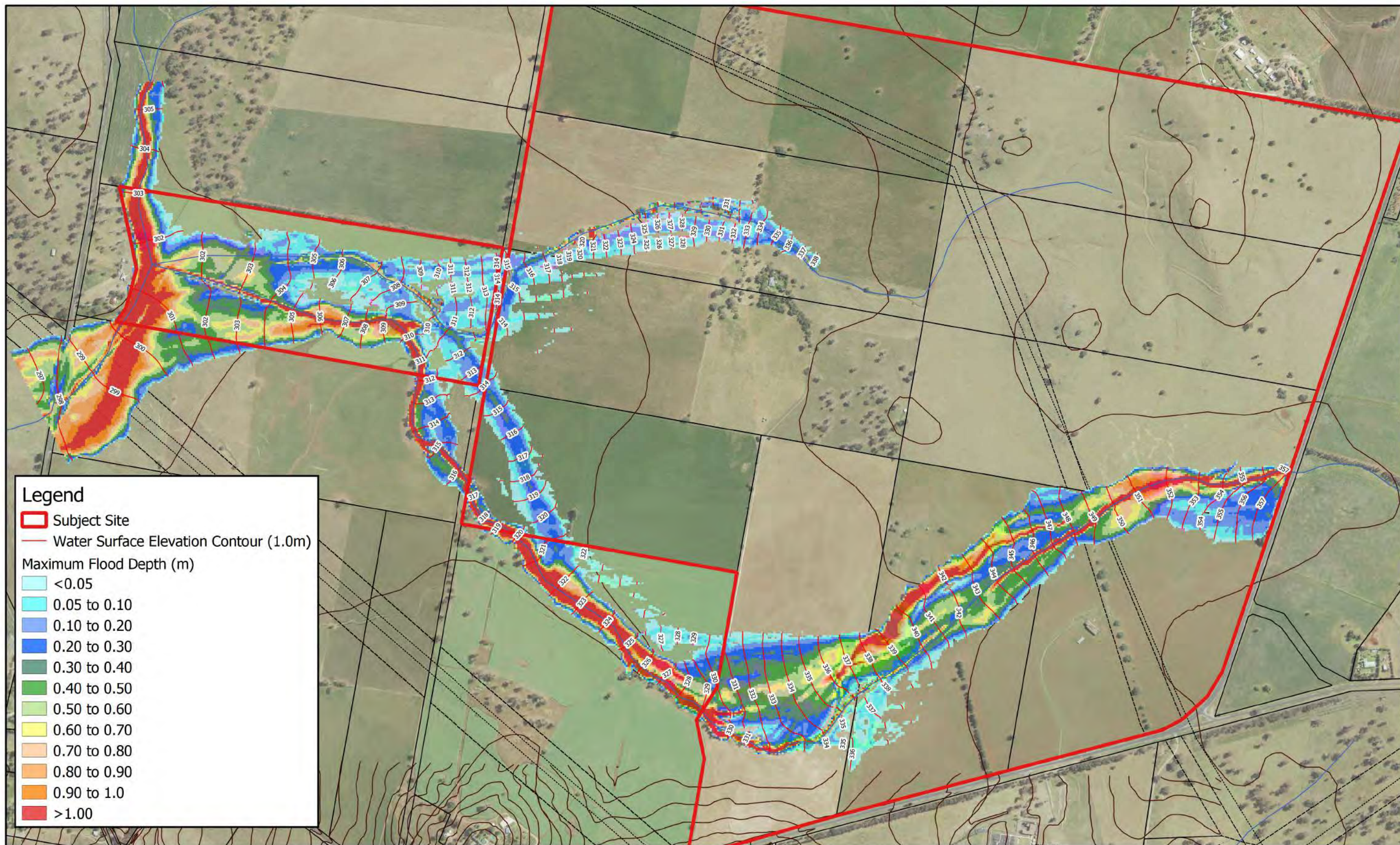




# APPENDIX E

## Flood Mapping





**Legend**

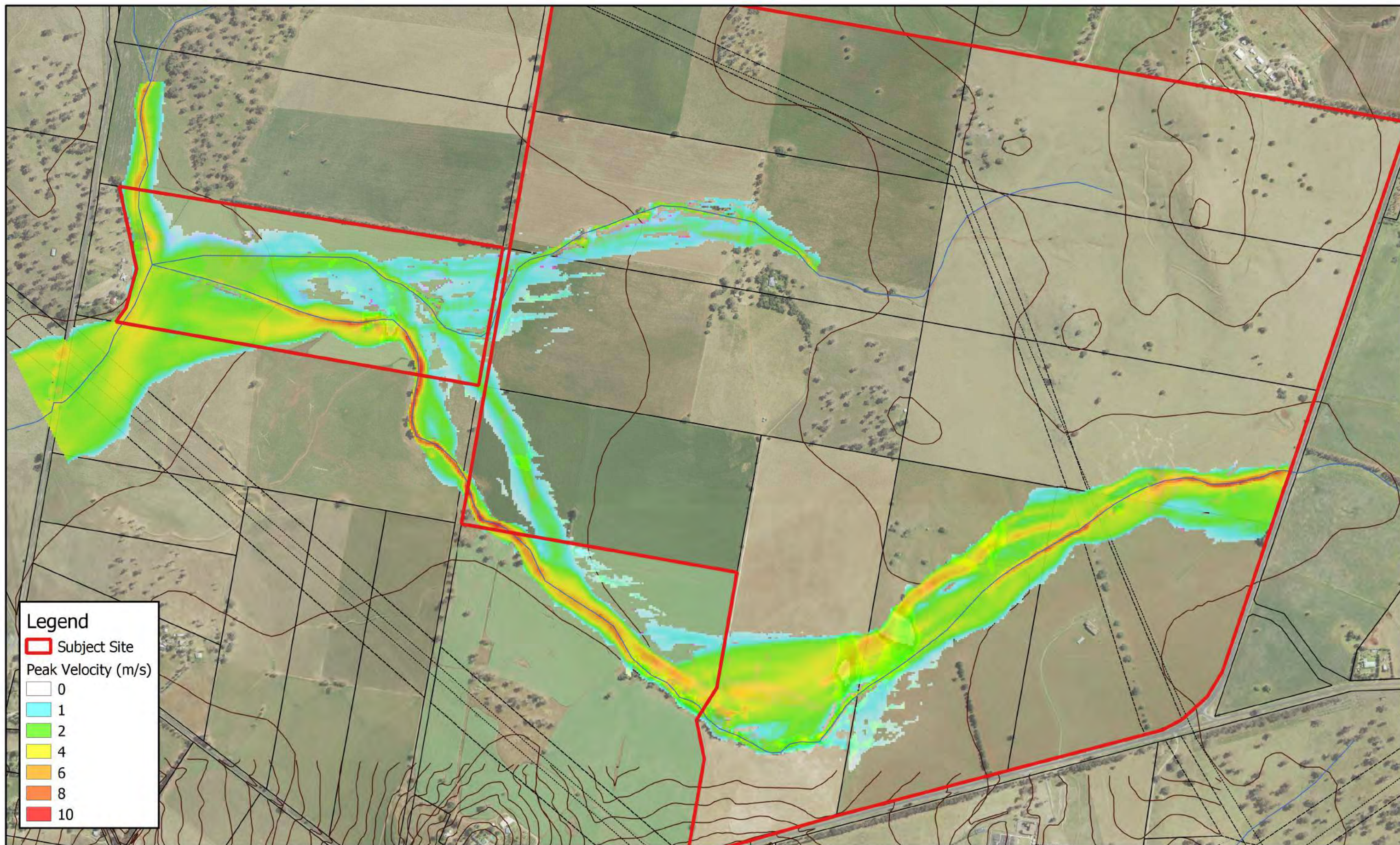
  Subject Site

— Water Surface Elevation Contour (1.0m)

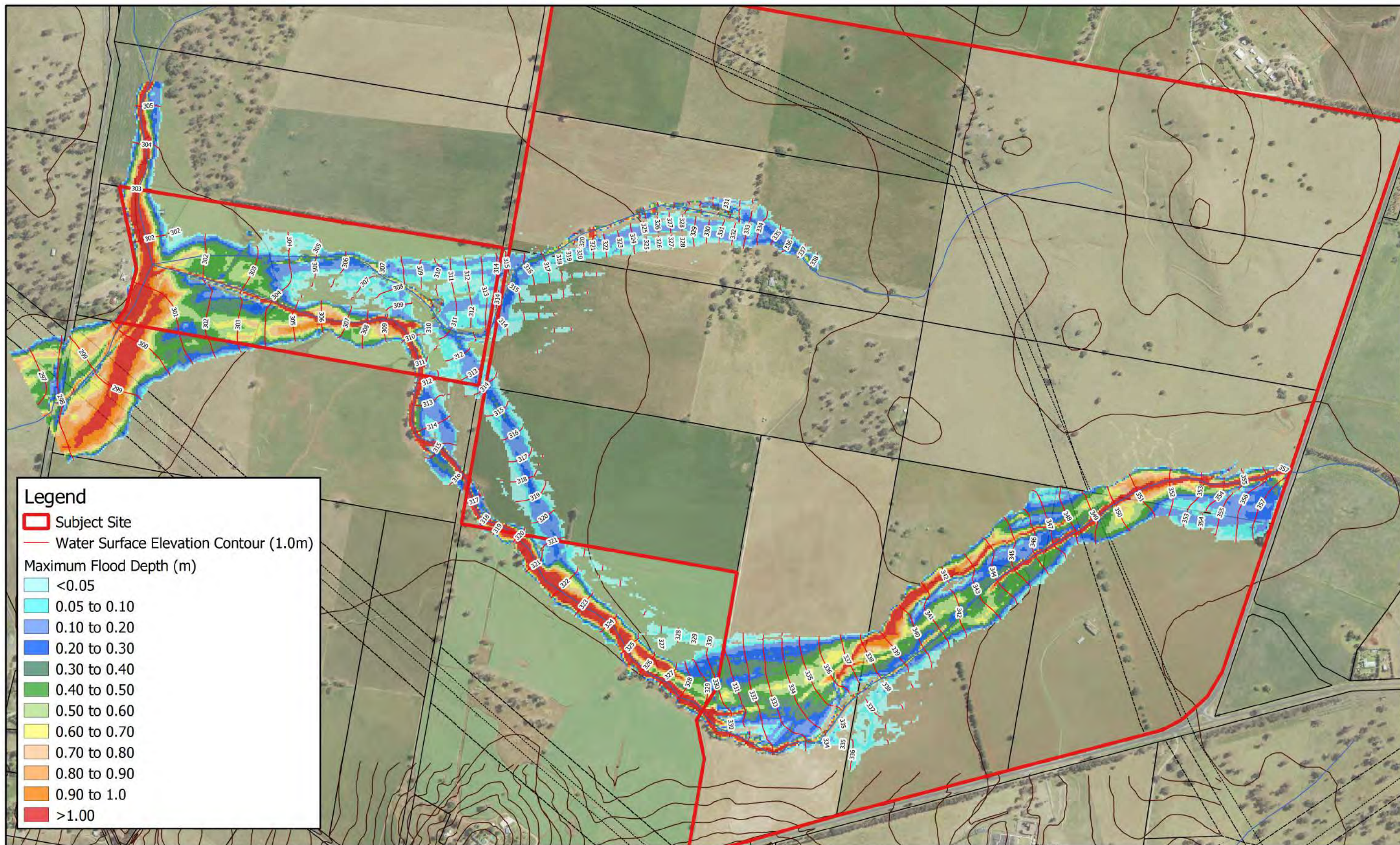
Maximum Flood Depth (m)

<span style="background-color: lightblue; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	<0.05
<span style="background-color: cyan; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	0.05 to 0.10
<span style="background-color: lightblue; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	0.10 to 0.20
<span style="background-color: blue; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	0.20 to 0.30
<span style="background-color: darkblue; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	0.30 to 0.40
<span style="background-color: green; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	0.40 to 0.50
<span style="background-color: lightgreen; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	0.50 to 0.60
<span style="background-color: yellow; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	0.60 to 0.70
<span style="background-color: orange; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	0.70 to 0.80
<span style="background-color: darkorange; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	0.80 to 0.90
<span style="background-color: red; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	0.90 to 1.0
<span style="background-color: darkred; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	>1.00





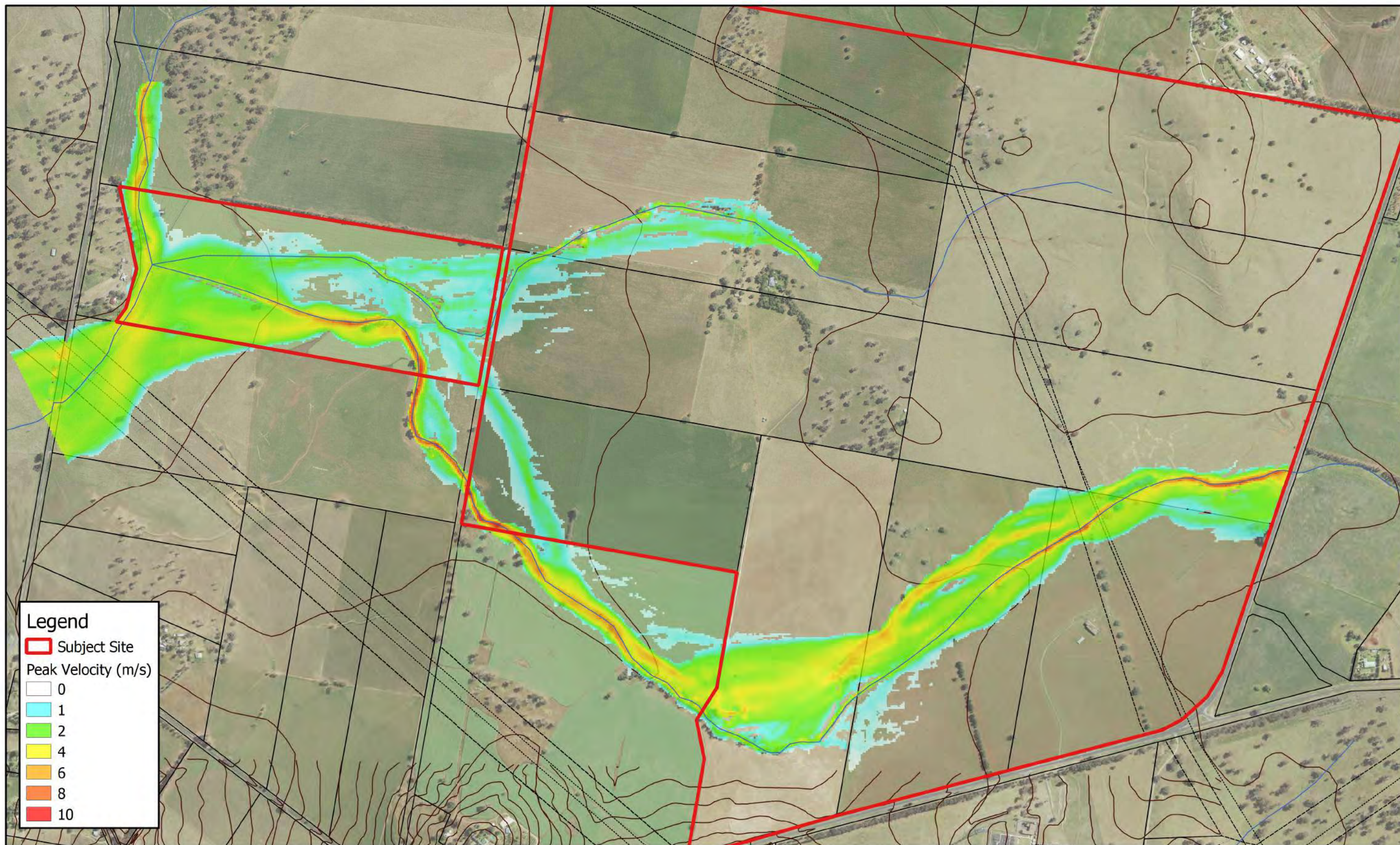




## Legend

- Subject Site
- Water Surface Elevation Contour (1.0m)
- Maximum Flood Depth (m)
- <0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.30
- 0.30 to 0.40
- 0.40 to 0.50
- 0.50 to 0.60
- 0.60 to 0.70
- 0.70 to 0.80
- 0.80 to 0.90
- 0.90 to 1.0
- >1.00





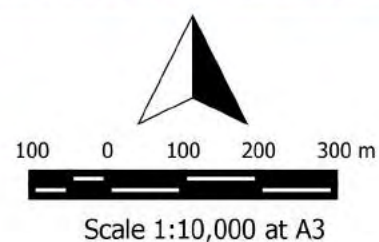
**Legend**

  Subject Site

Peak Velocity (m/s)

0
1
2
4
6
8
10

**footprint.**  
sustainable engineering.  
15 meehan drive, kiama downs,  
nsw 2533 p: (02) 4237 6770



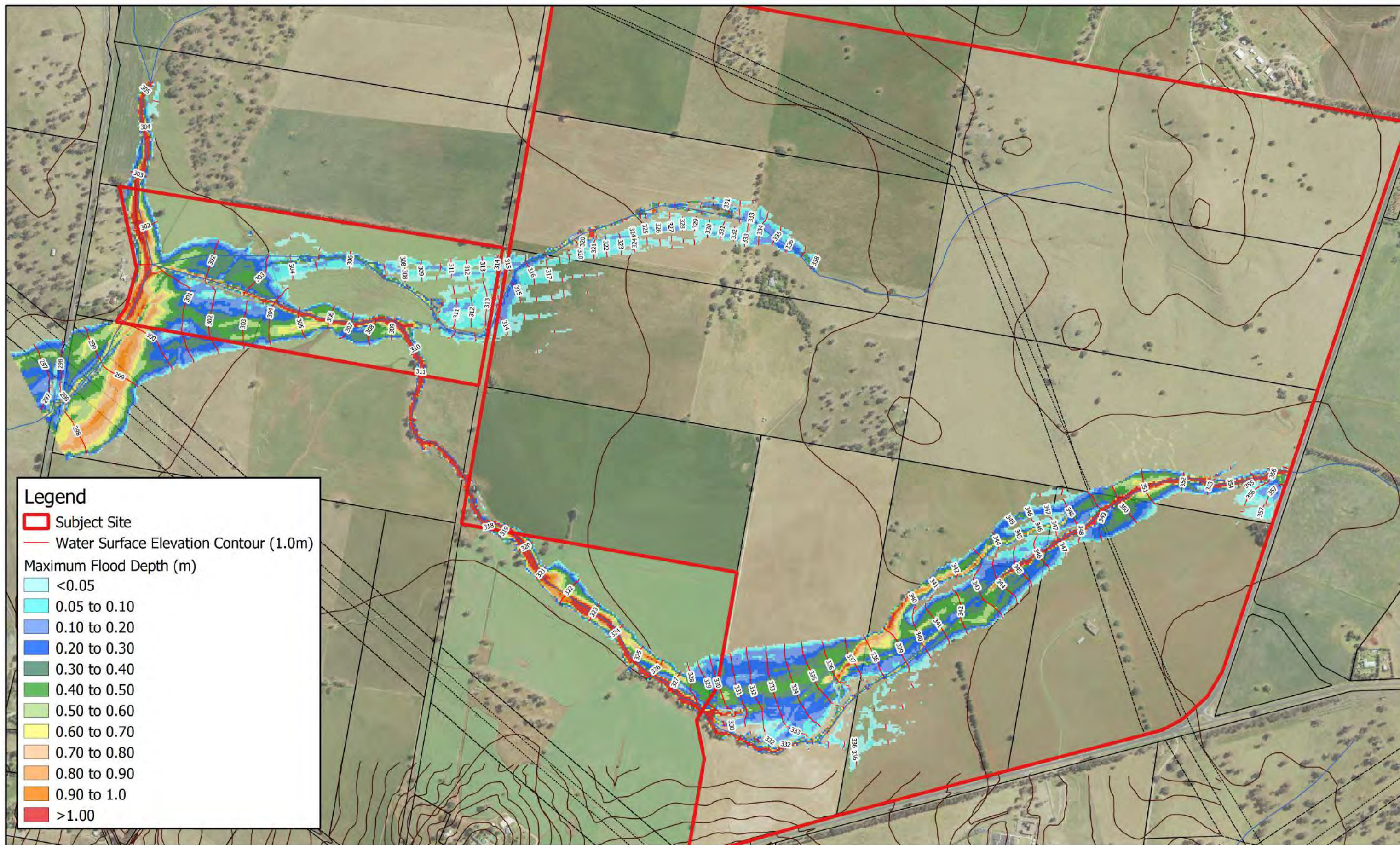
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## PROPOSED WELLINGTON SOLAR FARM HYDROLOGICAL AND HYDRAULIC ANALYSIS

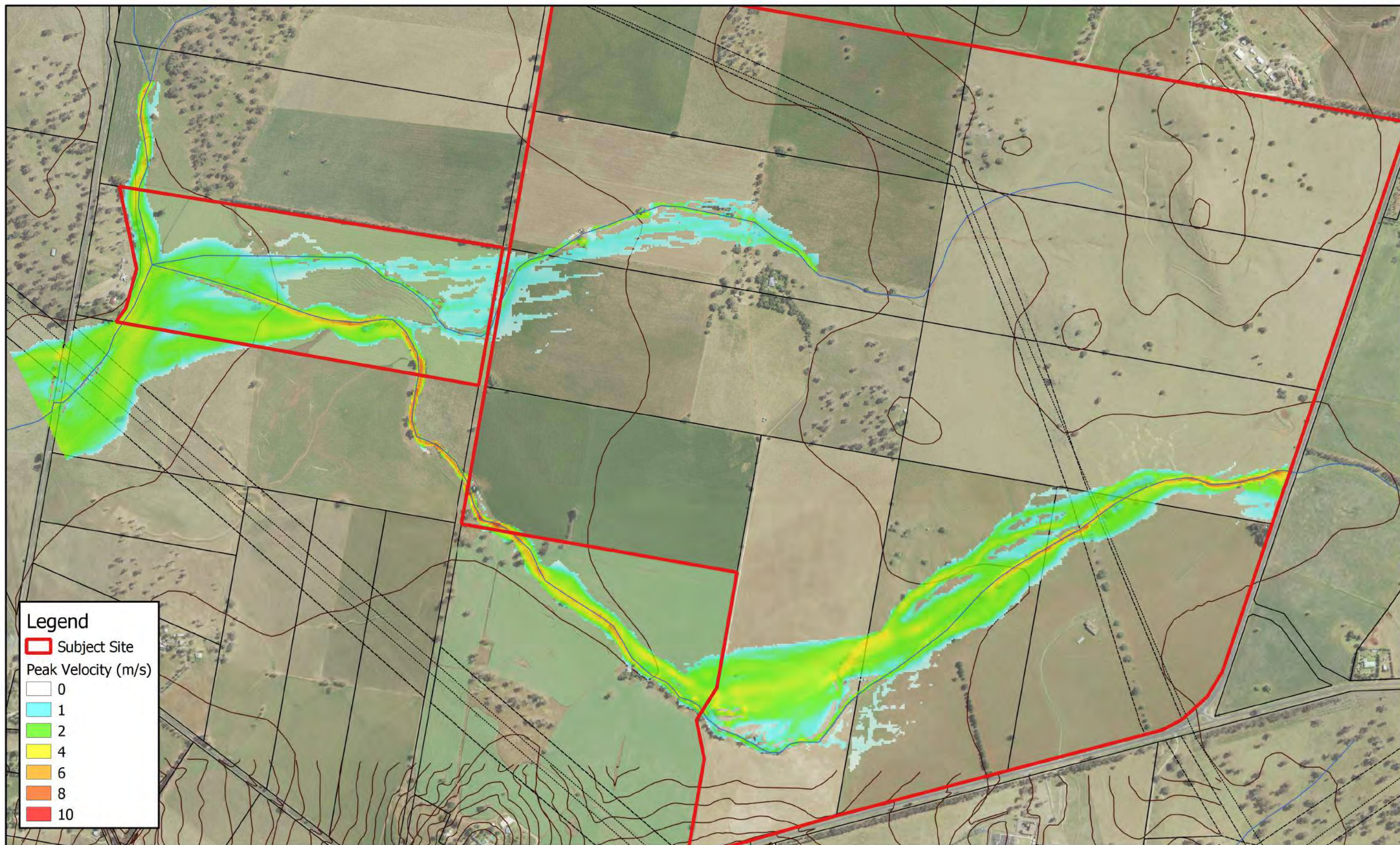
**FIGURE 2.2**  
Pre-Development 2% AEP Peak Velocity

Rev 2 - 15 November 2019









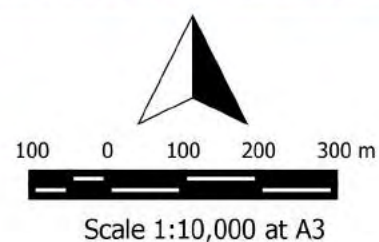
**Legend**

  Subject Site

Peak Velocity (m/s)

0
1
2
4
6
8
10

**footprint.**  
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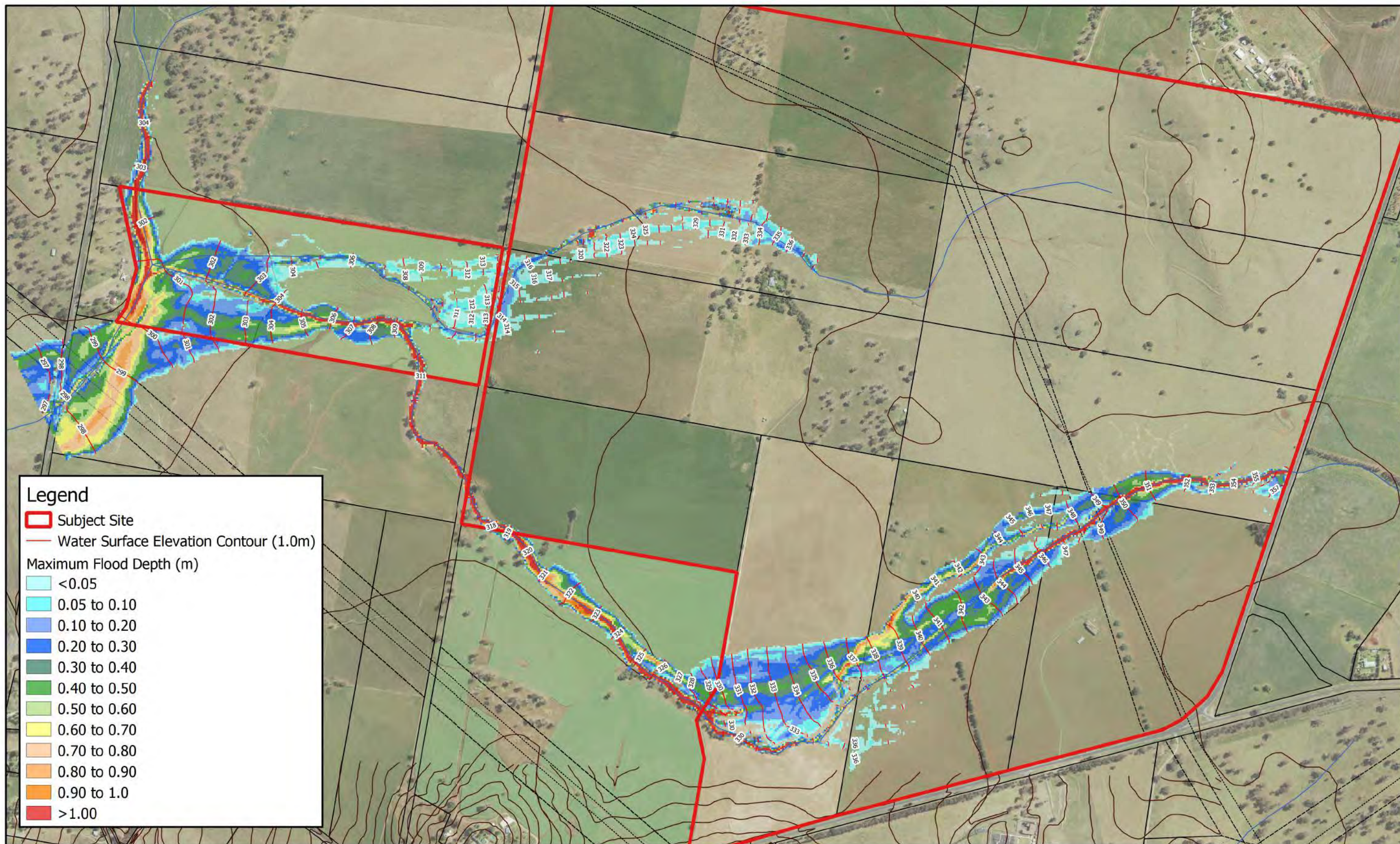
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## PROPOSED WELLINGTON SOLAR FARM HYDROLOGICAL AND HYDRAULIC ANALYSIS

**FIGURE 3.2**  
Pre-Development 5% AEP Peak Velocity

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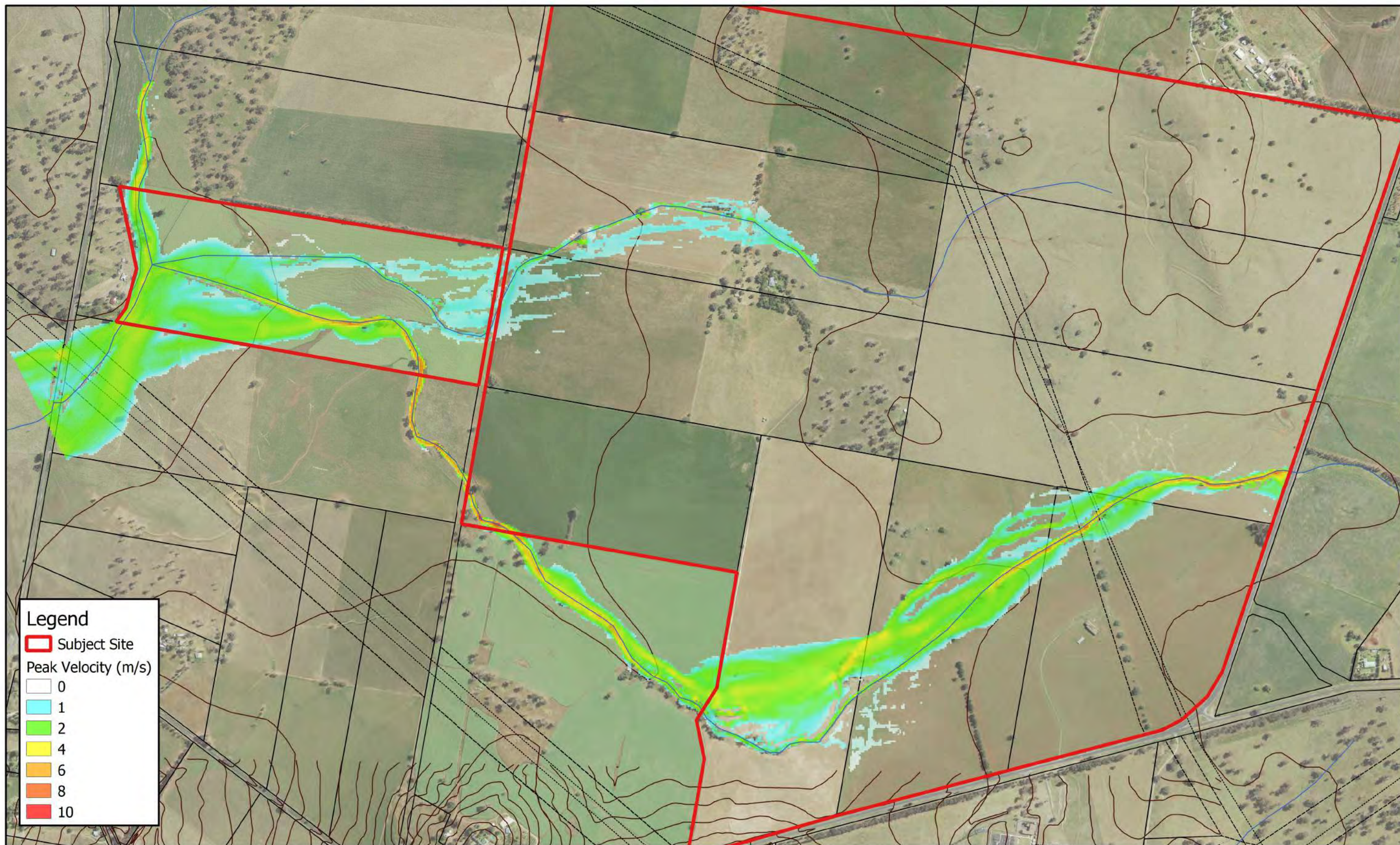




# Legend

- Subject Site
- Water Surface Elevation Contour (1.0m)
- Maximum Flood Depth (m)
  - <0.05
  - 0.05 to 0.10
  - 0.10 to 0.20
  - 0.20 to 0.30
  - 0.30 to 0.40
  - 0.40 to 0.50
  - 0.50 to 0.60
  - 0.60 to 0.70
  - 0.70 to 0.80
  - 0.80 to 0.90
  - 0.90 to 1.0
  - >1.00





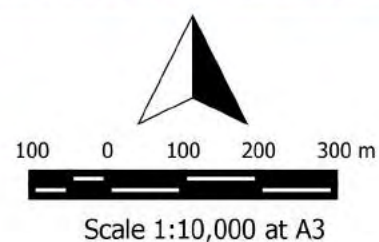
**Legend**

  Subject Site

Peak Velocity (m/s)

0
1
2
4
6
8
10

**footprint.**  
sustainable engineering.  
15 meehan drive, kiama downs,  
nsw 2533 p: (02) 4237 6770



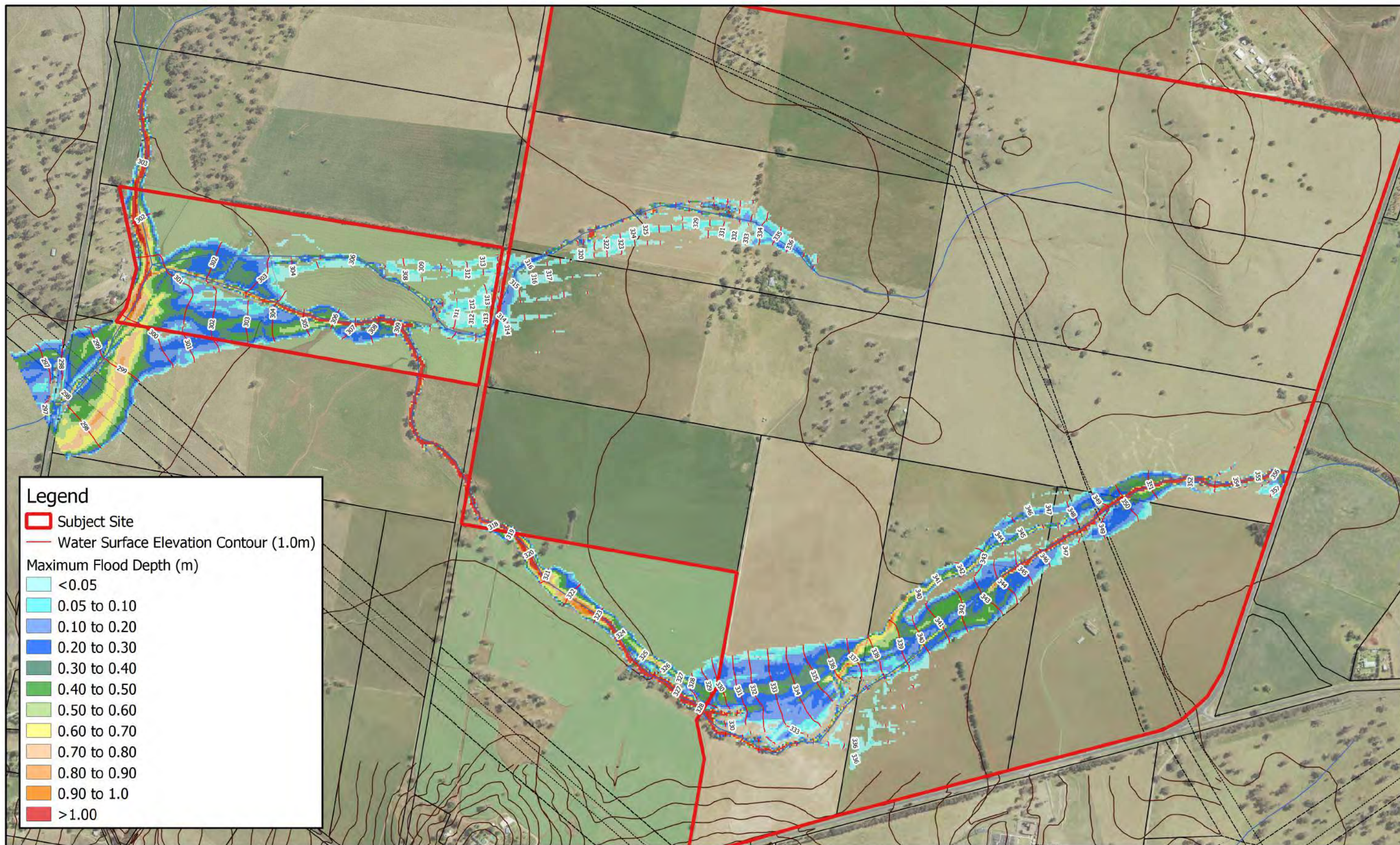
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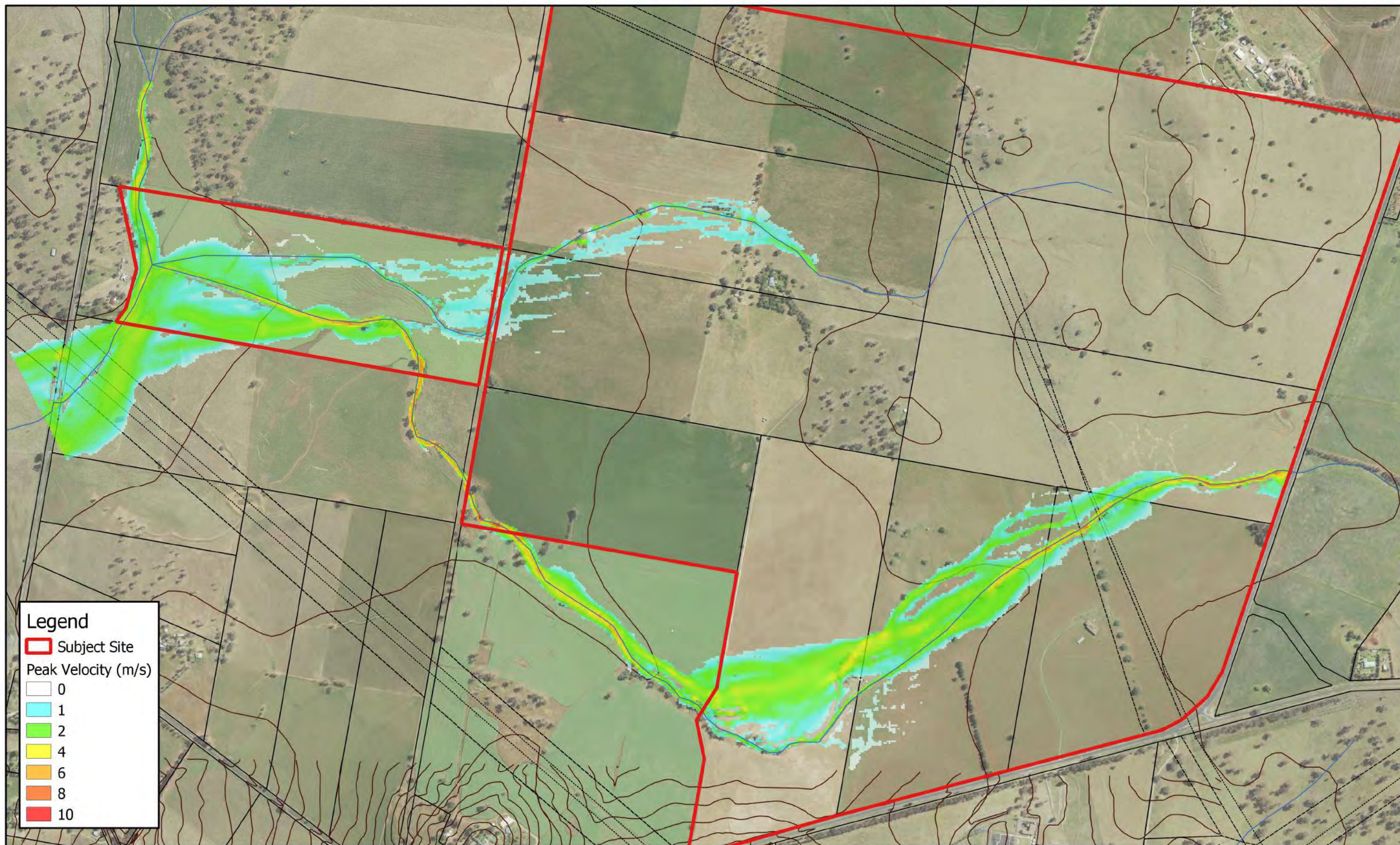
**FIGURE 4.2**  
Pre-Development 10% AEP Peak Velocity

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**Legend**

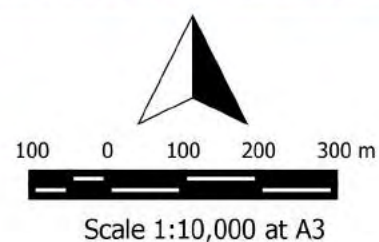
  Subject Site

Peak Velocity (m/s)

0
1
2
4
6
8
10

**footprint.**  
sustainable engineering.  
15 meehan drive, kiama downs,  
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lightsourcebp  



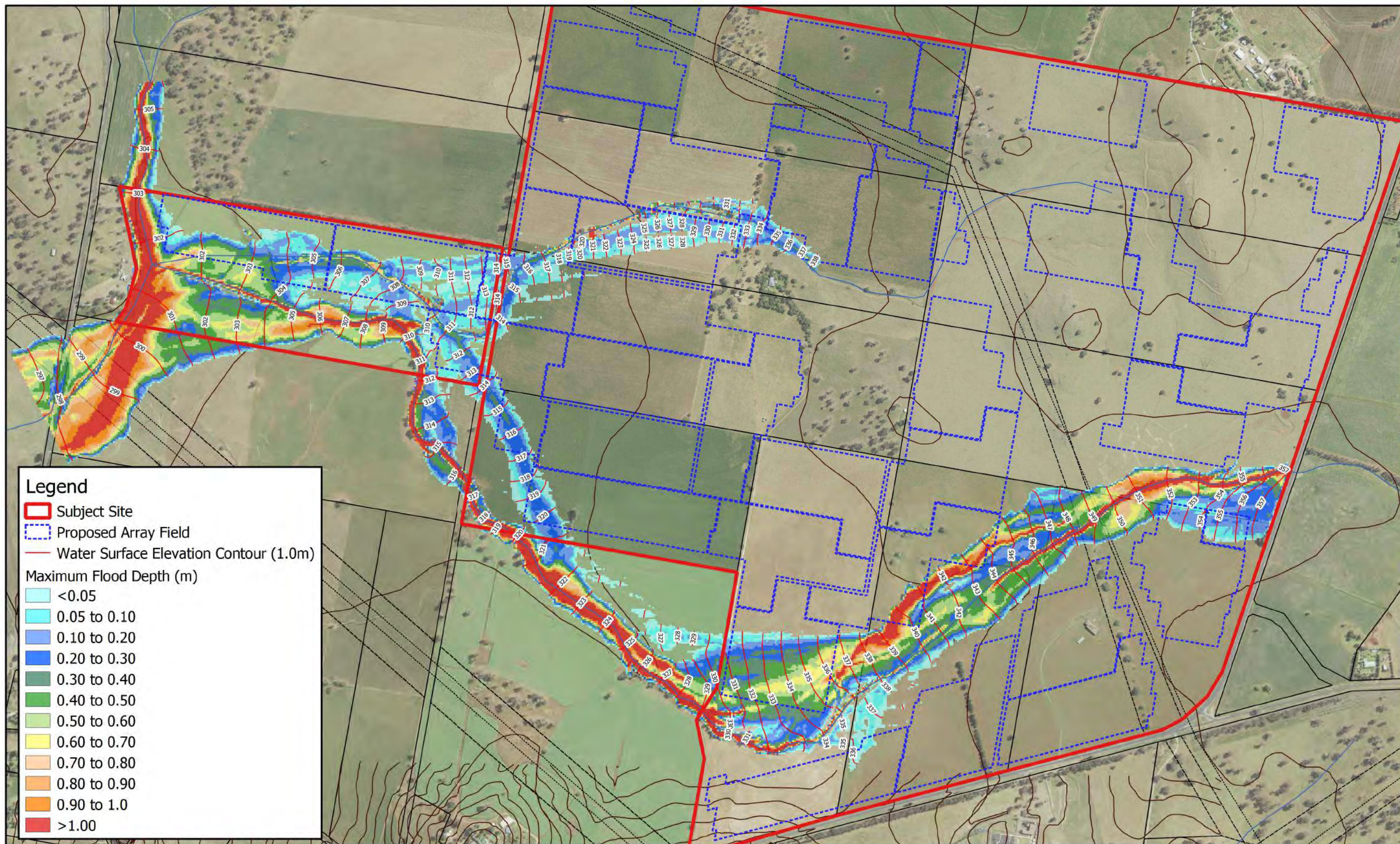
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## PROPOSED WELLINGTON SOLAR FARM HYDROLOGICAL AND HYDRAULIC ANALYSIS

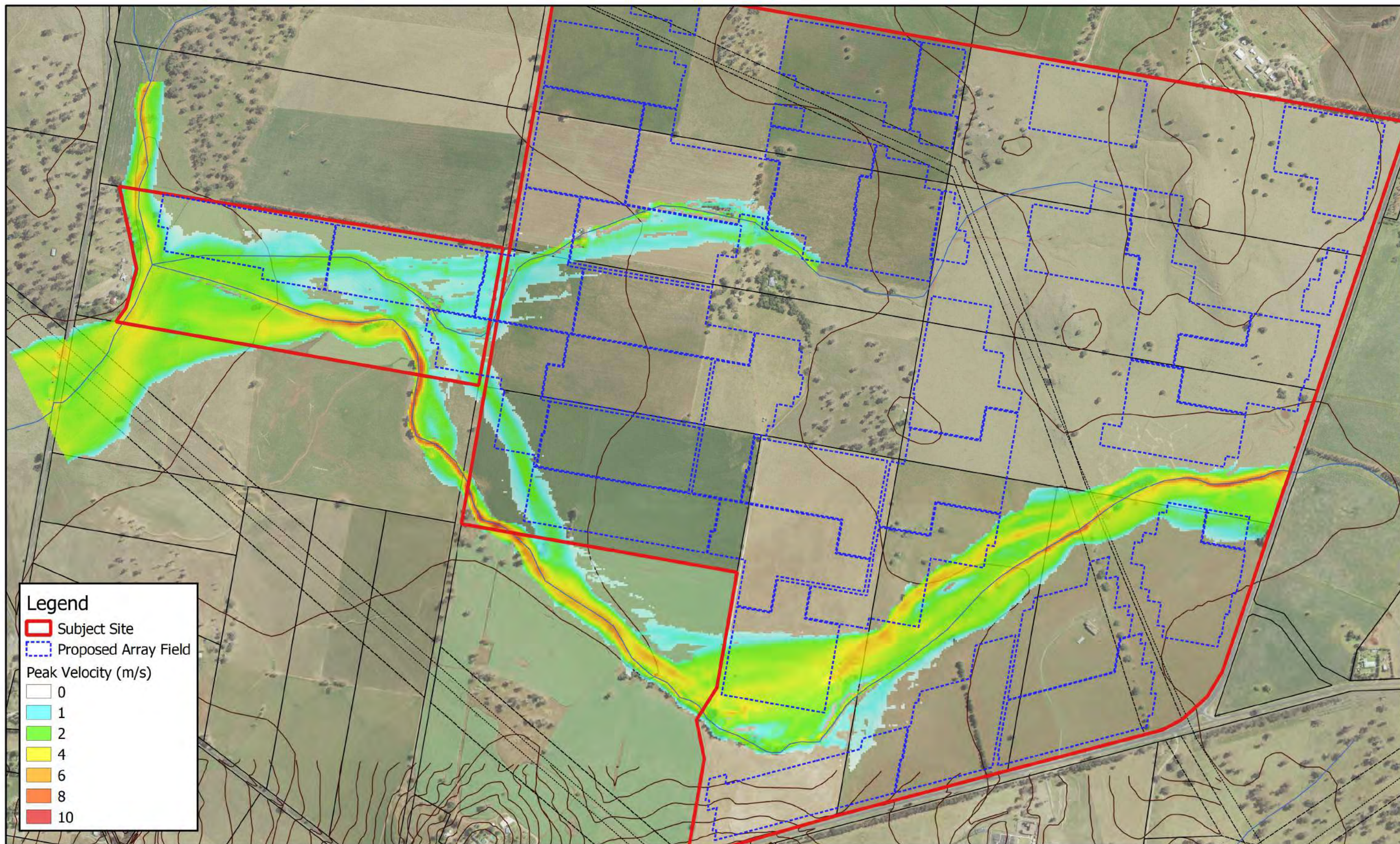
FIGURE 5.2  
Pre-Development 20% AEP Peak Velocity

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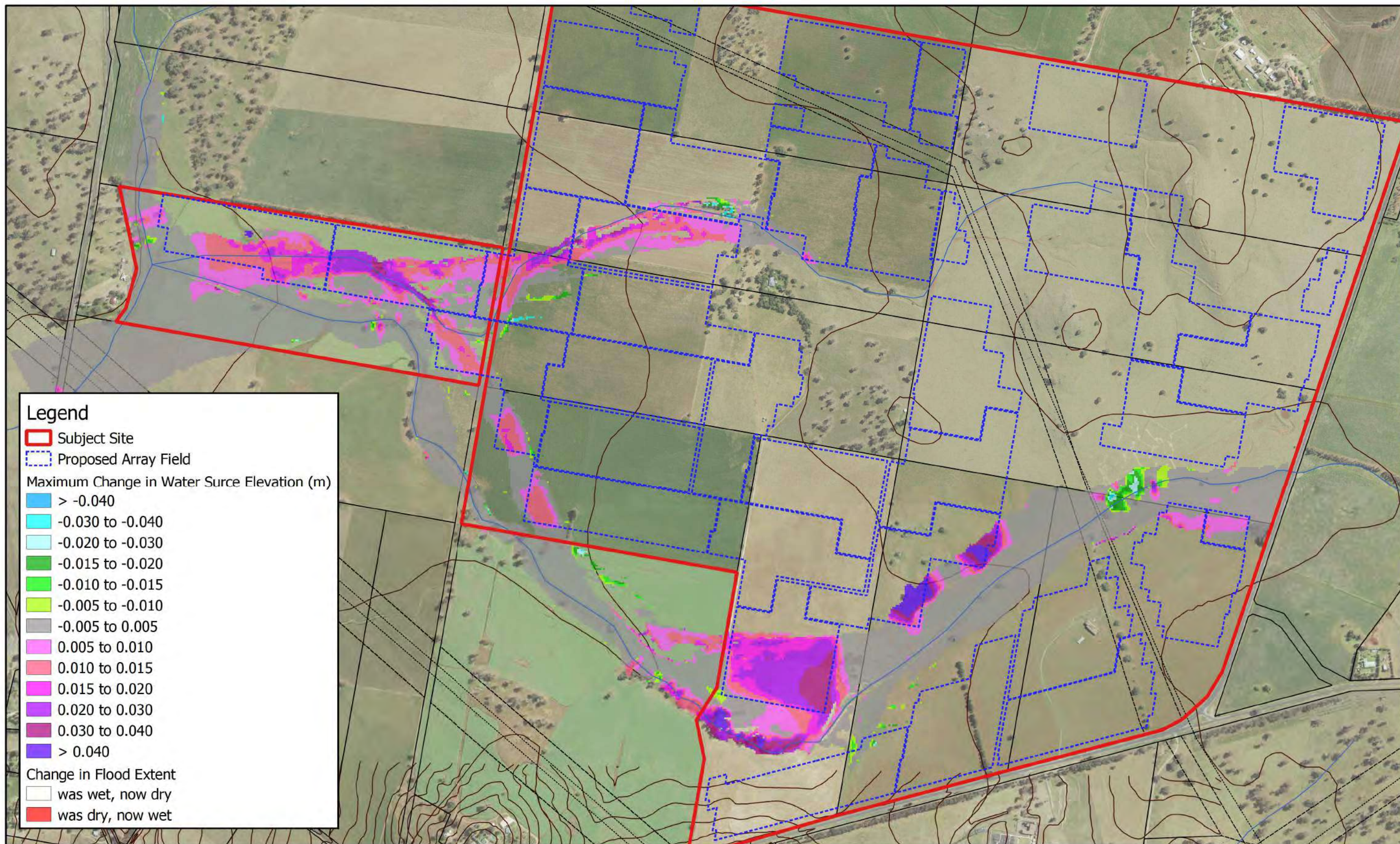




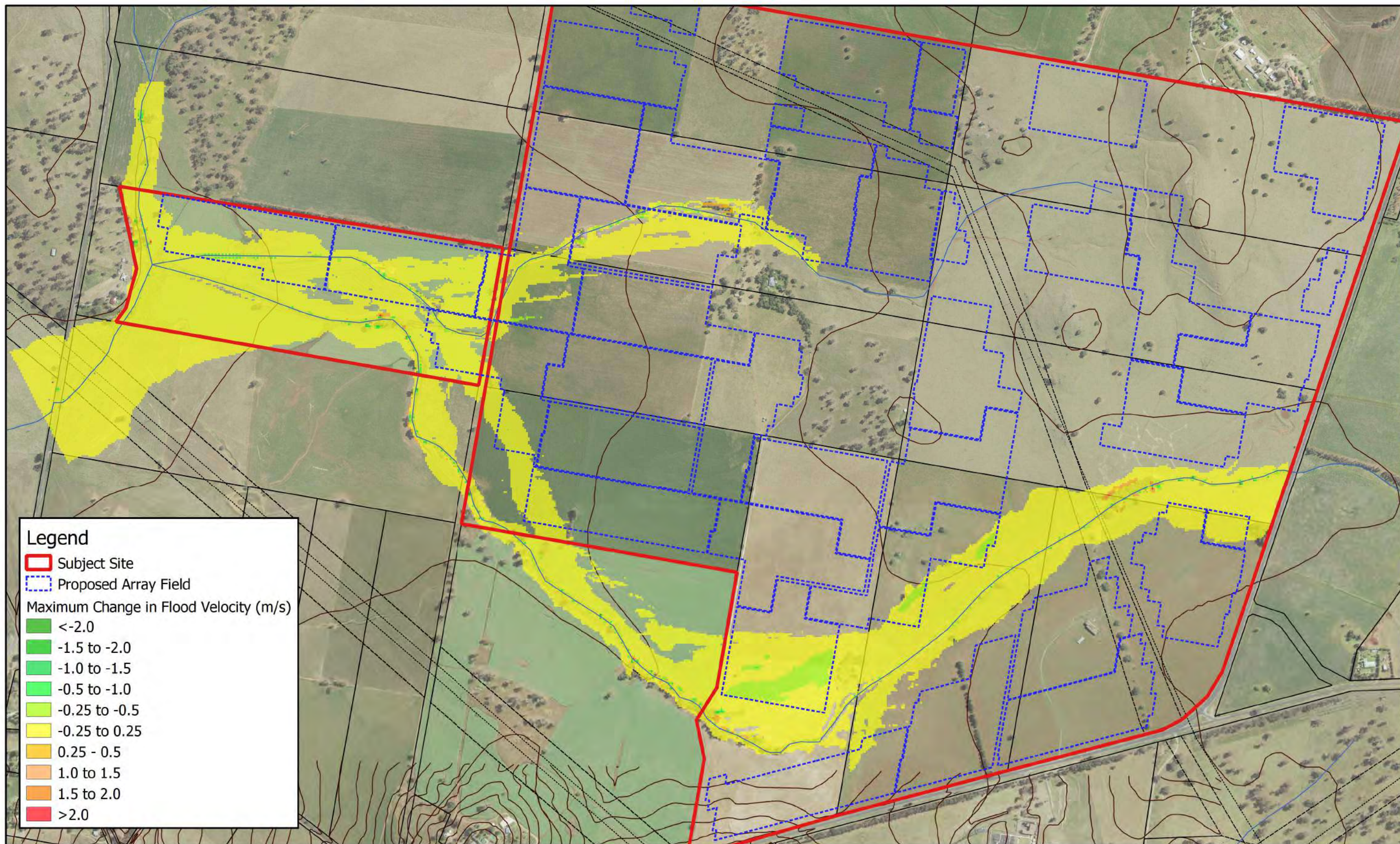




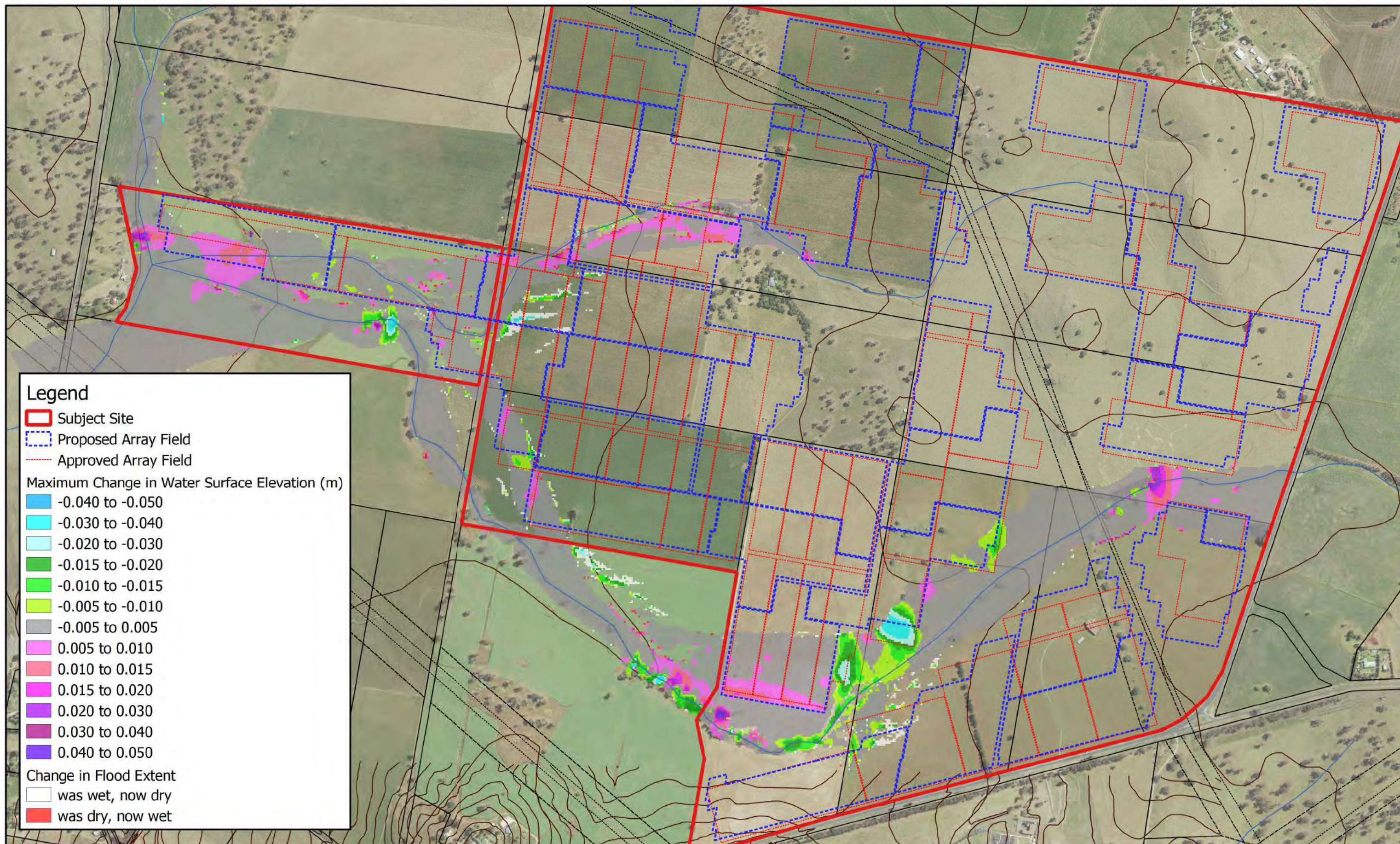














## **C.2 BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT**



**NGH**



# **BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT**

## **Wellington Solar Farm BDAR: Revised Project Layout**

February 2020





## DOCUMENT VERIFICATION

Project Title: Wellington Solar Farm BDAR: Revised Project Layout

Project Number: 19-134

Project File Name: Wellington Solar Farm BDAR

Revision	Date	Prepared by	Reviewed by	Approved by
Final v1	2/12/2019	Taylor Hume, Beth Noel	Brooke Marshall	Brooke Marshall
Final v2.1	17/01/2020	Taylor Hume, Beth Noel	Brooke Marshall	Brooke Marshall
Final V2.2	07/02/2020	Beth Noel	Brooke Marshall	Brooke Marshall

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## **ACRONYMS AND ABBREVIATIONS**

BAM	Biodiversity Assessment Methodology
BC Act	<i>Biodiversity Conservation Act 2016(NSW)</i>
BCD	Biodiversity and Conservation Division of DPIE
BDAR	Biodiversity Development Assessment Report
BGW	Box Gum Woodland
BOM	Australian Bureau of Meteorology
CEEC	Critically Endangered Ecological Community (CW listing)
Cwth	Commonwealth
DBH	Diameter at Breast Height
DNG	Derived Native Grassland
DPIE	(NSW) Department of Planning Infrastructure and Environment
EIS	Environmental Impact Statement
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Cwth)</i>
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW)</i>
ha	hectares
Heritage Act	<i>Heritage Act 1977 (NSW)</i>
HBT	Hollow-bearing Tree
ISEPP	<i>State Environmental Planning Policy (Infrastructure) 2007 (NSW)</i>
KFH	Key Fish Habitat
km	kilometres
m	Metres
NSW	New South Wales
OEH	(NSW) Office of Environment and Heritage, now BCD
PV	Photovoltaic
SSD	State Significant Development
sp/spp	Species/multiple species
TEC	Threatened Ecological Community – as defined under relevant law applying to the proposal

## EXECUTIVE SUMMARY

### Overview

This Biodiversity Assessment Report (BDAR) has been prepared by NGH on behalf of the proponent, Lightsource BP, who has proposed changes to Wellington Solar Farm, originally approved in May 2018 (SSD 8573). The first Modification Application for the substation extension – MOD 1 Substation Extension (NGH 2019) was approved by the Department of Planning Industry and Environment (DPIE) in December 2019. The approved SSD project has a credit requirement calculated under the 'Framework for Biodiversity Assessment' and subsequently converted using an application for reasonable equivalence to credits under the *Biodiversity Conservation Act* (BC Act). It also has a supplementary credit requirement calculated under the BC Act for an expansion to the existing Wellington substation under MOD 1.

A second Modification Application (MOD 2), this report, has been lodged to alter the indicative solar panel layout presented in the EIS. However, the entire project has *not* been reassessed under the BC Act, as this would have led to unnecessary duplication of assessment for areas that remain impacted in the new layout. These areas are already included in the reasonable equivalence credit profile. To account for new areas to be impacted and areas where impacts would now be avoided, the Biodiversity Assessment Method (BAM), pursuant to the BC Act, was applied to these 'additional' and 'excised' areas only. The *net* impact therefore becomes the updated project credit requirement.

Specifically, pursuant to the BC Act, the aim of this BDAR is to:

- identify, assess and derive the credit number for the additional areas now being impacted by the solar farm footprint, that were not impacted by the approved footprint.
- identify, assess and derive the credit number for the areas that will now be removed from the approved solar farm footprint (areas that *were* impacted but are now excised from the approved footprint).
- Reconcile the credit requirement of the original SSD approvals, MOD 1 and this proposed MOD 2 to give one updated credit requirement for the Wellington Solar Farm project.

This BDAR has been prepared to support the MOD 2 submission to Department of Planning Infrastructure and Environment.

### Key results

#### *Ecosystem credits*

In terms of the impacts on vegetation and the generation of ecosystem credits, the changes proposed in MOD 2 compared with the approved footprint are summarised as follows:

- An overall additional impact of 0.02 ha of PCT 277 White Box Yellow Box Blakely's Red Gum woodland. Zone 1, this generates no credits;
- An overall reduced impact of 6.90 ha of PCT 266 – White Box grassy woodland in the upper slopes sub-region of NSW South Western Slopes. Zones 2 and 4, together now generate 3 credits for the project. For Zones 3, 5 and 6, the net effect is zero credits;
- An overall additional impact of 15.43 ha of exotic vegetation. This generates no credits.

The changes to the development footprint have resulted in an overall reduction in native vegetation being impacted and therefore a reduced credit requirement. Even though there is an overall increase in clearing, the impacts to exotic/planted areas did not generate credits. This has resulted in the footprint increasing in size but the biodiversity impacts and offset requirement being reduced.



The following details the ecosystem credits generated for the additional and excised areas for each vegetation zone for MOD 2. The net credit requirement that now applies to the project is summarised in the righthand column. Note: as the areas that are now being excised in Zones 3, 5 and 6 represent more credits than the areas now being added, the net result is that there will be no ecosystem credits required to be retired in these zones.

Zone	PCT and structure	Condition	Approved Credit Requirements		Credits Requirements Mod 2 (this report)		Updated credit requirement
			Original Approval SSD8573 (converted via reasonable equivalence)	Mod 1	Additional area credits	Excised area credits	(Net)
PCT 277							
Zone 1	PCT 277 woodland	low condition	0	0	0	0	0
PCT 266							
Zone 2	PCT 266 planted woodland	moderate to good condition	0	1	0	0	1
Zone 3	PCT 266 woodland	low condition	1	0	+1	-2	0
Zone 4	PCT 266 woodland	moderate to good condition (hollow bearing trees present)	1	0	+1	0	2
Zone 5	PCT 266 derived grassland	moderate to good condition	0	0	+1	-5	0 (-4)
Zone 6	PCT 266 derived grassland	low condition	0	0	+64	-129	0 (-65)

#### *Species credits*

In completing the site assessment for MOD 2, only the additional and excised areas were assessed on site. Targeted surveys were undertaken for candidate flora species where habitat elements were known to exist onsite. Of the flora species surveyed, none were found during targeted surveys. The majority of fauna candidate species identified in the BAM calculator were excluded from further assessment due to a lack of suitable habitat available onsite. For the remainder, due to time constraints, fauna surveys were not conducted for species that had not been previously assessed such as the Bush Stone-curlew, Gang-gang Cockatoo, White-bellied Sea-eagle, Square-tailed Kite, Little Eagle and Superb Parrot. These were all assumed to be present and appropriate credits generated. Other fauna surveyed in 2016 and 2017 had sufficient data to exclude them.

In regard to Species Credit Species for MOD 2 there is one additional credit required for the Gang-gang Cockatoo and one additional credit required for the Superb Parrot, otherwise there are no additional impacts to species credit species due to less impacted areas than excised areas. Note: as the areas that are now being excised represent more species credits than the areas now being added for the White-bellied Sea-Eagle, Square-tailed Kite and Little Eagle, the net result is that there will be no credits required to be retired for these species.

The following details the updated (and net) species credit species generated for the project:

Species	Approved Credit Requirements		Change in credits Mod 2 (this report)		
	Original Approval	Mod 1	Additional areas	Excised areas	Updated project requirement (net)
Gang-gang Cockatoo	0	0	+1	0	1
White-bellied Sea-Eagle	0	0	+1	-2	0 (-1)
Square-tailed Kite	0	0	0	-2	0 (-2)
Little Eagle	0	0	0	-2	0 (-2)
Superb Parrot	0	0	+1	0	1
Pink-tailed Legless Lizard	0	2	0	0	2

The net credit requirement for the Wellington Solar Farm is:

- 1 ecosystem credit for PCT 266 planted woodland
- 2 ecosystem credits for PCT 266 woodland moderate to good (with hollow bearing trees)
- 1 species credit for Gang Gang
- 1 species credit for Superb Parrot
- 2 species credit for Pink-tailed Legless Lizard

Mitigation and management measures are proposed to adequately address impacts associated with the proposal, both directly and indirectly. The retirement of the updated credit requirement is proposed to be carried out in accordance with the NSW Biodiversity Offsets Scheme and will be achieved by either:

- a) Retiring credits under the Biodiversity Offsets Scheme, or
- b) Making payments into the Biodiversity Conservation Fund using the offset payments calculator, or
- c) Funding a biodiversity action that benefits the threatened entity impacted by the development.



# 1 INTRODUCTION

## 1.1 THE APPROVED PROJECT – WELLINGTON SOLAR FARM

Wellington Solar Farm is located 2 km north-east of Wellington in the Dubbo Regional Local Government Area (LGA). Development Consent was approved by the Executive Director Department of Planning and Environment (DPE) on May 25, 2018 (Application Number: SSD 8573) under Section 4.38 of the *Planning and Environment Act, 1979*. The development application is approved under Schedule 1, subject to the conditions in Schedules 2-4.

The conditions are required to:

- Prevent and/or minimise any adverse environmental impacts of the development
- Set standards and performance measures for acceptable environmental performance
- Provide for the ongoing environmental management of the development.

The existing consent permits the construction, operation and decommissioning of a 174 Megawatt (MW AC) photovoltaic (PV) solar farm and associated infrastructure including:

- Solar array modules.
- Substation and transformers.
- Underground transmission cable
- Battery storage facility.
- Access tracks.

The first Modification Application for the substation extension – MOD 1 Substation Extension (NGH 2019) was approved by the Department of Planning Industry and Environment (DPIE) in December 2019.

## 1.2 MODIFICATION APPLICATION

The proposed changes to the development are a result of the detailed design phase impacting on the arrangement of solar panel modules assumed by the previous assessment. The design aims to optimise the yield of the solar farm while minimising environmental impacts as much as possible. As these changes impact on the biodiversity credit requirement for the project, an updated credit assessment is required using the BC Act BAM calculator. This BDAR will support the second Modification Application (MOD 2) for this project.

## 1.3 PROPOSAL FOR THE REVISED PROJECT LAYOUT

The second Modification Application – MOD 2 Revised Project Layout (NGH 2019) was submitted to DPIE in December 2019, for changes to the Wellington Solar Farm (SF) infrastructure layout. The proposed changes to the development are a result of the detailed design phase impacting on the arrangement of solar panel modules assumed by the previous assessment. The design aims to optimise the yield of the solar farm while minimising environmental impacts as much as possible. Refer to Figure 1-1 showing the proposed development layout, Figure 1-2 showing the impact areas to be added and excised from the development footprint and Figure 1-3 shows the proposed development footprint in comparison with the approved development footprint.

Panels would be placed in additional areas within the proposal area, avoiding all exclusion zones stipulated in the modified Development Consent. The total developed area under the indicative layout presented in the EIS was 282 ha. The changes proposed:

- add approximately 30 ha to the development footprint;
- remove approximately 22 ha from the development footprint; and
- maintain a consistent impact development footprint of 258 ha.

The development footprint would now total 288 ha under the modified layout (a 6 ha or 2% increase in total development footprint). The following Table 1-1 shows a comparison of infrastructure changes from MOD 1 to MOD 2 and their impact upon the footprint (decrease vs increase).

*Table 1-1 Comparison of changes to infrastructure MOD 1 to MOD 2*

Parameter	Approved project (MOD 1)	Modification Application (MOD 2)	Extent of change for MOD 2
Panel layout	440,000  Approximately 262* ha	500,714  280 ha	Increased by 18 ha or 7%
Battery storage facility	0.25 ha	1.46 ha	Increased by 1.21 ha or 484%
O&M facility	0.14 ha	0.02 ha	Decreased by 0.12 ha or 86%
Shed	0	0.01 ha	Increased by 0.01 ha or 100%
Homestead	0.17	0.14 ha	Decreased by 0.03 ha or 18%
Temporary construction compound	7.7 ha	1.1 ha	Decreased by 6.6 ha or 86%
Electricity and connection routes	100 m overhead transmission line	No overhead transmission line  Underground cables: 15.72 km	Decreased by 100% due to incorporation of all underground cabling into existing development footprint (i.e. roads etc)



Parameter	Approved project (MOD 1)	Modification Application (MOD 2)	Extent of change for MOD 2
	Underground cables ** (length unspecified in EIS).		
Total development footprint	282 ha	288 ha	Increased by 6 ha or 2%

*\*This is an estimate based on mapping as this value was not require for the SSD approval. \*\*This cannot be reliably calculated due to mapping limitations.*



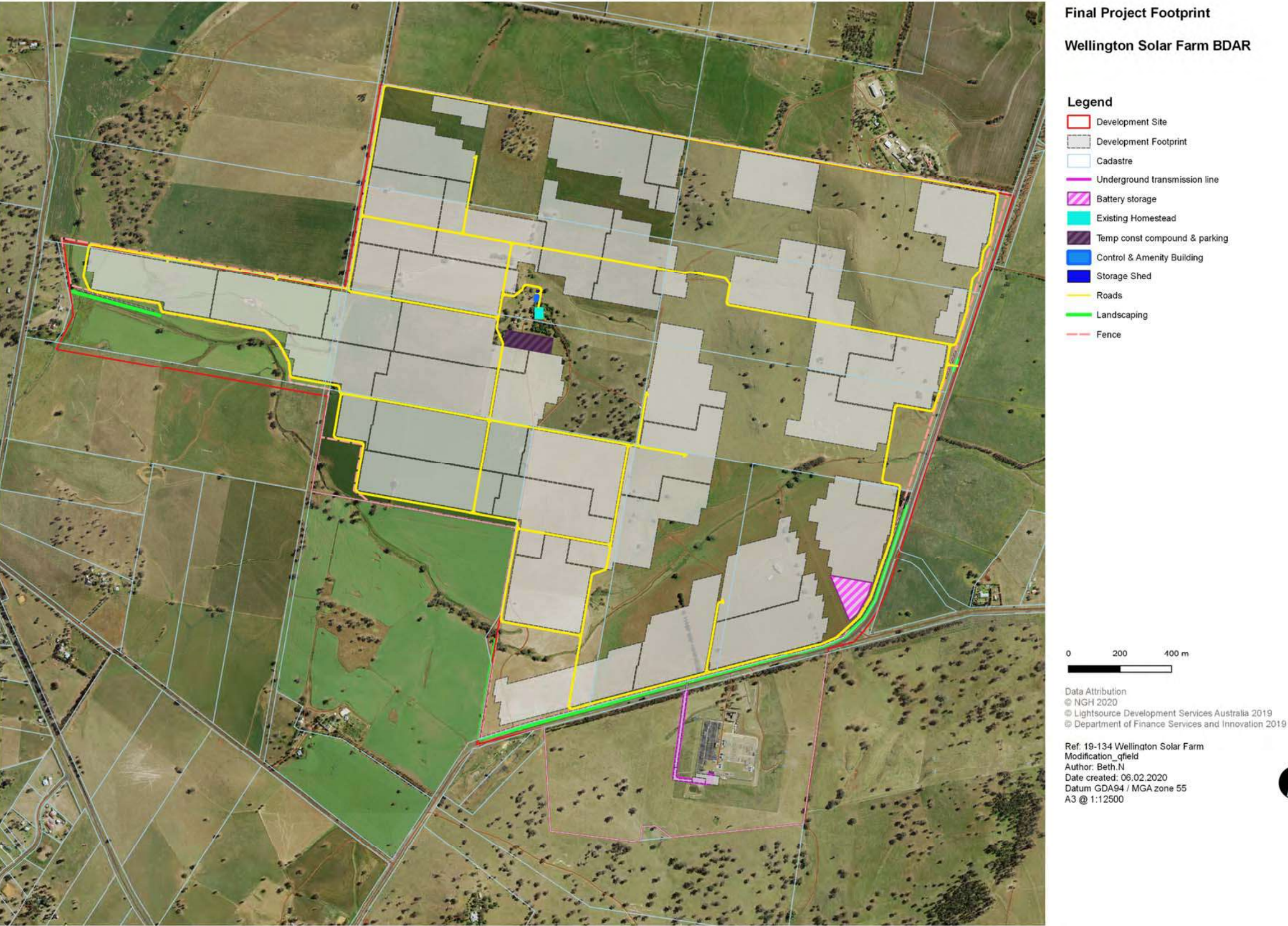


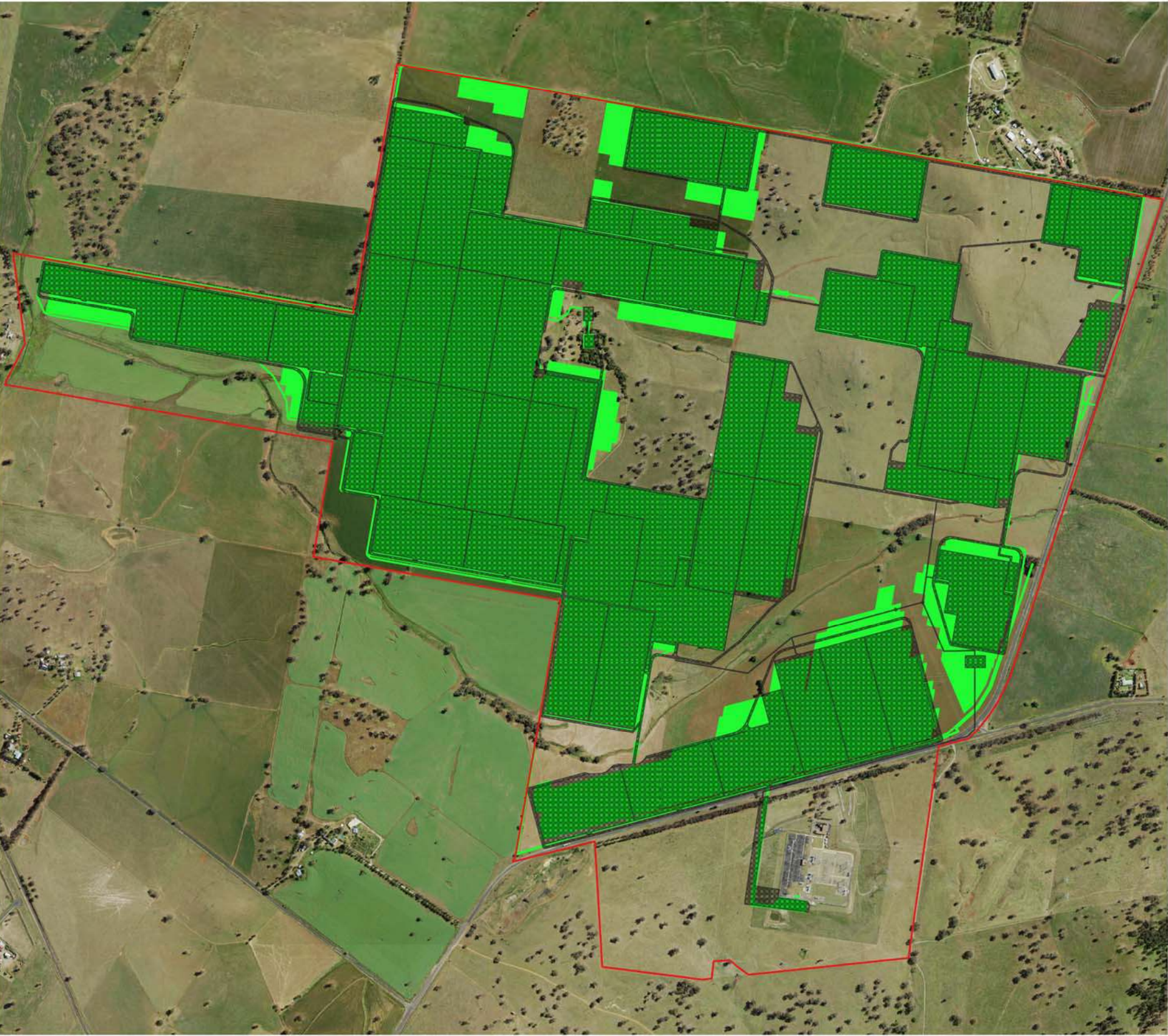
Figure 1-1 Final project development footprint





Figure 1-2 Final project development footprint, showing areas added and excised (the focus of this assessment for MOD 2)



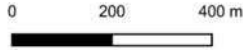


**Approved Impact Area Compared with  
Proposed Impact Area**

**Wellington Solar Farm**

**Legend**

- Development Site
- Proposed Development Footprint - MOD 2
- Approved Development Footprint - MOD 1



Data Attribution  
© NGH 2020  
© Lightsource Development Services 2019  
© Department of Finance Services and Innovation 2019

Ref: 19-134 Wellington Solar Farm  
Modification\_qfield  
Author: Beth.N  
Date created: 06.02.2020  
Datum GDA94 / MGA zone 55  
A3 @ 1:11546



Figure 1-3 Comparison of approved development footprint impact area with proposed development footprint impact area



## **1.4 THE DEVELOPMENT SITE**

### **1.4.1 Site location**

The Wellington SF proposal site is located approximately 2km north east of Wellington, in western central NSW, within the Dubbo Regional Local Government Area (LGA), north and south of Goolma Rd Wellington. The Wellington SF is located to the north and south of Goolma Rd Wellington, the majority of the Wellington SF is north of Goolma Rd. The development footprint is located within the following Lots and DPs:

- Lots 89, 90, 91, 92, 99, 102, 103 and 104 of DP2987
- Lot 1 of DP34690
- Lot 1 of DP520396
- Lot 2 of DP807187
- The portion of the Crown Road Reserve between Lot 2 of DP807187 and Lot 91 of DP2987 subject to Road Closure: Public Road Closure Application [W58925; Ref 17/09541]
- Lot 1 of DP1226751, existing TransGrid Substation

The location of the proposal site is illustrated in Figure 1-4.

### **1.4.2 Site description**

The proposal area is consistent with the approved Wellington Solar Farm which consists of partially native vegetation composed of PCT 277 Blakely's Red Gum – Yellow Box grassy tall woodland, PCT 266 White Box grassy woodland and Planted & Exotic vegetation. Each PCT is divided into zones depending on condition (low, moderate to good, planted) and different structural characteristics (either woodland or derived grassland).

Access to the proposal site would be from Goolma Road, on the eastern boundary of the site. The Mitchell Highway, which intersects with Goolma Road approximately 4.6 km south of the proposed site entrance, would be the major transport route for haulage and site vehicles during construction and operation of the proposal. The Mitchell Highway and Goolma Road are Oversized Over mass Load Carrying Approved Roads.

### **1.4.3 Construction and infrastructure requirements**

Changes to the infrastructure requirements are detailed in Table 1-1 above. The total development footprint has increased as per Figure 1-3.



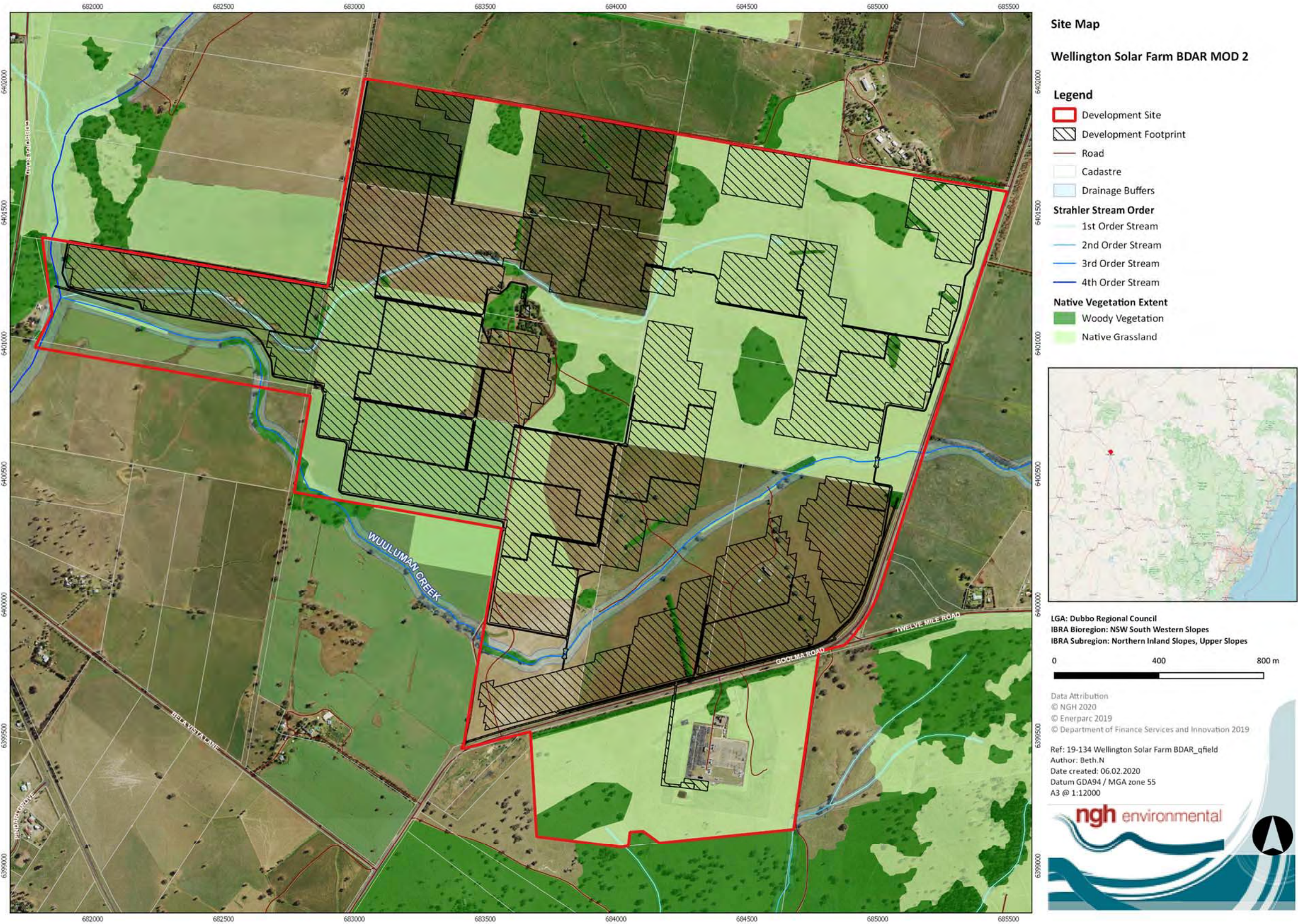


Figure 1-4 Site map



## 1.5 STUDY AIMS

This BDAR has been prepared by NGH on behalf of Lightsource BP. This BDAR has been prepared to support the second Modification Application to Department of Planning Infrastructure and Environment.

Two separate calculations were run in the BAM calculator to represent areas now added and excised from the solar farm development footprint. The net credit requirement will be used to update the credit requirement for the project.

This BDAR includes an assessment of impacts to protected matters listed under the federal *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). This assessment includes use of the Protected Matters Search Tool to determine potential species and communities occurring within the locality, and targeted surveys across the site to detect the presence of these entities or their habitats. Entities known or considered likely to occur have been included in the impact assessment, and Assessments of Significance have been prepared to determine the significance of impacts to these entities.

## 1.6 SOURCE OF INFORMATION USED IN THE ASSESSMENT

- Aerial Maps and Proposal layers provided by Lightsource BP.
- Commonwealth Department of Environment and Energy (DoEE) Species Profiles and Threats database (SPRAT) <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>.
- Department of Environment and Climate Change NSW (DECC) (2002). Descriptions for NSW (Mitchell) Landscapes, Version 2.
- NSW OEH's BioNet threatened biodiversity database  
Accessed online via login at <http://www.bionet.nsw.gov.au/>.
- OEH Threatened Biodiversity Profiles  
<http://www.environment.nsw.gov.au/threatenedSpeciesApp/>.
- Office of Environment and Heritage (OEH) (2007). Mitchell Landscapes with per cent cleared estimates.
- OEH BioNet Vegetation Classification Database (OEH 2017)  
Accessed online via login at <http://www.environment.nsw.gov.au/research/Visclassification.htm>.
- NSW OEH's Threatened Species Profiles  
<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  
Accessed online at <http://environment.gov.au/epbc/protected-matters-search-tool>
- Clean Energy Council of Australia website accessed online at  
<https://www.cleanenergycouncil.org.au/technologies/geothermal.html>
- Windpower Engineering and Development website accessed online at  
<https://www.windpowerengineering.com/projects/guidelines-selecting-sites/>
- Australia's IBRA Bioregions and sub-bioregions. Accessed  
<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.
- Lumsden L.F & Micaela J.L (2015). National Recover Plan for Southern Bent-wing Bat. Dept of Land, Water and Planning, Melbourne.

- NSW Government SEED Mapping
- Office of Environment and Heritage (OEH) (2017). Biodiversity Assessment Method.
- NSW OEH's Biodiversity Assessment Method (BAM) calculator (<http://www.environment.nsw.gov.au/bbccapp/ui/mynews.aspx>).
- NSW Biodiversity Values Map  
<https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BVMap>
- NSW OEH's BioNet threatened biodiversity database  
Accessed online via login at <http://www.bionet.nsw.gov.au/>.
- NSW OEH Threatened Species Profiles  
<http://www.environment.nsw.gov.au/threatenedSpeciesApp/> and  
[www.environment.nsw.gov.au/AtlasApp/UI\\_Modules/](http://www.environment.nsw.gov.au/AtlasApp/UI_Modules/)
- OEH BioNet Vegetation Classification Database (OEH 2017)  
Accessed online via login at <http://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx>
- OEH VIS Mapping
- Mitchell, P. 2002 Descriptions for NSW Mitchell Landscapes version 2, NSW National Parks and Wildlife Service, Hurstville.
- NSW Planning portal online <https://www.planningportal.nsw.gov.au/find-a-property>



## 2 LANDSCAPE FEATURES

### 2.1 IBRA BIOREGIONS AND SUBREGIONS

The proposal is located within NSW South Western Slopes Bioregion and the Inland Slopes Subregion (IBRA v.7 2012). The geology of the region is Ordovician to Early Carboniferous, with typical landforms a mixture of Mountain Ranges, dissected plateaus, hills and ridges and plains. The dominant pre-European vegetation type is Eucalypt Dry Grassy woodland dominated by Yellow Box (*Eucalyptus melliodora*) and White Box (*Eucalyptus albens*) (ASRIS accessed 15/05/17).

The dominant IBRA subregion affected by the proposal is the Inland Slopes Subregion. This was entered in the BAM Calculator for the proposal.

### 2.2 NSW LANDSCAPE REGIONS AND AREA

Two Mitchell Landscapes occur within the proposal site; Mullion Slopes and Macquarie Alluvial Plains. The dominant Mitchell Landscape affected by the proposal is Mullion Slopes. This is described as (DECC 2002):

Steep hills and strike ridges on tightly folded Ordovician andesite, conglomerate and tuff, Silurian rhyolite and shale, Devonian quartz sandstones, slate and minor limestone, general elevation 500 to 830m, local relief 200m. Stony uniform sand and loam in extensive rock outcrop along crests, stony red and brown texture-contrast soil on slopes, yellow harsh texture-contrast soil in valleys with some evidence of salinity. Gravel and sand in streambeds. Open forest to woodland of; White Gum (*Eucalyptus rossii*), Brittle Gum (*Eucalyptus mannifera*), Broad-leaved Peppermint (*Eucalyptus dives*), Red Box (*Eucalyptus polyanthemos*), Mountain Grey Gum (*Eucalyptus cypellocarpa*), White Box (*Eucalyptus albens*) with Yellow Box (*Eucalyptus melliodora*) on lower slopes and River Oak (*Casuarina cunninghamiana*) along the streams.

Macquarie Alluvial Plains is described as:

Holocene fluvial sediments of backplain facies of the Marra Creek Formation associated with the Macquarie River main alluvial fan and tributary stream system, relief 1 to 3m. Dark yellow-brown silty clay with patches of sand and carbonate nodules deposited from suspended sediments in floodwater, often with Gilgai. Slightly elevated areas with red-brown texture-contrast soils. Open grasslands with scattered Coolibah (*Eucalyptus microtheca*), Black Box (*Eucalyptus largiflorens*), River Cooba (*Acacia stenophylla*), Bimble Box (*Eucalyptus populnea*), Belah (*Casuarina cristata*), Lignum (*Muehlenbeckia cunninghamii*) and Myall (*Acacia pendula*).

The vegetation observed on the site indicates that Mullion Slopes is the dominant landscape present onsite.

### 2.3 NATIVE VEGETATION

Native vegetation extent within 1500 m of the subject land was mapped using aerial imagery (Figure 2-1). The pre-European assessment of the native vegetation occurring on the subject site was woodland. Native vegetation mapping used over-storey as a surrogate for native vegetation cover and is considered conservative as this would include non-native vegetation that may still provide some habitat value. The local area's native vegetation is derived from woodland and as such, no natural grasslands are relevant to the study area. The majority of the proposal area is composed of White-box Grassy woodland and derived grasslands with the predominant remnant overstorey species consisting of White Box.



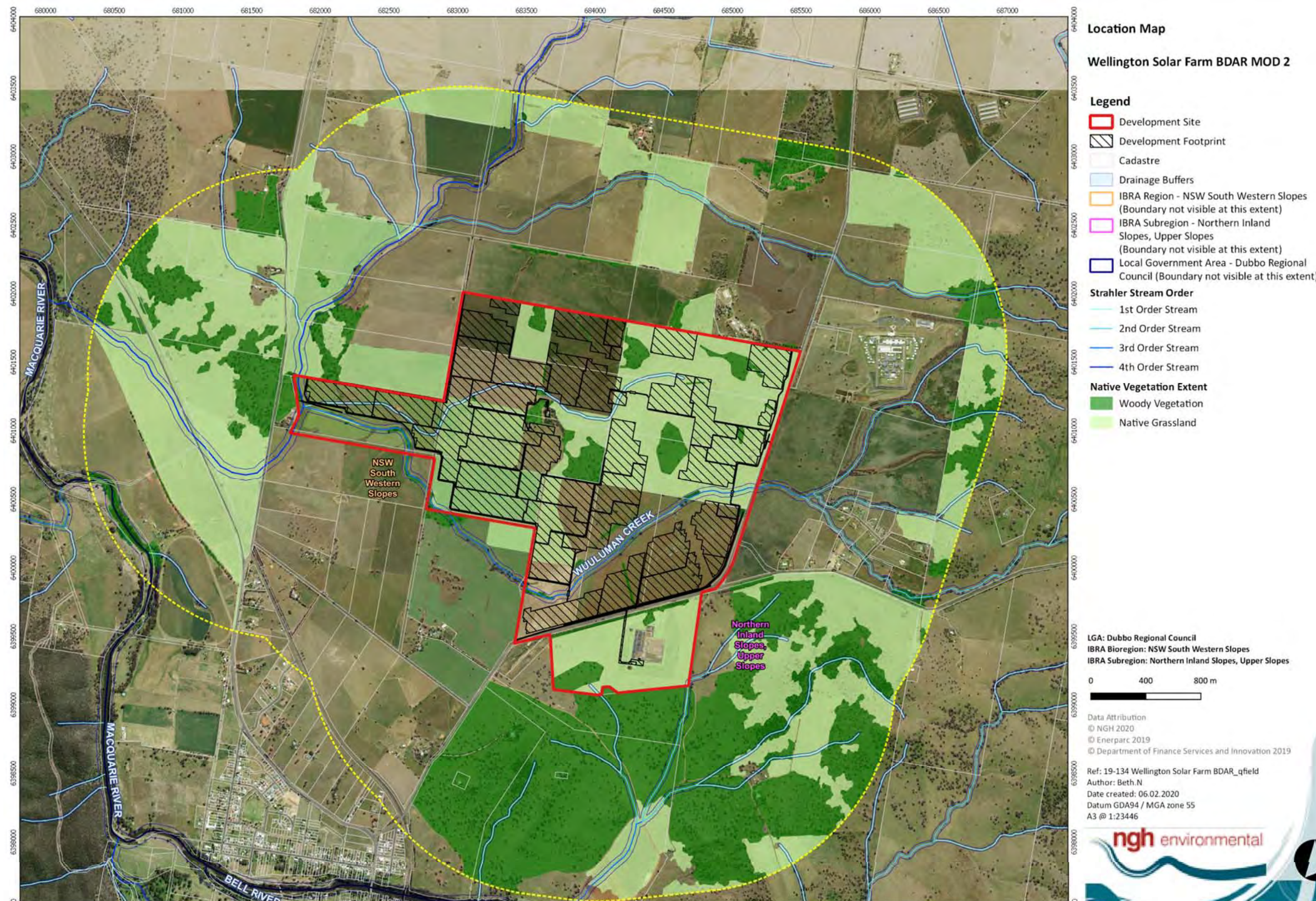


Figure 2-1 Location map



## **2.4 CLEARED AREAS**

Cleared areas in the local area are primarily used for cropping and grazing and provide very little in terms of native fauna habitat. These areas provide suitable foraging habitat for raptors, parrots, cockatoos and macropods, and introduced species such as cats, foxes and rabbits. Approximately 1550.3 ha (53%) within the 1500 m buffer area is cleared land.

In relation to the development footprint, 'non-native vegetation' was treated as a vegetation zone for the purposes of assessment for candidate species.

## **2.5 RIVERS AND STREAMS**

An un-named 1<sup>st</sup> order watercourse runs from the northern part of the development proposal through to the western boundary of the proposal area where it joins the Macquarie River. A 3<sup>rd</sup> order watercourse named Wuuluman Creek runs from the eastern boundary through the middle of the development proposal area to the western boundary of the site where it joins the Macquarie River a 9<sup>th</sup> order watercourse approximately 2.5 km downstream, see Figure 2-1.

## **2.6 WETLANDS**

No wetlands occur within or adjacent to the development site. The closest Nationally Important Wetland downstream from the proposal area is the Macquarie Marshes located approximately 150 km downstream.

## **2.7 CONNECTIVITY FEATURES**

To date, no biodiversity corridor plans have been approved by the Chief Executive of the Environment, Energy and Science Division of DPIE.

## **2.8 AREAS OF GEOLOGICAL SIGNIFICANCE**

The nearest site of geological significance are the Wellington Caves and phosphate mine, approximately 10 km south of the subject land.

## **2.9 AREAS OF OUTSTANDING BIODIVERSITY VALUE**

The area occupied by Wuuluman Creek and associated riparian zone is shown on the Biodiversity Values map (OEH 2018) as being within the proposal area see Figure 2-2.

## **2.10 SITE CONTEXT COMPONENTS**

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.



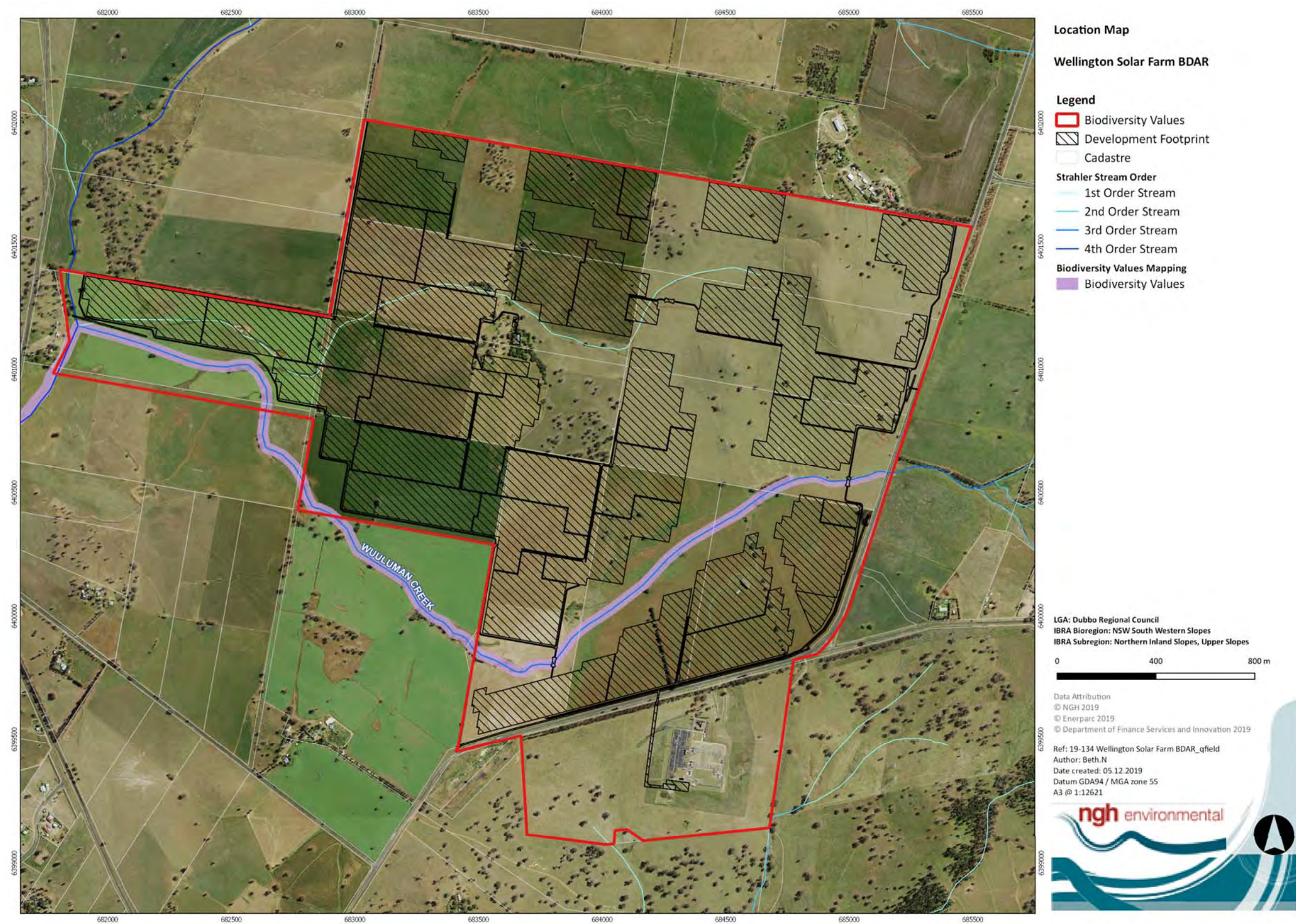


Figure 2-2 Biodiversity Values Mapping in relation to the development site



## 3 NATIVE VEGETATION

### 3.1 NATIVE VEGETATION EXTENT

Percent Native Vegetation was calculated by estimating the presence of any native vegetation based on aerial imagery within the 1500m buffer. Unless verified by visual inspection, areas containing grasslands inside the 1500 m buffer were assumed to be non-native grasslands because of existing farming operations in the surrounding landscape and because it could not be verified by site survey. The landscape surrounding the Wellington Solar Farm property contained similar land management practices and it was therefore assumed that groundcover was primarily dominated by native species.

The total area within the 1500 m buffer from the subject site is 2949 ha. The native vegetation woody cover within the 1500 m buffer area surrounding the development proposal is 539 ha or 18%. The non-woody vegetation is 860 ha, or 29% cover based on the vegetation survey in 2017 (NGH 2017). These results were entered into the BAM calculator. The remaining vegetation cover is assumed to be exotic cropping or introduced pastures and covers 1550.3 ha.

The native vegetation mapped with woody and non-woody vegetation covering approximately 1399 ha or 47% of the buffer area, refer to

Figure 3-1 for the mapped vegetation within the development extent.



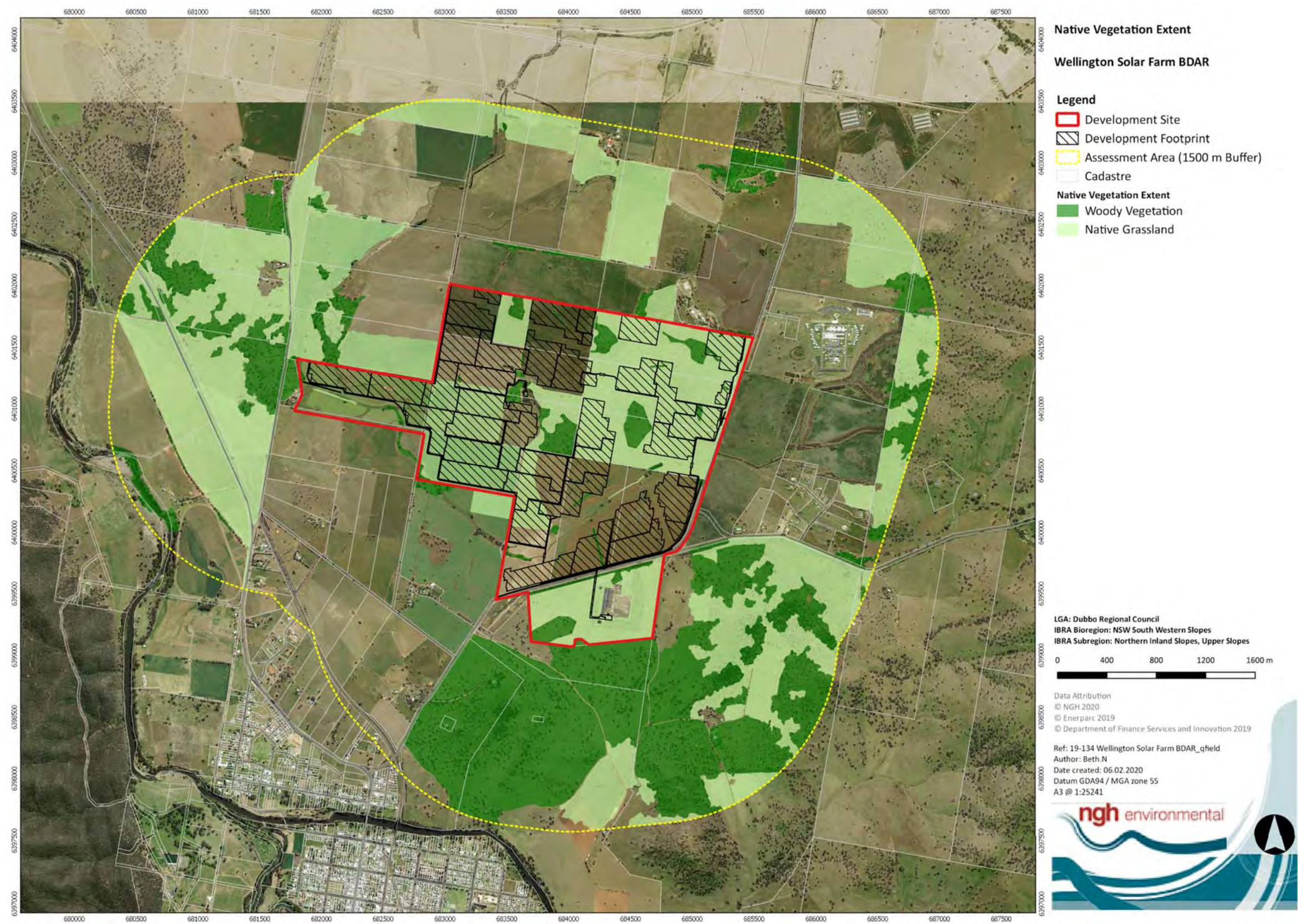


Figure 3-1 Native vegetation extent within the assessment area



## 3.2 PLANT COMMUNITY TYPES (PCTS)

### 3.2.1 Methods to assess PCTS

The PCTS within the proposal area are White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes (PCT 266) and Blakely's Red Gum – Yellow Box grassy tall woodland of the NSW South Western Slopes (PCT 277).

Areas that would now be impacted and areas that would now be excised from the approved layout are shown below with the plot number collected to represent them.

Table 3-1 PCT Zones additional and excised impacts - White Box Grassy Woodland

Zone	Plant Community Type and Condition - Zones	Additional Impact (ha)	Excised impact (ha)	Plots
1	PCT 277 Blakely's Red Gum – Yellow Box grassy tall woodland – low condition	0.03	0.01	1
2	PCT 266 White Box grassy woodland – planted, moderate to good condition	0	0.03	1
4	PCT 266 White Box grassy woodland – moderate to good condition	0.01	0	1
3	PCT 266 White Box grassy woodland – low condition	0.06	0.22	1
5	PCT 266 White Box grassy woodland derived grassland – moderate to good condition	0.05	0.34	1
6	PCT 266 White Box grassy woodland derived grassland – low condition	4.12	10.39	3
	<b>TOTAL</b>	<b>4.24</b>	<b>11.14</b>	<b>8</b>

These zones and plot locations are shown on Figure 3-2.

## FLORISTIC SURVEYS

### 3.2.2 PCTS identified on the development site

The PCTS were determined during the survey based on plot data collected during the solar farm assessment (NGH 2017) within the development envelope and on surveys conducted in adjacent less disturbed vegetation. Within the woodland vegetation (PCT 266), the overstorey is characteristically dominated by White Box (*Eucalyptus albens*) with occasional Kurrajong (*Brachychiton populneus*). Understorey vegetation is comprised of native grasses and forbs such as Cotton Panic Grass (*Digitaria brownii*), Red Grass (*Bothriochloa macra*), Windmill Grass (*Chloris truncata*), Twining Glycine (*Glycine clandestina*) and Oxalis (*Oxalis perennans*). Exotics detected in 2019 plots in PCT 266 included Barley Grass (*Hordeum leporinum*),

Spear Thistle (*Cirsium vulgare*), Burr Medic (*Medicago polymorpha*) and Flaxleaf Fleabane (*Conyza bonariensis*).

Within the woodland vegetation (PCT 277), the overstorey onsite is characteristically dominated by Yellow Box (*Eucalyptus melliodora*) and White Cypress Pine (*Callitris glaucophylla*). Understorey is comprised of native grasses and forbs such as Spear Grasses (*Austrostipa* sp.), Wallaby Grass (*Rytidosperma caespitosum*), Nineawn Grass (*Enneapogon nigricans*), some native shrubs Creeping Saltbush (*Atriplex semibaccata*), Climbing Saltbush (*Einadia nutans*) and Black Rolypoly (*Sclerolaena muricata*) also occur in the understory. Exotics detected in 2019 plots in PCT 277 included Burr Medic (*Medicago polymorpha*), Barley Grass (*Hordeum leporinum*), Wireweed (*Polygonum aviculare*), Black Crumbweed (*Cheopodium melanocarpum*) and Lucerne (*Medicago sativa*).

Within the derived grassland vegetation (PCT 266) the ground layer is dominated by Wallaby Grass (*Rytidosperma caespitosum*), Spear Grasses (*Austrostipa aristiglumis*, *Austrostipa scabra*, *Austrostipa bigeniculata*), Red Grass (*Bothriochloa macra*), Kangaroo Grass (*Themeda triandra*) Panic Grass (*Panicum effusum*) and exotic species including Skeleton Weed (*Chondrilla juncea*) and Barley Grass (*Hordeum leporinum*).

## **ENDANGERED ECOLOGICAL COMMUNITIES**

PCT 266 and PCT 277 form part of the White Box – Yellow Box – Blakely's Red Gum Woodland EEC listed under the NSW BC Act.

This vegetation community is also listed under the Commonwealth EPBC Act as White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands, a Critically Endangered Ecological community (CEEC). The area of Box Gum Woodland surveyed in November 2019 was not considered to be CEEC under the EPBC Act due to a lack of dominance of native species in the understorey.



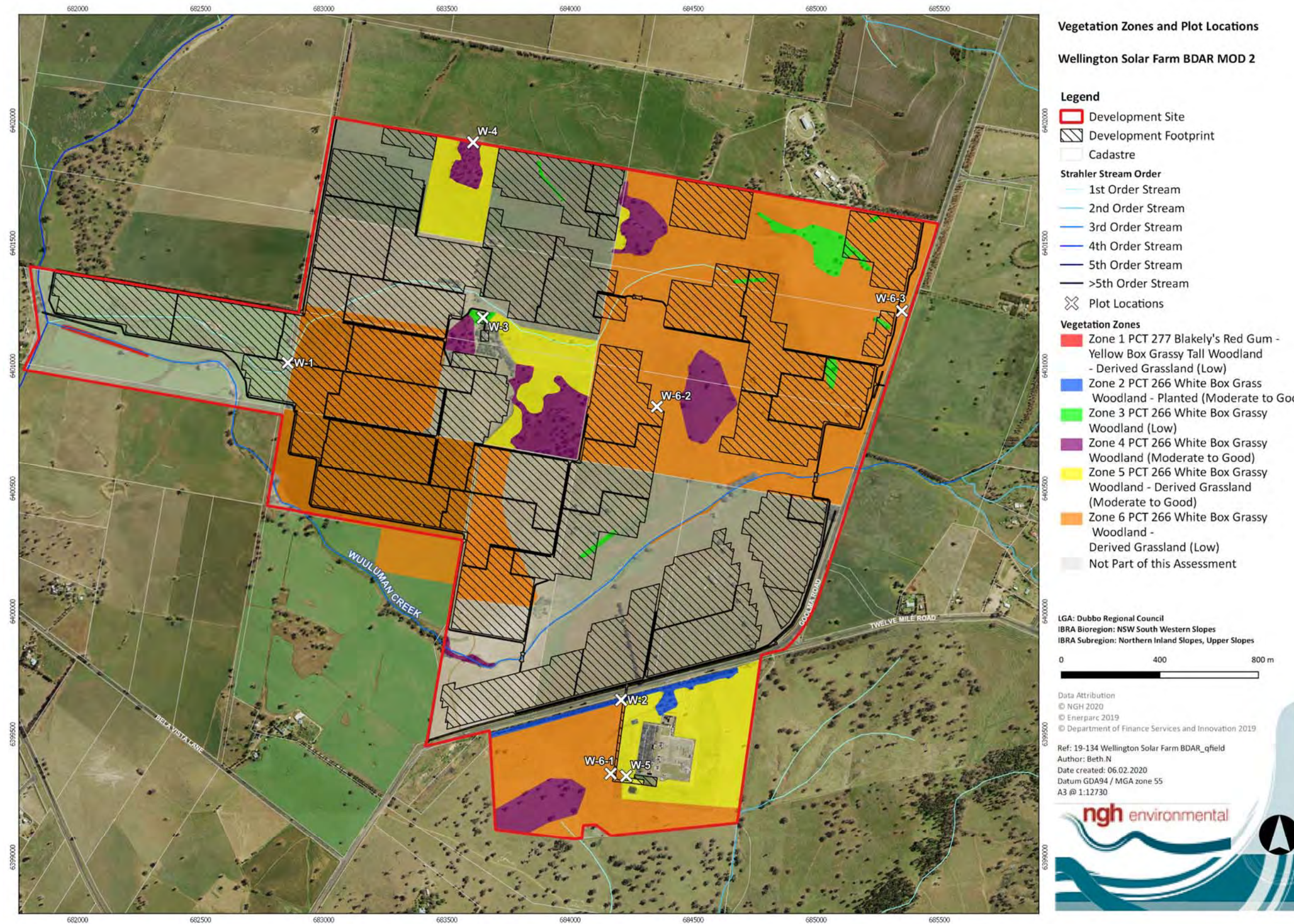


Figure 3-2 Vegetation Zones and plot locations



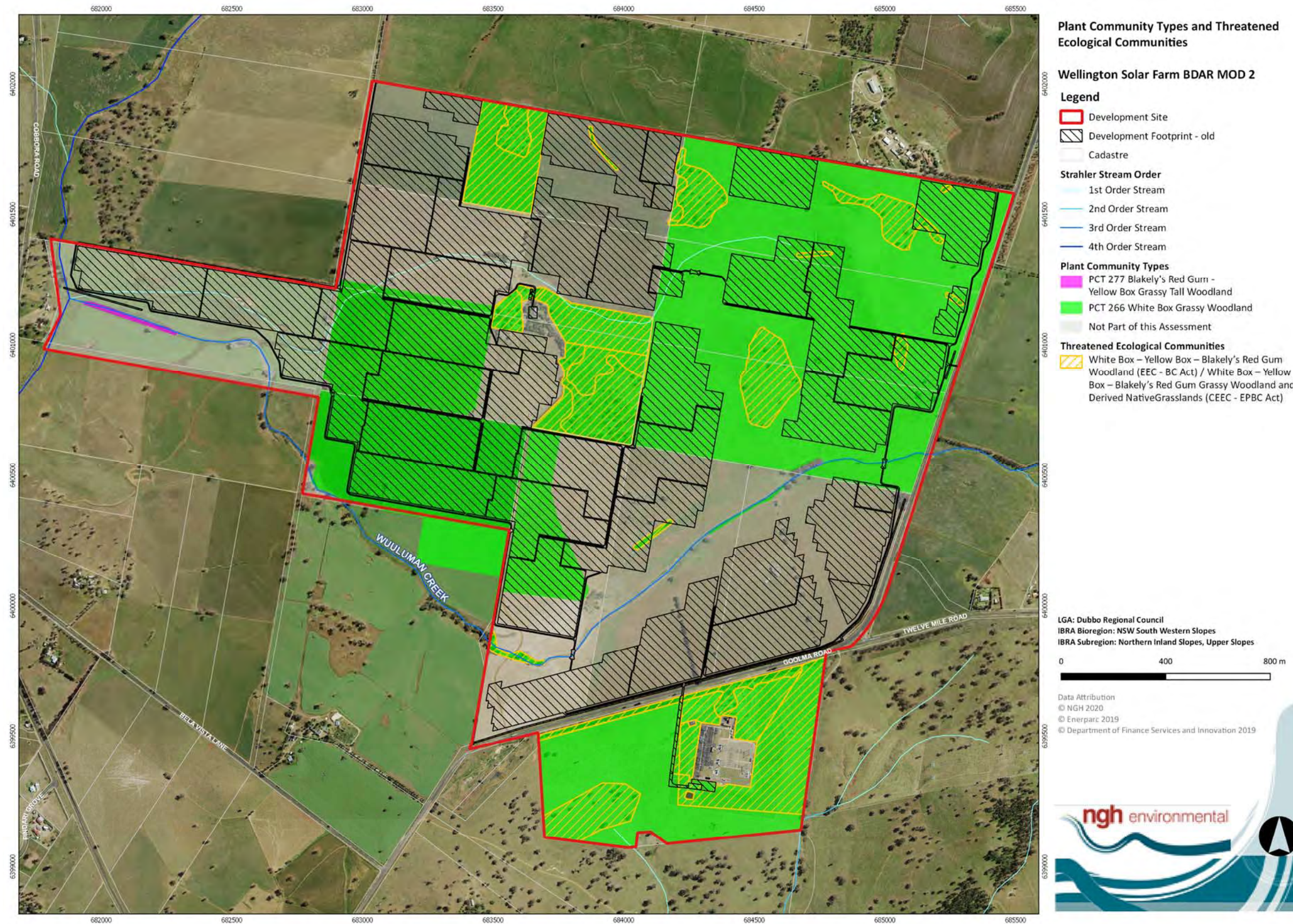


Figure 3-3 PCTs and TECs at the development site



### 3.2.3 Vegetation integrity assessment results

Six vegetation integrity plots were conducted within PCT 266 and one vegetation integrity plot was conducted in PCT 277 to reflect the variation in the condition of these communities. The results of the vegetation integrity assessment are provided in Table 3-2.

Table 3-2 Current vegetation integrity scores for each vegetation zone within the development site

Zone ID	Composition score	Structure score	Function score	Vegetation Integrity Score
1	41.7	0.4	14.4	6.1
2	48.9	4	9.3	12.3
3	70.9	9.2	15	21.4
4	42.6	8	54.4	26.5
5	65.4	27.5	15	30.0
6	59.9* or 58.4**	34.2* or 16.8**	14.9* or 14.8**	31.3* or 24.4**

\*Additional area

\*\*Excised area

Note: the reason each area gave different vegetation integrity scores is due to the different sizes requiring different number of plots for each. The additional area only required 2 plots whilst the excised area required 3 plots.

## 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.

#### 4.1.1 Species excluded from the assessment

Table 4-1 Ecosystem credit species returned

Ecosystem Credit Species	Relevant Vegetation Zones	NSW Listing Status	National listing status
Regent Honeyeater ( <i>Anthochaera phrygia</i> )	Zones 1-4	Critically endangered	Critically endangered
Dusky Woodswallow ( <i>Artamus cyanopterus cyanopterus</i> )	Zones 1-6	Vulnerable	Not listed
Gang-Gang Cockatoo ( <i>Callocephalon fimbriatum</i> )	Zones 1-4	Vulnerable	Not listed
Glossy Black-cockatoo ( <i>Calyptorhynchus lathamii</i> )	Zones 1-4	Vulnerable	Not listed
Speckled Warbler ( <i>Chthonicola sagittata</i> )	Zones 1-6	Vulnerable	Not listed
Spotted Harrier ( <i>Circus assimilis</i> )	Zones 1-6	Vulnerable	Not listed
Brown Treecreeper (eastern subspecies) ( <i>Climacteris picumnus victoriae</i> )	Zones 1-4	Vulnerable	Not listed
Varied Sitella ( <i>Daphoenositta chrysoptera</i> )	Zones 1-4	Vulnerable	Not listed
Spotted-tailed Quoll ( <i>Dasuirus maculatus</i> )	Zones 1-6	Vulnerable	Endangered
Purple-crowned Lorikeet ( <i>Glossopsitta porphyrocephala</i> )	Zones 1-6	Vulnerable	Not listed
Little Lorikeet ( <i>Glossopsitta pusilla</i> )	Zones 1-6	Vulnerable	Not listed
Painted Honeyeater ( <i>Grantiella picta</i> )	Zones 1-4	Vulnerable	Vulnerable
White-bellied Sea-Eagle ( <i>Haliaeetus leucogaster</i> )	Zones 1-6	Vulnerable	Not listed
Little Eagle	Zones 1-6	Vulnerable	Not listed



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Ecosystem Credit Species	Relevant Vegetation Zones	NSW Listing Status	National listing status
<i>(Hieraetus morphnoides)</i>			
Swift Parrot ( <i>Lathamus discolor</i> )	Zones 1-4	Endangered	Critically endangered
Square-tailed Kite ( <i>Lophoictinia isura</i> )	Zones 1-6	Vulnerable	Not listed
Hooded Robin (south-eastern form) ( <i>Melanodryas cucullata cucullata</i> )	Zones 1-6	Vulnerable	Not listed
Large Bentwinged Bat ( <i>Miniopterus orianae oceanensis</i> )	Zones 1-6	Vulnerable	Not listed
Turquoise Parrot ( <i>Neophema pulchella</i> )	Zones 1-6	Vulnerable	Not listed
Scarlet Robin ( <i>Petroica boodang</i> )	Zones 1-6	Vulnerable	Not listed
Flame Robin ( <i>Petroica phoenicea</i> )	Zones 1-6	Vulnerable	Not listed
Koala ( <i>Phascolarctos cinereus</i> )	Zones 1-4	Vulnerable	Vulnerable
Superb Parrot ( <i>Polytelis swainsonii</i> )	Zones 1-6	Vulnerable	Vulnerable
Grey-crowned Babbler (eastern species) ( <i>Pomatostomus temporalis temporalis</i> )	Zones 1-6	Vulnerable	Not listed
Grey-headed Flying-fox ( <i>Pteropus poliocephalus</i> )	Zones 1-4	Vulnerable	Vulnerable
Yellow-bellied Sheathtail-bat ( <i>Saccolaimus flaviventris</i> )	Zones 1-6	Vulnerable	Not listed
Diamond Firetail ( <i>Stagonopleura guttata</i> )	Zones 1-6	Vulnerable	Not listed
Masked Owl ( <i>Tyto novaehollandiae</i> )	Zones 1-6	Vulnerable	Not listed

### 4.1.2 Species excluded from the assessment

Table 4-2 Species excluded from the assessment

Ecosystem Credit Species	Vegetation Zones Excluded	Reason for exclusion
Regent Honeyeater ( <i>Anthochaera phrygia</i> )	Zone 5 -6	Insufficient habitat for foraging within grasslands, no trees or shrubs.
Gang-Gang Cockatoo ( <i>Callocephalon fimbriatum</i> )	Zone 5 -6	Insufficient habitat for foraging within grasslands, no trees or shrubs.
Glossy Black-cockatoo ( <i>Calyptorhynchus lathamii</i> )	Zone 5 -6	Insufficient habitat for foraging within grasslands, no trees or shrubs.
Brown Treecreeper (eastern subspecies) ( <i>Climacteris picumnus victoriae</i> )	Zone 5-6	Insufficient habitat for foraging within grasslands, no fallen timber.
Varied Sitella ( <i>Daphoenositta chrysoptera</i> )	Zone 5-6	Insufficient habitat for foraging within grasslands, no trees.
Painted Honeyeater ( <i>Grantiella picta</i> )	Zone 5-6	Insufficient habitat for foraging within grasslands, no trees or shrubs.
Swift Parrot ( <i>Lathamus discolor</i> )	Zone 5-6	Insufficient habitat for foraging within grasslands, no trees or shrubs.
Koala ( <i>Phascolarctos cinereus</i> )	Zone 5-6	Insufficient habitat for foraging within grasslands, no trees.
Grey-headed Flying-fox ( <i>Pteropus poliocephalus</i> )	Zone 5-6	Insufficient foraging and roosting habitat within grassland, no trees.

## 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 4-3 Candidate species credit species requiring assessment

Species Credit Species	Habitat components and geographic restrictions	Sensitivity to gain class	NSW Listing Status	National listing status
Ausfield's Wattle <i>(Acacia ausfeldii)</i>	Associated with <i>E albens</i> , <i>E blakelyi</i> and <i>Callitris</i> spp., germination stimulated by fire	High	Vulnerable	Not listed
Yass Daisy <i>(Ammobium craspedioides)</i>	Found in moist or dry forest communities, Box Gum Woodland and secondary grassland.	High	Vulnerable	Vulnerable
Regent Honeyeater <i>(Anthochaera Phrygia)</i> (Breeding)	Inhabits temperate woodland and open forests. The species inhabits Box-ironbark woodland. Usually inhabit woodlands that have large numbers of mature trees, high canopy cover and abundance of mistletoe	High	Critically Endangered	Critically Endangered
Pink-tailed Legless Lizard <i>(Aprasia parapulchella)</i>	Inhabits sloping, open woodland areas with predominantly native grassy ground layers. Habitat is usually well drained, with rock outcrops or scattered, partially buried rocks. Commonly found beneath small, partially embedded rocks.	High	Vulnerable	Vulnerable
Bush Stone-curlew <i>(Burhinus grallarius)</i>	Inhabits open forest and woodlands with a sparse grassy ground layer and fallen timber. Nocturnal, feed on insects and small vertebrates.	High	Endangered	Not listed
Gang-gang Cockatoo <i>(Calyptorhynchus lathami)</i> (Breeding)	Generally found in tall mountain forests and woodland in spring and summer. In autumn and winter they usually move to lower altitudes in drier, more open eucalypt forests and woodland, particularly Box-gum and Box-ironbark woodlands. Favour old growth forest and woodland as nesting hollows are required.	High	Vulnerable	Not Listed
Glossy Black-Cockatoo <i>(Calyptorhynchus lathami)</i> (Breeding)	Inhabits open forest and woodlands where stands of she oak occur. Feeds almost exclusively on She-oak species. Depending on large hollow bearing trees for nesting.	High	Vulnerable	Not Listed

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Species Credit Species	Habitat components and geographic restrictions	Sensitivity to gain class	NSW Listing Status	National listing status
Eastern Pygmy-possum ( <i>Cercartetus nanus</i> )	Woodlands and heath preferred. Feds on nectar and pollen from banksias, eucalypts and bottlebrushes.	High	Vulnerable	Not Listed
Large-eared Pied Bat ( <i>Chalinolobus dwyeri</i> )	Roosts in caves, crevices in cliffs, old mine workings, frequenting low to mid elevation dry open forest and woodland close to these features.	Very High	Vulnerable	Vulnerable
Small Scurf-pea ( <i>Cullen parvum</i> )	Plants are found in River Red Gum Woodland or Box Gum Woodland. Plants tend to die back in dry seasons and re-sprout with rain in winter or spring.	High	Endangered	Not Listed
Striped Legless Lizard ( <i>Delma impar</i> )	Found occasionally in open Box Gum Woodland where grassland is dominated by tussock forming grasses such as Kangaroo Grass, Spear Grass and Poa.	Moderate	Vulnerable	Vulnerable
Euphrasia arguta ( <i>Euphrasia arguta</i> )	Found in limited area near Nundle. Plants have been reported in eucalypt forest with a mixed grass and shrub understorey. Usually dies off in winter months, most active growth during January to April. It is semi parasitic and attaches to the roots of other associated plants.	High	Critically endangered	Critically endangered
Tumut Grevillea ( <i>Grevillea wilkinsonii</i> )	Restricted to the NSW South-west slopes. Can be associated with Blakey's Red Gum, Yellow Box and Kurrajongs. Flowers mid-September to mid-October. Recruits readily where there is some bare ground.	High	Endangered	Endangered
White-bellied Sea-Eagle  <i>Haliaeetus leucogaster</i>	Terrestrial habitat includes woodland. Breeding habitat consists of mature tall open forest, tall woodland close to foraging habitat.	High	Vulnerable	Not Listed
Little Eagle  <i>Hieraaetus morphnoides</i> (Breeding)	Occupies open eucalypt forest, woodland or open woodland. Nests in tall living trees within a remnant patch, build stick nests in winter.	Moderate	Vulnerable	Not Listed
Swift Parrot  <i>Lathamus discolor</i>	Breeds in Tasmania during spring and summer. In NSW mostly occurs on the coast and south west slopes.	Moderate	Endangered	Critically Endangered



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Species Credit Species	Habitat components and geographic restrictions	Sensitivity to gain class	NSW Listing Status	National listing status
(Breeding)				
Booroolong Frog <i>(Litoria booroolongensis)</i>	Requires permanent streams with fringing cover and rocks for shelter.	High	Endangered	Endangered
Square-tailed Kite <i>Lophoictinia isura</i> (Breeding)	Found in habitats including dry woodlands. Shows preference for watercourses. Has been observed in north west NSW in stony country with a ground cover of chenopods and grasses and low open eucalypt woodland.	Moderate	Vulnerable	Not Listed
Large Bent-winged Bat <i>Miniopterus orianae oceanensis</i> (Breeding)	Breeding habitat is within caves and manmade tunnels.	Very High	Vulnerable	Not Listed
Barking Owl <i>Ninox connivens</i> (Breeding)	Hollow bearing trees with greater than 20cm diameter and greater than 4m above the ground.	High	Vulnerable	Not Listed
Squirrel Glider <i>(Pteaurus norfolcensis)</i>	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range. Prefers a mid storey of shrub or acacia. Requires abundant tree hollows for refuge and nest sites.	High	Vulnerable	Not Listed
Brush-tailed Phascogale <i>(Phascogale tapoatafa)</i>	Depends upon hollow bearing trees and prefers to forage in trees 25cm DBH or greater. Needs multiple hollows for nesting and shelter.	High	Vulnerable	Not Listed

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Species Credit Species	Habitat components and geographic restrictions	Sensitivity to gain class	NSW Listing Status	National listing status
Koala <i>(Phascolarctos cinereus)</i>	Inhabit a range of eucalypt forest and woodland communities and will utilise paddock trees. White Box ( <i>Eucalyptus albens</i> ) and Yellow Box ( <i>Eucalyptus melliodora</i> ) are secondary food trees of the Koala in this region.	High	Vulnerable	Vulnerable
Superb Parrot <i>(Polytelis swainsonii)</i>	Inhabit Box Gum and Box-Cypress-pine woodlands. They require hollow bearing trees for nesting.	High	Vulnerable	Vulnerable
Tarengo Leek Orchid <i>(Prasophyllum petilum)</i>	East of Binalong, south and east of Boorowa. Found in Natural Temperate Grasslands at Boorowa and Delegate and grassy ground layer dominated by Kangaroo Grass under Box Gum Woodland in ACT. Highly susceptible to grazing.	High	Endangered	Endangered
Grey-headed Flying-fox <i>(Pteropus poliocephalus)</i>	Roosting camps are generally within 20km of a regular food source, usually found in gullies close to water in vegetation with a dense canopy. Feed on nectar from Eucalyptus, Melaleuca and Banksia species.	High	Vulnerable	Vulnerable
Small Purple-pea <i>(Swainsona recta)</i>	Was considered to occur in the understorey of woodlands and open forests dominated by Blakely's Red Gum, Yellow Box, Candlebark Gum and Long-leaf Box. It is considered likely to be extinct.	Moderate	Endangered	Endangered
Silky Swainson-pea <i>(Swainsona sericea)</i>	Found in Box Gum Woodland on South West slopes. Sometimes found in association with <i>Callitris</i> species. Regenerates from seed after fire.	High	Vulnerable	Not Listed
Golden Sun Moth <i>(Synemon plana)</i>	Occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands with ground layers dominated by Wallaby grasses (possibly several species), they require bare ground between tussocks. Habitat may have also have Austrostipa species or Kangaroo Grass. They have also been known to use areas containing weeds such as Serrated Tussock.	Moderate	Endangered	Critically Endangered



Species Credit Species	Habitat components and geographic restrictions	Sensitivity to gain class	NSW Listing Status	National listing status
Masked Owl <i>(Tyto novaehollandiae)</i>  (Foraging)	Inhabit dry eucalypt forests and woodlands. Require large hollow bearing trees for nesting.	High	Vulnerable	Not Listed
Zieria obcordata <i>(Zieria obcordata)</i>	Known to occupy an area near Wellington. Grow in eucalypt woodland or shrubland. Also occurs on Eucalyptus and Callitris dominated woodland with an open low shrub understorey, on moderately steep, mainly west to north facing slopes amongst granite boulders. Associated with Box Gum Woodland.	High	Endangered	Endangered

#### 4.2.2 Inclusions and exclusions based on habitat features

The following species credit species have been either included or excluded from further assessment based on the habitat features present at the development site.

Table 4-4 Species credit species included and excluded based on habitat features

Species Credit Species	Habitat components and abundance on site	Included or excluded	Reason for inclusion or exclusion
Ausfeld's Wattle <i>(Acacia ausfeldii)</i>	Associated with <i>E albens</i> , <i>E blakelyi</i> and <i>Callitris</i> spp.	Included	All associated tree species are present at the site. Some within the development footprint
Yass Daisy <i>(Ammobium craspedioides)</i>	Found in moist or dry forest communities, Box Gum Woodland and secondary grassland.	Excluded	Not found north of Cowra
Regent Honeyeater <i>(Anthochaera Phrygia)</i>  (Breeding)	Inhabits temperate woodland and open forests. The species inhabits Box-ironbark woodland. Usually inhabit woodlands that have large numbers of mature trees, high canopy cover and abundance of mistletoe	Included	Some woodland habitat within the development footprint

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Species Credit Species	Habitat components and abundance on site	Included or excluded	Reason for inclusion or exclusion
Pink-tailed Legless Lizard ( <i>Aprasia parapulchella</i> )	Inhabits sloping, open woodland areas with predominantly native grassy ground layers. Habitat is usually well drained, with rock outcrops or scattered, partially buried rocks. Commonly found beneath small, partially embedded rocks.	Excluded	Some rocky habitat within the development site but not within the development footprint
Bush Stone-curlew ( <i>Burhinus grallarius</i> )	Inhabits open forest and woodlands with a sparse grassy ground layer and fallen timber. Nocturnal, feed on insects and small vertebrates.	Included	Open woodland habitat, some fallen timber within development footprint
Gang-gang Cockatoo ( <i>Calyptorhynchus lathami</i> ) (Breeding)	Generally found in tall mountain forests and woodland in spring and summer. In autumn and winter they usually move to lower altitudes in drier, more open eucalypt forests and woodland, particularly Box-gum and Box-ironbark woodlands. Favour old growth forest and woodland as nesting hollows are required.	Included	Suitable HBTs are present within the development footprint
Glossy Black-Cockatoo ( <i>Calyptorhynchus lathami</i> ) (Breeding)	Inhabits open forest and woodlands where stands of she oak occur. Feeds almost exclusively on She-oak species. Depending on large hollow bearing trees for nesting.	Excluded	No foraging habitat (she-oak) present within the development footprint.
Eastern Pygmy-possum ( <i>Cercartetus nanus</i> )	Woodlands and heath preferred. Feeds on nectar and pollen from banksias, eucalypts and bottlebrushes.	Excluded	Insufficient foraging habitat to provide sufficient winter food.
Large-eared Pied Bat ( <i>Chalinolobus dwyeri</i> )	Roosts in caves, crevices in cliffs, old mine workings within 2km, frequenting low to mid elevation dry open forest and woodland close to these features.	Excluded	No caves, crevices or cliffs within 2km of the development footprint.
Small Scurf-pea ( <i>Cullen parvum</i> )	Plants are found in River Red Gum Woodland or Box Gum Woodland. Plants tend to die back in	Included	Box Gum woodland habitat present within development footprint.



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Species Credit Species	Habitat components and abundance on site	Included or excluded	Reason for inclusion or exclusion
	dry seasons and re-sprout with rain in winter or spring.		
Striped Legless Lizard ( <i>Delma impar</i> )	Found occasionally in open Box Gum Woodland where grassland is dominated by tussock forming grasses such as Kangaroo Grass, Spear Grass and Poa.	Excluded	Box Gum woodland habitat present within development footprint, however outside of the expected range and without native grassland tussock structure.
Euphrasia arguta ( <i>Euphrasia arguta</i> )	Found in limited area near Nundle. Plants have been reported in eucalypt forest with a mixed grass and shrub understorey. Usually dies off in winter months, most active growth during January to April. It is semi parasitic and attaches to the roots of other associated plants.	Included	Site has the potential to have a mixed grass understorey in better climatic conditions.
Tumut Grevillea ( <i>Grevillea wilkinsonii</i> )	Restricted to the NSW South-west slopes. Can be associated with Blakey's Red Gum, Yellow Box and Kurrajongs. Flowers mid-September to mid-October. Recruits readily where there is some bare ground.	Included	Suitable woodland habitat and eucalypt species available within the development footprint.
White-bellied Sea-Eagle <i>Haliaeetus leucogaster</i>	Terrestrial habitat includes woodland. Breeding habitat consists of mature tall open forest, tall woodland close to foraging habitat.	Included	Woodland habitat present within the development footprint.
Little Eagle <i>Hieraaetus morphnoides</i> (Breeding)	Occupies open eucalypt forest, woodland or open woodland. Nests in tall living trees within a remnant patch, build stick nests in winter.	Included	Woodland habitat present within the development footprint.
Swift Parrot <i>Lathamus discolor</i> (Breeding)	Breeds in Tasmania during spring and summer. In NSW mostly occurs on the coast and south west slopes.	Excluded	Breeding occurs in Tasmania.

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Species Credit Species	Habitat components and abundance on site	Included or excluded	Reason for inclusion or exclusion
Booroolong Frog <i>(Litoria booroolongensis)</i>	Requires permanent streams with fringing cover and rocks for shelter .	Excluded	No permanent streams within the development footprint.
Square-tailed Kite <i>Lophoictinia isura (Breeding)</i>	Found in habitats including dry woodlands. Shows preference for watercourses. Has been observed in north west NSW in stony country with a ground cover of chenopods and grasses and low open eucalypt woodland.	Included	Woodland habitat present within the development footprint.
Large Bentwinged Bat <i>Miniopterus orianae oceanensis (Breeding)</i>	Breeding habitat is within caves and manmade tunnels.	Excluded	No caves or other suitable breeding habitat within or adjacent the development footprint.
Barking Owl <i>Ninox connivens (Breeding)</i>	Hollow bearing trees with greater than 20cm diameter and greater than 4m above the ground.	Included	Suitable HBTs are present within the development footprint
Squirrel Glider <i>(Pteaurus norfolcensis)</i>	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range. Prefers a mid storey of shrub or acacia. Requires abundant tree hollows for refuge and nest sites.	Included	Suitable HBTs are present within the development footprint
Brush-tailed Phascogale <i>(Phascogale tapoatafa)</i>	Depends upon hollow bearing trees and prefers to forage in trees 25cm DBH or greater. Needs multiple hollows for nesting and shelter.	Included	Suitable HBTs are present within the development footprint
Koala <i>(Phascolarctos cinereus)</i>	<u>Inhabit a range of eucalypt forest and woodland communities and will utilise paddock trees. White Box (<i>Eucalyptus albens</i>) and Yellow Box</u>	Included	Secondary food trees available within the development footprint.



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Species Credit Species	Habitat components and abundance on site	Included or excluded	Reason for inclusion or exclusion
	( <i>Eucalyptus melliodora</i> ) are secondary food trees of the Koala in this region.		
<b>Superb Parrot</b> ( <i>Polytelis swainsonii</i> ) (Breeding)	Inhabit Box Gum and Box-Cypress-pine woodlands. They require hollow bearing trees for nesting.	Included	Suitable HBTs are present within the development footprint
Tarengo Leek Orchid ( <i>Prasophyllum petilum</i> )	East of Binalong, south and east of Boorowa. Found in Natural Temperate Grasslands at Boorowa and Delegate and grassy ground layer dominated by Kangaroo Grass under Box Gum Woodland in ACT. Highly susceptible to grazing.	Excluded	Location is unlikely due to known populations only.
Grey-headed Flying-fox ( <i>Pteropus poliocephalus</i> ) (Breeding)	Roosting camps are generally within 20km of a regular food source, usually found in gullies close to water in vegetation with a dense canopy. Feed on nectar from Eucalyptus, Melaleuca and Banksia species.	Included	Possible camp/roosting habitat available within the development footprint.
Small Purple-pea ( <i>Swainsona recta</i> )	Was considered to occur in the understorey of woodlands and open forests dominated by Blakely's Red Gum, Yellow Box, Candlebark Gum and Long-leaf Box. It is considered likely to be extinct.	Included	Woodland habitat present within the development footprint.
Silky Swainson-pea ( <i>Swainsona sericea</i> )	Found in Box Gum Woodland on South West slopes. Sometimes found in association with <i>Callitris</i> species. Regenerates from seed after fire.	Included	Woodland habitat present within the development footprint.
Golden Sun Moth ( <i>Synemon plana</i> )	Occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands with ground layers dominated by Wallaby grasses (possibly several species), they	Excluded	Not within the geographic limitations for this species.

Species Credit Species	Habitat components and abundance on site	Included or excluded	Reason for inclusion or exclusion
	require bare ground between tussocks. Habitat may have also have Austrostipa species or Kangaroo Grass. They have also been known to use areas containing weeds such as Serrated Tussock.		
Masked Owl ( <i>Tyto novaehollandiae</i> ) (Foraging)	Inhabit dry eucalypt forests and woodlands. Require large hollow bearing trees for nesting.	Included	Suitable HBTs are present within the development footprint
Zieria obcordata ( <i>Zieria obcordata</i> )	Known to occupy an area near Wellington. Grow in eucalypt woodland or shrubland. Also occurs on <i>Eucalyptus</i> and <i>Callitris</i> dominated woodland with an open low shrub understorey, on moderately steep, mainly west to north facing slopes amongst granite boulders. Associated with Box Gum Woodland.	Included	Box Gum Woodland habitat present within the development footprint, including <i>eucalyptus</i> and <i>callitris</i> species.

#### 4.2.3 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. Six of these species are assumed to be present on the site. Surveys have been conducted or expert reports obtained for the remaining species. The results are summarised in Table 4-5. Details of the survey methodologies and results are provided for each surveyed species below. Targeted survey locations are mapped on Figure 4-1. Habitat for threatened species has been calculated across the entire area of each zone containing habitat suitable for that species. This is due to the fact that there have been no surveys done for raptors and the threatened species polygons for threatened parrots is 100m radius around hollow bearing trees which results in polygons greater than the calculated ecosystem impact area (see Table 4-5 for details).

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

Species Credit Species	Biodiversity risk weighting	Assumed to occur/survey/ expert report	Present on site?	Species polygon area or count addition	Species polygon area or count excised
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Ausfeld's Wattle ( <i>Acacia ausfeldii</i> )	High	Surveyed 2017, not recorded during targeted surveys.	No	0 ha	0 ha
Regent Honeyeater ( <i>Anthochaera Phrygia</i> ) (Breeding)	Very High	Surveyed 2017, not recorded during targeted surveys, not a mapped breeding habitat area.	No	0 ha	0 ha
Bush Stone-curlew ( <i>Burhinus grallarius</i> )	High	Yes, assumed present, not surveyed for in 2017 or 2019.	Yes assumed	Zone 4 0.01 ha	Zone 4 0 ha
Gang-gang Cockatoo ( <i>Calyptorhynchus lathami</i> ) (Breeding)	High	Suitable HBTs are present within the development footprint	Yes assumed	Zone 1 2 HBTs, Zone 3 1 HBT  Area = $A = \pi r^2$ (3.14 x 100 <sup>2</sup> ) x 3 HBTs  9.42 ha, however the maximum impact area is 0.03 ha in Zone 1 and 0.06 ha in Zone 3	Zone 1 1 HBT  Area = $A = \pi r^2$ (3.14 x 100 <sup>2</sup> ) x 1 HBTs 3.14 ha, however the maximum impact area is 0.01 ha Zone 1
Small Scurf-pea ( <i>Cullen parvum</i> )	High	No targeted surveyed 2017, however was not detected during eight 20 x 20m floristic plots in 2019.	No	0 ha	0 ha
Euphrasia arguta ( <i>Euphrasia arguta</i> )	Very High	Surveyed 2017, not recorded during targeted surveys.	No	0 ha	0 ha
Tumut Grevillea ( <i>Grevillea wilkinsonii</i> )	Very High	No targeted surveyed 2017, however was not detected during eight 20 x 20m floristic plots in 2019.	No	0 ha	0 ha
White-bellied Sea-Eagle	High	2017 surveys conducted in May, not suitable for Raptor breeding detection.	Yes assumed	Zones 1-4 0.10 ha	Zones 1-4 0.26 ha

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<i>Haliaeetus leucogaster</i>					
Little Eagle <i>Hieraaetus morphnoides</i> (Breeding)	Moderate	2017 surveys conducted in May, not suitable for Raptor breeding detection.	Yes assumed	Zones 1-4 0.10 ha	Zones 1-4 0.26 ha
Square-tailed Kite <i>Lophoictinia isura</i> (Breeding)	Moderate	2017 surveys conducted in May, not suitable for Raptor breeding detection.	Yes assumed	Zones 1-4 0.10 ha	Zones 1-4 0.26 ha
Barking Owl <i>Ninox connivens</i> (Breeding)	High	Surveyed 2017, not recorded during targeted surveys.	No	0 ha	0 ha
Squirrel Glider <i>Pteaurus norfolcensis</i>	High	Surveyed 2017, not recorded during targeted surveys.	No	0 ha	0 ha
Brush-tailed Phascogale <i>Phascogale tapoatafa</i>	High	Surveyed 2017, not recorded during targeted surveys.	No	0 ha	0 ha
Koala <i>Phascolarctos cinereus</i>	High	Surveyed 2017, not recorded during targeted surveys.	No	0 ha	0 ha
Superb Parrot <i>Polytelis swainsonii</i> (Breeding)	High	Surveyed 2017, not recorded during targeted surveys, however bird survey timing was May therefore not suitable to detected Superb Parrot breeding. Suitable hollow bearing trees present.	Yes assumed.	Zone 1 2 HBTs, Zone 3 1 HBT  Area = $A = \pi r^2$ (3.14 x 100 <sup>2</sup> ) x 3 HBTs  9.42 ha, however the maximum	Zone 1 1 HBT  Area = $A = \pi r^2$ (3.14 x 100 <sup>2</sup> ) x 1 HBTs  3.14 ha, however the maximum impact area is



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				impact area is 0.03 ha in Zone 1 and 0.06 ha in Zone 3	0.01 ha Zone 1
Grey-headed Flying-fox ( <i>Pteropus poliocephalus</i> ) (Breeding)	High	Surveyed 2019, not recorded during targeted surveys.	No	0 ha	0 ha
Small Purple-pea ( <i>Swainsona recta</i> )	High	Surveyed 2017, not recorded during targeted surveys.	No	0 ha	0 ha
Silky Swainson-pea ( <i>Swainsona sericea</i> )	High	Surveyed 2017, not recorded during targeted surveys.	No	0 ha	0 ha
Masked Owl ( <i>Tyto novaehollandiae</i> ) (Foraging)	High	Surveyed 2017, not recorded during targeted surveys.	No	0 ha	0 ha
Zieria obcordata ( <i>Zieria obcordata</i> )	Very High	Surveyed 2017, not recorded during targeted surveys.	No	0 ha	0 ha

## TARGETED SURVEYS

Targeted surveys were conducted onsite in 2016 and 2017 to assess the candidate species as determined by the Biobanking calculator in 2017. It is noted that while the indicative footprint and therefore credit requirements have changed, that the broader subject site was subject to targeted surveys and therefore the results can be applied to the additional and excised areas, for species that were returned in 2017. 2017 surveys and the survey effort applied are detailed as follows:

### *Fauna habitat survey*

An assessment of habitat types available and their quality and suitability as threatened species habitat was conducted across the development site. Factors such as hollow bearing trees, sticknests, fallen timber, leaf litter, rocky outcrops, vegetation structure, connectivity and disturbance were noted.

### *Diurnal Bird Survey Effort*

Six bird monitoring plots were undertaken within the development site using the area search method. These consisted of 20 minute searches within a 2 ha area in the early morning over two days. Area searches were conducted in areas of remnant woodland. One full day of opportunistic searches also occurred in areas of suitable habitat.

### *Nocturnal Bird Survey Effort*

Numerous trees containing hollows of a suitable size for nesting were identified within the project area. Two nights of nocturnal spotlighting surveys and call playback were undertaken within woodland areas and areas containing hollow-bearing trees to observe for large forest owls in May 2017.

### *Nocturnal mammal survey effort*

Numerous trees containing hollows of a suitable size for nesting were identified within the project area. Two nights of nocturnal spotlighting surveys and call playback were undertaken within the woodland areas in October 2017 (refer Figure 4-1).

### *Koala survey effort*

The dominant overstorey species in the small woodland areas is White Box (*Eucalyptus albens*). White Box is listed as a secondary food tree species for the Koala in the Central and Southern Tablelands (OEH, 2016). Surveys of the woodland areas were undertaken for the Koala by actively searching each of the trees for scratchings and scats in 2017. Two nights of nocturnal spotlighting surveys were also undertaken within the woodland areas containing hollow bearing trees (refer Figure 4-1). One Bionet record for the Koala occurred within 10km of the project in the town of Wellington

### *Flora survey effort*

Targeted surveys were undertaken for Silky Swainson-Pea, Small Purple Pea, *Euphrasia arguta*, *Ziera obcordata*, *Tylophora linearis* and Bluegrass (*Dichanthium setosum*) in May and October 2016, Ausfeld's Wattle was surveyed for in October 2017. Both surveys were conducted by an ecologist from NGH environmental and were performed within the optimal detection period for these species as recommended by the Biobanking (and BAM) calculator. Areas of suitable habitat were surveyed using the parallel field traverse survey technique in accordance with the NSW Guide to Surveying Threatened Plants (OEH, 2016). Parallel field traverses were 10 metres apart in areas of open woodland and derived native grassland. Approximately 4 hours were spent surveying for these species.

In addition, 20 x 20 m BAM plots in areas of impact and or excised areas were conducted in November 2019 within Zones 1-6. Small Scurf Pea and Tumut Grevillea, if they were present within these areas, would have been detected especially with the current drought conditions and sparse groundcover in all zones.

## **SURVEY RESULTS**

### *Fauna habitat survey results*

A number of trees occurring within the development site were considered to be potentially hollow-bearing. An assessment was undertaken of all accessible trees within the development site to record the species, presence of hollows, tree height, diameter and the number, size and location of hollows. A total of 60 hollow-bearing trees were identified during surveys of the proposal area. Zones 1, 2 and 3 (associated with the current areas to be added and excised) were found to contain hollow bearing trees and thus would provide



breeding habitat for Gang-gang Cockatoo and Superb Parrot, no stag watches or surveys for these species were conducted during the 2017 fauna surveys.

#### *Diurnal Bird Survey Results*

The Regent Honeyeater was not detected during surveys. White Box is a key foraging species for the Regent Honey Eater (OEH, 2016), however the White Box was not in flower during the time of the surveys. The regent Honeyeater is nomadic over large distances and unlikely to be detected if food sources are scarce in the area at the time of surveys. There are records of the species in the Wellington area and as such it is assumed to occur on the site from time to time when foraging resources are present.

The BCT clarifies the Regent Honeyeater is a species credit species only in mapped important areas which align with breeding habitat. The Regent Honeyeater has three key breeding areas in NSW; the Capertee Valley, Bundarra-Barraba region and the Lower Hunter (OEH 2017). The development site is not near any of the known key breeding areas. It is therefore assumed that the development site is unlikely to be a mapped important area and that species credits are not generated for this species.

#### *Nocturnal Bird Survey Results*

A single Masked Owl was recorded during spotlighting surveys in 2017. Although habitat is present on site that meets the breeding habitat constraint for this species, it is considered unlikely that the Masked Owl would use these habitat features given the context in which these habitat features occur.

The Masked Owl is a large forest owl, it prefers uncleared or lightly cleared areas with high densities of old hollow-bearing trees (DEC 2006). Studies of woodland fragments on privately-owned and unprotected lands in south-eastern New South Wales showed that virtually all records of the Masked Owl were associated with extensively forested areas or occurred within one kilometre of the boundary of these areas (Kavanagh and Stanton, 2002). The development site is highly cleared and fragmented with the nearest densely forested area over two kilometres to the south-west. As such, the development site is unlikely to be preferred habitat for this species. Further, breeding usually occurs in close proximity to foraging areas. Common Ringtail Possum, Greater Glider and the Sugar Glider are important prey species for large forest owls (Kavanagh and Stanton, 2002), none of which were recorded at the development site during nocturnal surveys. The development site is therefore unlikely to provide foraging habitat for the Masked Owl. The NSW Recovery Plan for large forest owls (DEC 2006) states that the Masked Owl requires old hollow eucalypts with hollows greater than 40cm wide and greater than 100cm deep for nesting. None of the hollows within the development site are greater than 40cm wide and none are likely to be 100cm deep. Based on the above it is considered unlikely that the Masked Owl would utilise the hollows within the development site for nesting. It is likely that the individual observed was resting within the development site while travelling through. As such, no breeding resources would be impacted by the proposal and species credits are not considered to be generated for this species. Bush-stone Curlew were not targeted in 2017 surveys, however the presence of fallen timber in Zone 4 allows an assumption to be made that there is habitat for this species within part of the development footprint.

#### *Nocturnal mammal survey results*

The Squirrel Glider, Brush-tailed Phascogale, Brush-tailed Rock Wallaby and Eastern Pygmy Possum were not detected during nocturnal surveys. No records of these species occur within 10km of the development site. The woodland vegetation within the proposal area supports hollow-bearing trees that could provide breeding habitat for these species. However, there are no flowering shrubs in the understory that would provide a food source for these species. The White Box Woodlands within the proposal area are sparsely vegetated, fragmented and lack connectivity to vegetation within the surrounding landscape. It is considered

unlikely that the White Box trees would be utilised by these species and the development site is not considered to provide habitat for these species.

#### *Koala survey results*

No Koala's or signs of Koala's were detected during the targeted surveys of the small woodland areas within the development site. As such, the area is not considered to currently support a Koala population and it would not comprise *Core Koala Habitat* under SEPP44. As White Box is a feed species under Schedule 2 of SEPP44 and it comprises more than 15% of the total number of trees in the tree component, the area is defined as *Potential Koala Habitat* under SEPP44. The White Box Woodlands within the proposal area are sparsely vegetated, fragmented and lack connectivity to vegetation within the surrounding landscape. It is considered unlikely that the White Box trees would be utilised by the Koala on a regular basis and the development site is not considered to provide habitat for this species.

#### *Frog survey results*

The Booroolong Frog inhabits rocky permanent streams with some fringing vegetation cover and requires exposed rocks and rock crevices for breeding near and within shallow pools. No rocky permanent streams occurred within the development site and there is little to no fringing vegetation. Wuuluman Creek which runs through the development site is degraded from grazing and has no rocks or crevices present within the stream that would provide breeding habitat for this species. As no suitable habitat is present within the proposal area, it is not considered to occur within the development site.

#### *Flora survey results*

Silky Swainson-Pea (*Swainsona sericea*) is a prostrate or erect perennial up to 10cm tall (OEH, 2016). It is found in Box Gum Woodland in the Southern Tablelands and the South West Slopes. Small Purple Pea (*Swainsona recta*) is an erect perennial herb growing to 30 cm tall. It occurs in the grassy understory of woodland and open forests (OEH, 2017). Suitable habitat exists for these species within the areas of White Box grassy woodland with a native understory. Surveys for these species were undertaken within the optimal survey time. These species were not detected during the targeted surveys and as such are not considered to occur within the development site.

*Euphrasia arguta* is an erect annual herb up to 35 cm tall. This species is semi-parasitic and it is found in Eucalypt forests with a mixed grass and shrub understory. The nearest known current population of this species is in Nundle, over 300 km north east of the development site. Suitable habitat for this species could occur within the woodland habitat. Surveys for this species was undertaken within the optimal survey time in October. This species was not detected during the targeted surveys and as such is not considered to occur within the development site.

Ausfeld's Wattle (*Acacia ausfeldii*) was not detected during the surveys. It is a conspicuous shrub 2-4 m tall. Very few understory shrubs were detected within the development site. It is considered unlikely that the species would have been overlooked if present and as such it is not considered to occur at the development site.

Small Scurf Pea and Tumut Grevillea were not detected during 2019 20 x 20 m botanical plots within the additional and excised areas.



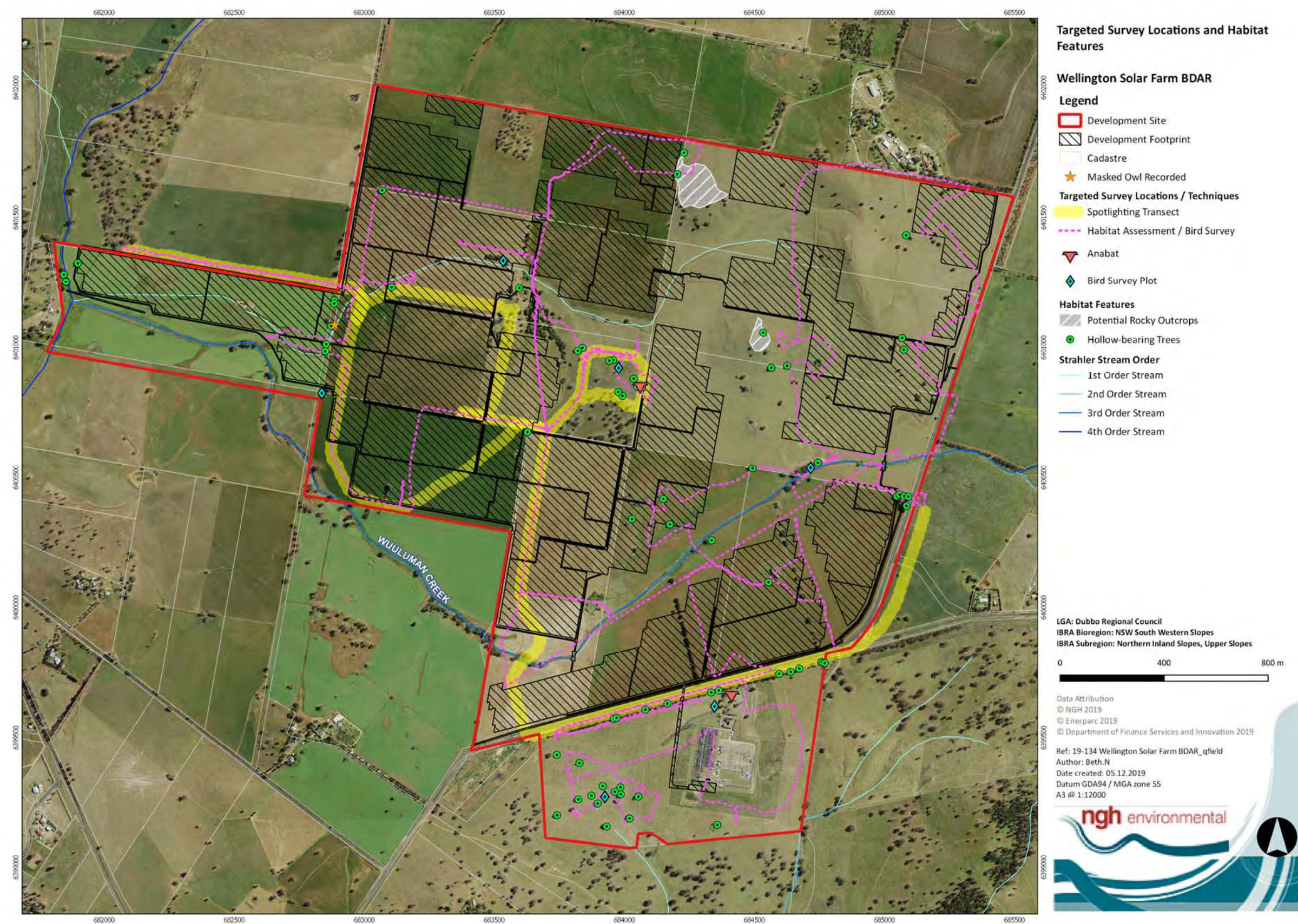


Figure 4-1 Targeted survey locations, threatened species polygons and hollow bearing trees



## **4.3 ADDITIONAL HABITAT FEATURES RELEVANT TO PRESCRIBED BIODIVERSITY IMPACTS**

### **4.3.1 Occurrences of karst, caves, crevices and cliffs**

There are no known occurrences of karst, caves, crevices and cliffs at the subject site.

### **4.3.2 Occurrences of rock**

There were occurrences of rock recorded within the development site but not within the development footprint (see Figure 4-1). These consisted of small rocks (less than 15cm) sometimes scattered and sometimes embedded in the ground surface locations of outcrops are shown on Figure 4-1

### **4.3.3 Occurrences of human made structures and non-native vegetation**

The human-made structures include the existing substation infrastructure and the transmission lines feeding into the substation. This type of infrastructure includes cyclone fencing around the site. There is a dwelling located within the development footprint, however it has been excised from the approved development footprint and thus will not be impacted. There is non-native vegetation within the proposal area, an additional 26.56 ha of exotic vegetation is now included in the development footprint with 11.26 ha excised from the development footprint, see Figure 1-2(exotic areas are in grey; not part of this assessment).

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

No threatened aquatic or semi aquatic species were determined as having habitat within the development footprint.



## 5 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

An EPBC protected matters report was undertaken on the 08 November 2018 (10 km buffer of the development site) to identify Matters of National Environmental Significance (MNES) that have the potential to occur within the development site (refer to APPENDIX B). Relevant to Biodiversity these include:

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

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

### 5.1 WETLANDS OF INTERNATIONAL IMPORTANCE

Four wetlands of international importance were returned from the protected matters report. The nearest of these (within 200 km of the development site) is the Macquarie Marshes. All other wetlands returned from the search are over 500 km away. The Macquarie Marshes occurs approximately 150km north west of the development site. It is fed by the Macquarie River. There is no apparent connectivity between the development site and the Macquarie River.

### 5.2 THREATENED ECOLOGICAL COMMUNITIES

Five threatened ecological communities were found in the protected matters report. These were the Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia, which is listed Endangered Community, Natural Temperate Grassland of the South Eastern Highlands which is Critically Endangered, Poplar Box Grassy Woodland on Alluvial Plains listed as an Endangered Community, Weeping Myall Woodlands which is Endangered and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland which is a Critically Endangered Community.

There is White Box – Yellow Box Blakely's Red Gum Grassy Woodland and Derived Grassland present within the development footprint, however due to the fact that the understorey is dominated by exotics it would not be classified as EPBC listed Critically Endangered Ecological Community (CEEC).

### 5.3 THREATENED SPECIES

There were eight threatened flora, ten threatened birds, seven mammals, two reptiles and four fish returned from the protected matters report. The additional mammal since 2017 is the Greater Glider. Of these 31 species, seventeen were considered to have the potential to utilise the habitats within the development footprint:

- Regent Honeyeater (*Anthochaera phrygia*) – Critically Endangered EPBC Act
- Swift Parrot (*Lathamus discolor*) – Critically Endangered EPBC Act
- Superb Parrot (*Polytelis swainsonii*) – Vulnerable EPBC Act
- Koala (*Phascolarctos cinereus*) – Vulnerable EPBC Act
- Corben's Long-eared Bat (*Nyctophilus corbeni*) – Vulnerable EPBC Act
- Large-eared Pied Bat (*Chalinolobus dwyeri*) – Vulnerable EPBC Act.
- Small Purple Pea (*Swainsona recta*) – Endangered EPBC Act.

- Euphrasia arguta (*Euphrasia arguta*) - Endangered EPBC Act.
- Painted Honey-eater (*Grantiella picta*) – Vulnerable EPBC Act.
- Spotted-tailed Quail – Endangered EPBC Act.
- Brush-tailed Rock-wallaby – Vulnerable EPBC Act.
- Grey-headed Flying-fox (*Pteropus poliocephalus*) – Vulnerable EPBC Act.
- Pink-tailed Worm-lizard (*Aprasia parapulchella*) – Vulnerable EPBC Act.
- Striped Legless Lizard (*Delma impar*) – Vulnerable EPBC Act.
- Tarengo Leek Orchid (*Prasophyllum petilum*) – Endangered EPBC Act
- Bluegrass (*Dichanthium setosum*) – Vulnerable EPBC Act.
- Tylophora linearis (*Tylophora linearis*) – Endangered EPBC Act.

Surveys in 2017 (NGH, 2017) and flora surveys and assessment in 2019, demonstrate that the Swift Parrot, Regent Honeyeater, Koala, Euphrasia arguta, Painted Honey-eater, Large-eared Pied Bat, Spotted-tailed Quoll, Brush-tailed Rock-wallaby, Grey-headed Flying-fox, Striped Legless Lizard, Pink-tailed Legless Lizard, Small Purple-pea, Tarengo Leek Orchid, Tylophora linearis and Bluegrass are unlikely to occur within the development footprint. The remaining species are assessed further in section 10.1.3 and APPENDIX B, assessment was conducted in relation to the Corben's Long-eared Bat, and Superb Parrot to determine whether a referral to the Commonwealth was necessary.

## 5.4 MIGRATORY SPECIES

Eleven listed migratory species were returned from the protected matters report. A habitat assessment was conducted for these species. Two of these species could occur on the site on occasion. – the Forktailed Swift, White-throated Needletail. However, as these species are almost exclusively aerial (DoE, 2015) impacts to these species are considered unlikely.

Name	Scientific Name	Habitat Present	Impact
Fork-tailed Swift	<i>Apus pacificus</i>	Present	Unlikely – almost exclusively aerial species.
White-throated Needletail	<i>Hirundapus caudacutus</i>	Present	Unlikely – almost exclusively aerial species
Yellow Wagtail	<i>Motacilla flava</i>	Absent – No wetlands, mangroves or dense vegetation within the development site.	Unlikely – No suitable habitat
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	Absent – No wet forests within development site	Unlikely – No suitable habitat
Rufous Fantail	<i>Rhipidura rufifrons</i>	Absent – No wet forests/mangroves within development site	Unlikely – No suitable habitat
Common Sandpiper	<i>Actitis hypoleucos</i>	Absent – No wetlands or mudflats within development site	Unlikely – No suitable habitat
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	Absent -No wetlands or mudflats within development site	Unlikely – No suitable habitat
Pectoral Sandpiper	<i>Calidris melanotos</i>	Absent – No mudflats within development site	Unlikely – No suitable habitat



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Name	Scientific Name	Habitat Present	Impact
Curlew Sandpiper	<i>Calidris ferruginea</i>	Absent – No mudflats within development site	Unlikely – No suitable habitat
Latham's Snipe	<i>Gallinago hardwickii</i>	Absent – No wetlands within development site	Unlikely – No suitable habitat
Eastern Curlew	<i>Numenius madagascariensis</i>	Absent – No mudflats within development site	Unlikely – No suitable habitat

## **6 AVOID AND MINIMISE IMPACTS**

### **6.1 AVOIDING AND MINIMISING IMPACTS ON NATIVE VEGETATION AND HABITAT**

#### **6.1.1 Site selection and proposal planning phase**

A preliminary constraints analysis was conducted by NGH Environmental (2017) 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 as far as practical. Key changes to the proposal design included the avoidance of areas of White Box grassy woodland in moderate to good condition, streams and rocky outcrops.

The addition and excision of areas within the approved development footprint have resulted in a further reduction in biodiversity impacts by reducing the development footprint's impact on native vegetation whilst continuing to avoid the CEEC White Box grassy woodland.

#### **6.1.2 Proposal components – consideration of alternate modes or technologies**

All efforts have been made to minimise the impacts within the development footprint. This assessment is required due to final changes made during the detailed design phase; the design aims to optimise the yield of the solar farm while minimising environmental impacts as much as possible.

### **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:

- a) Impacts of development on the habitat of threatened species or ecological communities associated with:
  - There are no karst, caves, crevices, cliffs or other geological features within the development footprint.
  - There are some rocks within the development footprint that will be impacted, however due to the reduction in the development footprint there should be less impact due to the proposed changes described in this report.
  - There is a heritage building within the development footprint. Commitments have been made to avoid impacting on the heritage values of this site.
  - There are impacts to non-native vegetation within the development footprint including an additional impact area of 26.41 ha with 10.55 ha excised, totalling 15.86 ha impacted. However, the addition of exotic vegetation to be impacted has enabled an overall reduction in native vegetation impacts.
- b) Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range
  - This is a highly fragmented landscape, connectivity has limitations in this setting, the excision of woodland areas will assist in maintaining the remaining connectivity features within the development footprint. Species such as Koala which are highly mobile are unlikely to utilise the development footprint.
- c) Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining)



- Water quality is unlikely to be impacted by the proposed changes to the development footprint.
- d) Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.
- An increase in vehicle strike risk to threatened species is unlikely to occur as a result of the proposed changes to the development footprint.

## 7 IMPACTS UNABLE TO BE AVOIDED

### 7.1 DIRECT IMPACTS

The construction and operational phases of the Wellington Solar Farm have the potential to impact biodiversity values at the site that cannot be avoided. However, the changes proposed in Mod 2 reduce the impacts on native vegetation. Direct impacts attributable to the construction, operational and decommissioning phases include:

- Disturbances to native vegetation, soil, water and air quality
- Potential to impact on cultural features and values
- Noise generated by equipment and traffic movements
- Public safety and hazards
- Public amenity

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

Nature of impact	Extent	Frequency	Duration and timing	Consequence
<b>Direct impacts</b>				
Habitat clearance for permanent and temporary construction facilities (e.g. solar infrastructure, transmission lines, compound sites, stockpile sites, access tracks)	4.32 ha additional clearing, 11.03 excised clearing.  <b>Total reduction in clearing 6.71 ha</b>	Regular	Construction phase	<ul style="list-style-type: none"> <li>• Direct loss of native flora and fauna habitat including semi mature trees</li> <li>• Potential loss of groundcover resulting in unstable ground surfaces</li> <li>• Injury and mortality to fauna during clearing of fauna habitat</li> <li>• Introduction and spread of noxious weeds and pathogens</li> <li>• Disturbance to fallen timber, dead wood and bush rock</li> </ul>
Loss of Threatened Ecological Community – White Box Grassy Woodland – planted, remnant and derived grassland		Regular	Construction phase	<ul style="list-style-type: none"> <li>• Loss of woodland and derived vegetation areas</li> </ul>



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Impacts to Wuuluman Creek and riparian vegetation		Rare	Construction phase	<ul style="list-style-type: none"> <li>Water quality impacts could occur during construction</li> </ul>
Displacement of resident fauna		Regular	Construction phase	<ul style="list-style-type: none"> <li>Loss trees, particularly hollow bearing trees will result in displacement of fauna.</li> </ul>
Injury or death of fauna		Rare	Construction and operational phase	<ul style="list-style-type: none"> <li>Possible injury or death to fauna could occur as a result of machinery and/or traffic movement</li> </ul>
Disruption to connectivity		Rare	Construction and operational phase	<ul style="list-style-type: none"> <li>Clearing as a result of the proposed development will result in possible disruption to connectivity which is already limited across the development footprint</li> </ul>
Removal of habitat features e.g. HBTs		Rare	Construction and operational phase	<ul style="list-style-type: none"> <li>Removal of HBTs will result in displaced fauna. However, the changes to the development footprint will not significantly increase this impact</li> </ul>
Shading by solar infrastructure	112 ha	Constant	Operation phase	<ul style="list-style-type: none"> <li>Potential loss of groundwater resulting in unstable ground surfaces and potential sedimentation of adjacent waterways</li> </ul>
Existence of permanent solar infrastructure	288 ha	Constant	Operation phase	<ul style="list-style-type: none"> <li>Collision risk to birds and microbats (fencing, array infrastructure).</li> </ul>

### 7.1.1 Changes in vegetation integrity scores

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 Current and future vegetation integrity scores for each vegetation zone within the development site

Zone ID	PCT	EEC and/or threatened species habitat?	Area added (ha)	Area excised (ha)	Current vegetation Integrity Score	Future vegetation Integrity Score
1	277 Woodland mod-good	Yes	0.03	0.01	6.1	0.00
2	266 planted woodland mod-good	Yes	0.00	0.03	12.3	0.00
3	266 woodland low	Yes	0.06	0.22	21.4	0.00
4	266 woodland mod-good	Yes	0.01	0.00	26.5	0.00
5	266 derived grassland mod to good	Yes	0.05	0.34	30	0.00
6	266 derived grassland low	Yes	4.12	10.55	31.3* 24.4**	0.00

\*Additional area

\*\*Excised area

Note: the reason each area gave different vegetation integrity scores is due to the different sizes requiring different number of plots for each. The additional area only required 2 plots whilst the excised area required 3 plots.

### 7.1.2 Loss of species credit species habitat or individuals

The loss of species credit species habitat or individuals 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 or count of individuals lost (additional)	Area of habitat or count of individual lost (excised)
Bush Stone-curlew ( <i>Burhinus grallarius</i> )	2	0.01 ha	0 ha



Gang-gang Cockatoo ( <i>Callocephalon fimbriatum</i> )	2	0.09 ha	0.01 ha
White-bellied Sea-Eagle ( <i>Haliaeetus leucogaster</i> )	2	0.10 ha	0.26 ha
Little Eagle ( <i>Hieraaetus morphnoides</i> )	1.5	0.10 ha	0.26 ha
Square-tailed Kite ( <i>Lophoictinia isura</i> )	1.5	0.10ha	0.26 ha
Superb Parrot ( <i>Polytelis swainsonii</i> )	2	0.09 ha	0.01 ha

### 7.1.3 Loss of hollow-bearing trees

No additional hollow bearing trees are to be lost when compared with the approved development footprint. One additional HBT would be impacted, however one HBT is to be excised making the total loss of HBTs 16 with no net change in HBT loss.

## 7.2 INDIRECT IMPACTS

Indirect impacts include the follow-on or cascading impacts on local community and the potential to impact existing and future land uses. See Table 7-4 below for details of proposed indirect impacts.

Table 7-4 Potential impacts to biodiversity during the construction and operational phases

Nature of impact	Extent	Frequency	Duration and timing	TEC, threatened species and habitats likely to be affected	Consequence for bioregional persistence
<b>Indirect impacts (those listed below are included in the BAM)</b>					
<b>Inadvertent impacts on adjacent habitat or vegetation</b>	Unknown	Rare	Construction Phase: Short – term.	Zone 1 PCT 277 woodland low 0.03 ha Zone 3 PCT 266 woodland low 0.06 ha Zone 4 PCT 266 woodland mod-good 0.01 ha Zone 5 PCT 266 derived grassland mod-good 0.05 ha Zone 6 PCT 266 derived grassland low 4.12 ha	Direct loss of native flora and fauna habitat
<b>Reduced viability of adjacent habitat due to edge effects</b>	Unknown	Permanent impact	Operational phase: Long-term.	Zone 1 PCT 277 woodland low 0.03 ha Zone 3 PCT 266 woodland low 0.06 ha Zone 4 PCT 266 woodland mod-good 0.01 ha Zone 5 PCT 266 derived grassland mod-good 0.05 ha Zone 6 PCT 266 derived grassland low 4.12 ha	Disturbances caused from increased infrastructure presence.
<b>Reduced viability of adjacent habitat due to noise, dust or light spill</b>	Unknown	Temporary (construction)	Construction Phase: Short – term.	Zone 1 PCT 277 woodland low 0.03 ha	Disturbances to native fauna through excessive



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Nature of impact	Extent	Frequency	Duration and timing	TEC, threatened species and habitats likely to be affected	Consequence for bioregional persistence
<b>Indirect impacts (those listed below are included in the BAM)</b>					
				Zone 3 PCT 266 woodland low 0.06 ha Zone 4 PCT 266 woodland mod-good 0.01 ha Zone 5 PCT 266 derived grassland mod-good 0.05 ha Zone 6 PCT 266 derived grassland low 4.12 ha	dust, noise and light during construction.
<b>Transport of weeds and pathogens from the site to adjacent vegetation</b>	Unknown	Ongoing	Construction and operation: long-term	Zone 1 PCT 277 woodland low 0.03 ha Zone 3 PCT 266 woodland low 0.06 ha Zone 4 PCT 266 woodland mod-good 0.01 ha Zone 5 PCT 266 derived grassland mod-good 0.05 ha Zone 6 PCT 266 derived grassland low 4.12 ha	Introduction of new weed outbreaks on airport land and surrounding habitat.
<b>Increased risk of starvation, exposure and loss of shade or shelter</b>	Unknown	Permanent impact (operation)	Construction Phase: Short-term.	Zone 1 PCT 277 woodland low 0.03 ha Zone 3 PCT 266 woodland low 0.06 ha Zone 4 PCT 266 woodland mod-good 0.01 ha	Loss of woodland habitat.

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Nature of impact	Extent	Frequency	Duration and timing	TEC, threatened species and habitats likely to be affected	Consequence for bioregional persistence
<b>Indirect impacts (those listed below are included in the BAM)</b>					
				Zone 5 PCT 266 derived grassland mod-good 0.05 ha Zone 6 PCT 266 derived grassland low 4.12 ha	
<b>Rubbish dumping</b>	Unknown	Ongoing	Construction and operation long-term	Zone 1 PCT 277 woodland low 0.03 ha Zone 3 PCT 266 woodland low 0.06 ha Zone 4 PCT 266 woodland mod-good 0.01 ha Zone 5 PCT 266 derived grassland mod-good 0.05 ha Zone 6 PCT 266 derived grassland low 4.12 ha	Contamination of surrounding habitat with rubbish associated with construction.



### **7.3 PRESCRIBED IMPACTS**

The prescribed biodiversity impacts identified in the BC Regulation (clause 6.1) relevant to the proposal are:

- Impact of development on the habitat for threatened species or ecological communities associated with rocks.
- 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 lifecycle.
- Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining or other development).
- Impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community.

Each of these prescribed impacts to biodiversity has been addressed in the following sections.

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

The surrounding areas of habitat to development site includes:

- The linear tree line of Goolma Road which contains trees with hollows.
- The Woodland areas and derived grasslands and paddock trees to the south and north of the development.
- Wuuluman Creek to the north within the Wellington Solar Farm.
- A larger patch of vegetation is Mount Arthur north of Wellington township.

The closest area of habitat connectivity for threatened species is linear tree line along Goolma Road which is rather isolated. Adjoining patches of planted vegetation or paddock trees are within 50-100 metres with no connection to larger patches of native vegetation. These small linear patches are foraging and refuge areas for birds and bats as these species move through the landscape, but these areas would not be considered adequate habitat connectivity for threatened species.

The development footprint has been reduced as practical as possible to avoid any unnecessary impacts. All impacted areas are included the BAM calculation.

#### **7.3.2 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)**

There is one water body, a small farm dam, to the south of the current substation. There is potential for indirect impacts to this small farm dam during construction, but this can be prevented by mitigation measures. It is anticipated there are no direct impacts on waterbodies or water quality from the development that will impact upon threatened species.

#### **7.3.3 Impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC**

It is possible threatened species that utilise the Box Gum Woodland (TEC) may be impacted by vehicle strike particularly during construction but this will be avoided as much as possible through mitigation measures such as reduced speed limits and fauna management. This potential impact has been managed in mitigation measures in the Submissions Report (NGH 2018).

## **7.4 IMPACTS TO BIODIVERSITY VALUES THAT ARE UNCERTAIN**

Due to the changes proposed to the development footprint resulting in less impact than the approved development footprint it is unlikely that any uncertain impacts apply.

## **7.5 IMPACTS TO MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE**

The following species listed under the EPBC could possibly be impacted by the proposed development:

- Corben's Long-eared Bat (*Nyctophilus corbeni*),
- Superb Parrot (*Polytelis swainsonii*)

The Superb Parrot has the potential to utilise hollows within the development footprint. No additional HBTs would be impacted by the proposed layout changes.

Further details on the assessment of these species is provided in section 10.1.3. An EPBC referral is not considered necessary.



## **8 MITIGATING AND MANAGING IMPACTS**

### **8.1 MITIGATION MEASURES**

Mitigation measures are required to minimise direct and indirect impacts to threatened communities and species. Mitigation measures have been approved through the Development Consent Conditions and the previous Biodiversity Assessment Report. Table 8-1 proposes the mitigation measure to minimise impact on native vegetation and habitat.

#### **8.1.1 Impacts from the clearing of vegetation and habitats**

Direct impacts attributable to the construction, operational and decommissioning phases include:

- Loss of vegetation and fauna habitat
- Loss of threatened species habitat
- Loss of endangered ecological community Box Gum Woodland
- Loss of hollow bearing trees

#### **8.1.2 Indirect impacts**

Indirect impacts include:

- Impacts of habitat loss on adjacent habitat values
- Edge effects of habitat that has reduced in size
- Changes in habitat value due to noise, light, dust.
- Transport of weeds

#### **8.1.3 Prescribed impacts**

Prescribed impacts include:

- Impacts on habitat of threatened species and endangered ecological communities.
- Impacts on vegetation connectivity for threatened species movement
- Impacts of vehicle strike on threatened species.

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						
<b>timing works to avoid critical life cycle events such as breeding or nursing</b>	<ul style="list-style-type: none"> <li>Hollow-bearing trees within the development site would not be cleared between June and February, to avoid the breeding season of Superb Parrot and Corben's Long-eared Bat and the core hibernation period for Corben's Long-eared Bat.</li> <li>If clearing outside of this period cannot be achieved, pre-clearing surveys would be undertaken to ensure these species do not occur.</li> </ul>	Tree clearing to be undertaken between February and June Pre construction phase	Once off	Lightsource BP	Low	There is still a chance these species will be impacted upon due to out of season breeding, however the risk is low and if the species is detected they will be relocated or referred to a wildlife rescue group if dependent young are detected.
<b>instigating clearing protocols including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecologist during clearing events</b>	<ul style="list-style-type: none"> <li>Update the Biodiversity Management Plan (BMP) to incorporate protocols for: <ul style="list-style-type: none"> <li>Protection of native vegetation to be retained</li> <li>Best practice removal and disposal of vegetation</li> <li>Staged removal of hollow-bearing trees and other habitat features such as fallen logs with attendance by an ecologist</li> <li>Weed management</li> <li>Unexpected threatened species finds</li> <li>Rehabilitation of disturbed areas</li> </ul> </li> </ul>	Pre-construction phase Construction phase	Regular	Lightsource BP	Low	There is s still a risk that fauna may be impacted upon due to construction, however this will minimise the impacts.



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Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
	<ul style="list-style-type: none"> <li>The BMP would form part of the Wellington Solar Farm Construction Environmental Management Plan (CEMP).</li> </ul>					
<b>relocation of habitat features (fallen timber, hollow logs) from within the development site.</b>	<ul style="list-style-type: none"> <li>Hollow logs and significant surface rock will be relocated from the development footprint into areas that are not being impacted upon. Works will be supervised by an ecologist.</li> </ul>	Pre construction	Regular	Lightsource BP	Low	This is a low risk activity, it will not make up for the loss of habitat but it will enable the retention of more habitat onsite than if no relocation and retention occurred.
Indirect impacts on native vegetation and habitat						
<b>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</b>	<ul style="list-style-type: none"> <li>The BMP will incorporate details of marking up of vegetation that is to be retained. This could include the development of a marking and communication protocol to ensure that ensures appropriate retention and minimal damage to surrounding vegetation</li> </ul>	Pre construction	One off	Lightsource BP	Low	If this activity is carried out as per protocols there is very low risk and there will be little to no residual impacts
<b>noise barriers or daily/seasonal timing of construction and</b>	<ul style="list-style-type: none"> <li>As detailed above, activities such as HBT removal will be timed to avoid critical breeding periods for</li> </ul>	Construction	Regular	Lightsource BP	Low	If this activity is carried out as per protocols then the risk of noise impacts to fauna during construction are minimal

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Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
<b>operational activities to reduce impacts of noise</b>	threatened species. This will be detailed in the BMP					
<b>light shields or daily/seasonal timing of construction and operational activities to reduce impacts of light spill</b>	<ul style="list-style-type: none"> <li>Avoid night works ie works after sunset or before sunrise.</li> <li>Direct operation lights away from vegetated areas particularly woodlands</li> </ul>	Construction Operation	Regular	Lightsource BP	Low	If protocols are followed, minimal impacts will result. If protocols fail consequences could be moderate due to the presence of threatened species.
<b>adaptive dust monitoring programs to control air quality</b>	<ul style="list-style-type: none"> <li>Details of dust management will be in the Construction Environmental Management Plan</li> </ul>	Construction	Regular	Lightsource BP	Low	If protocols are followed minimal impacts will result. If protocols fail the consequences are minimal.
<b>temporary fencing to protect significant environmental features such as riparian zones</b>	<ul style="list-style-type: none"> <li>Details of riparian zone protection will be in the Biodiversity Management Plan (BMP) and Construction Environmental Management Plan (CEMP)</li> </ul>	Construction	Ongoing	Lightsource BP	Low	If protocols are followed failure is unlikely. If protocols fail the consequences are minimal due to the distance from sensitive receptors and the lack of aquatic habitat for threatened species.
<b>hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas</b>	<ul style="list-style-type: none"> <li>Weed, hygiene and pest management protocols will be prepared and implemented as part of the Biodiversity Management Plan for the development.</li> </ul>	Pre construction, Construction and Operation	Ongoing	Lightsource BP	Low	If protocols are followed failure is still possible. If failure does occur consequences could be moderate due to the adjacent farming lands and waterway that has the potential to transport weed seed.
<b>staff training and site briefing to</b>	<ul style="list-style-type: none"> <li>Details of staff briefing, toolbox talks and post incident protocols will be in</li> </ul>	All stages	Regular	Lightsource BP	Low	If protocols are followed residual impacts are minimal.



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Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
<b>communicate environmental features to be protected and measures to be implemented</b>	the CEMP to ensure that all staff onsite are aware of the biodiversity constraints throughout the Pre Construction, Construction and Operation phases					If protocols fail then there is a moderate risk of impacts occurring.
<b>making provision for the ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on or adjacent to the development site.</b>	<ul style="list-style-type: none"> <li>Details of site rehabilitation will be provided in the BMP. This includes replanting of indigenous species, ongoing maintenance of plantings and measures of success</li> </ul>	All stages	Regular	Lightsource BP	Low	If the protocols are followed there will be no residual impacts only benefits to the surrounding environment. If protocols fail then there will be no improvement to biodiversity following construction.
Prescribed biodiversity impacts						
<b>programming construction activities to avoid critical life cycle events; for example, timing construction activities for when migratory species are absent from the site, or when particular species known to or likely to use the habitat on</b>	<ul style="list-style-type: none"> <li>Hollow-bearing trees within the development site would not be cleared between June and February, to avoid the breeding season of Superb Parrot and Corben's Long-eared Bat and the core hibernation period for Corben's Long-eared Bat.</li> <li>If clearing outside of this period cannot be achieved, pre-clearing surveys would be undertaken to ensure these species do not occur.</li> </ul>	Pre construction	One off	Lightsource BP	Low	There is still a chance these species will be impacted upon due to out of season breeding, however the risk is low and if the species is detected they will be relocated or referred to a wildlife rescue group if dependent young are detected.

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Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
the site are not breeding or nesting						
instigating clearing protocols including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological or licensed wildlife handler during clearing events for rocks, human made structures and non-native vegetation	<ul style="list-style-type: none"> <li>Update the Biodiversity Management Plan (BMP) to incorporate protocols for: <ul style="list-style-type: none"> <li>Protection of native vegetation to be retained</li> <li>Best practice removal and disposal of vegetation</li> <li>Staged removal of hollow-bearing trees and other habitat features such as fallen logs with attendance by an ecologist</li> <li>Weed management</li> <li>Unexpected threatened species finds</li> <li>Rehabilitation of disturbed areas</li> </ul> </li> <li>The BMP would form part of the Wellington Solar Farm Construction Environmental Management Plan (CEMP).</li> </ul>	Pre-construction phase Construction phase	Regular	Lightsource BP	Low	There is s still a risk that fauna may be impacted upon due to construction, however protocols will minimise the impacts.
retention of habitat features (fallen timber, hollow logs, rocks) within the development site	<ul style="list-style-type: none"> <li>Hollow logs and significant surface rock will be relocated from the development footprint into areas that are not being impacted upon. Works will be supervised by an ecologist.</li> </ul>	Pre construction	Regular	Lightsource BP	Low	This is a low risk activity, it will not make up for the loss of habitat but it will enable the retention of more habitat onsite than if no relocation and retention occurred.



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Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	of Risk and consequences of residual impacts
<b>sediment barriers or sedimentation ponds to control the quality of water released from the site into the receiving environment</b>	<ul style="list-style-type: none"> <li>The CEMP will detail protocols installed to control sediment during construction</li> </ul>	Pre construction and Construction	Regular	Lightsource BP	Low	If protocols are followed there is a low risk of impact. If protocols fail there is a low level of consequences due to limited creek and the distance from sensitive receptors.
<b>staff training and site briefing to communicate environmental features to be protected and measures to be implemented</b>	<ul style="list-style-type: none"> <li>Details of staff briefing, toolbox talks and post incident protocols will be in the CEMP to ensure that all staff onsite are aware of the biodiversity constraints throughout the Pre Construction, Construction and Operation phases</li> </ul>	All stages	Regular	Lightsource BP	Low	If protocols are followed residual impacts are minimal. If protocols fail then there is a moderate risk of impacts occurring.
<b>making provision for the ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on or adjacent to the development site</b>	<ul style="list-style-type: none"> <li>Details of site rehabilitation will be provided in the BMP. This includes replanting of indigenous species, ongoing maintenance of plantings, monitoring and measures of success</li> </ul>	All stages	Regular	Lightsource BP	Low	If the protocols are followed there will be no residual impacts only benefits to the surrounding environment. If protocols fail then there will be no improvement to biodiversity following construction.

## **8.2 ADAPTIVE MANAGEMENT STRATEGY**

For major projects: details of the adaptive management strategy proposed to monitor and respond to impacts on biodiversity values that are uncertain). The Biodiversity Management Plan (BMP) developed for Wellington Solar Farm will incorporate any adaptive management required for the larger development footprint.

## **9 SERIOUS AND IRREVERSIBLE IMPACTS (SAIL)**

### **9.1 POTENTIAL SERIOUS AND IRREVERSIBLE IMPACT ENTITIES**

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.

#### **9.1.1 Threatened ecological communities**

The following relevant TEC has SAIL potential:

- White Box Yellow Box Blakely's Red Gum Woodland.

This site is composed of White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion. This TEC is specifically referring to the EPBC listed Box Gum Woodland for which the vegetation within the development footprint does not meet the criteria. This TEC will not be considered any further.

#### **9.1.2 Threatened species**

No species established as having potential habitat onsite or likely to be impacted by the proposed development has SAIL potential.

## **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  $\geq 15$  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  $\geq 17$  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  $\geq 20$  where the PCT is not representative of a TEC or associated with threatened species habitat.

The PCTs and vegetation zones requiring offset (in addition to the current approval) and the ecosystem credits required are documented in Table 10-1 and shown on Figure 10-1. Ecosystem credits that will be excised from the credit requirement are shown in Table 10-2 and mapped on Figure 10-1.

Table 10-1 PCTs and vegetation zones that are additional to approved development and require offsets

Zone ID	PCT ID	PCT name	Zone area (ha) additional	Vegetation integrity score	Ecosystem credits required
3	266	Woodland low	0.06	21.4	1
4	266	Woodland moderate to good	0.01	26.5	1
5	266	Derived grassland moderate to good	0.05	30	1
6	266	Derived grassland low	4.12	31.3	64

Table 10-2 PCTs and vegetation zones that are excised from the approved development and require removal from offset requirements

Zone ID	PCT ID	PCT name	Zone area (ha) excised	Vegetation integrity score	Ecosystem credits required
3	266	Woodland low	0.22	21.4	2
5	266	Derived grassland moderate to good	0.34	30	5
6	266	Derived grassland low	10.55	24.4	129

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

### 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 10-3.

Table 10-3 Species credit species that require offsets additional to approved footprint

Species Credit Species	Biodiversity risk weighting	Area of habitat or count of individuals lost	Species required	credits
Bush Stone-curlew ( <i>Bruhinus grallarius</i> )	2	0.01	0	
Gang-gang Cockatoo ( <i>Callocephalon fimbriatum</i> )	2	0.09	1	
White-bellied Sea-Eagle ( <i>Haliaeetus leucogaster</i> )	2	0.10	1	
Little Eagle ( <i>Hieraaetus morphnoides</i> )	1.5	0.10	0	
Square-tailed Kite ( <i>Lophoictinia isura</i> )	1.5	0.10	0	
Superb Parrot ( <i>Polytelis swainsonii</i> )	2	0.09	1	

Table 10-4 Species credit species that require removal from offset requirements

Species Credit Species	Biodiversity risk weighting	Area of habitat or count of individuals lost	Species required	credits
Gang-gang Cockatoo ( <i>Callocephalon fimbriatum</i> )	2	0.01	0	
White-bellied Sea-Eagle ( <i>Haliaeetus leucogaster</i> )	2	0.26	2	
Little Eagle ( <i>Hieraaetus morphnoides</i> )	1.5	0.26	2	
Square-tailed Kite ( <i>Lophoictinia isura</i> )	1.5	0.26	2	
Superb Parrot ( <i>Polytelis swainsonii</i> )	2	0.01	0	

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

### 10.1.3 Offsets required under the EPBC Act

Assessment was conducted in relation to Box Gum Woodland, Corben's Long-eared Bat and Superb Parrot to determine whether a referral to the Commonwealth was necessary, as documented in APPENDIX B. As such, the proposal is not considered to require offsets in accordance with the EPBC Offsets Policy.

## 10.2 IMPACTS NOT REQUIRING AN OFFSET

Impacts to PCTs that do not meet the thresholds identified in Section 10.1.1 do not require offsets. These PCTs and vegetation zones are identified in Table 10 3 and mapped on Figure 10 1.

Table 10-5 PCTs and vegetation zones that do not require additional offsets



Zone ID	PCT ID	PCT name	Zone area (ha)	Vegetation score	integrity
1	277	Woodland low	0.03	6.1	

Table 10-6 PCTs and vegetation that do not require excised offsets

Zone ID	PCT ID	PCT name	Zone area (ha)	Vegetation score	integrity
1	277	Woodland low	0.01	6.1	
2	266	Planted Woodland moderate to good	0.03	12.3	

### 10.3 AREAS NOT REQUIRING ASSESSMENT

Areas not requiring assessment in accordance with BAM Section 10.4 i.e. land without native vegetation, as shown in Figure 10-1(exotic areas are in grey; not part of this assessment).

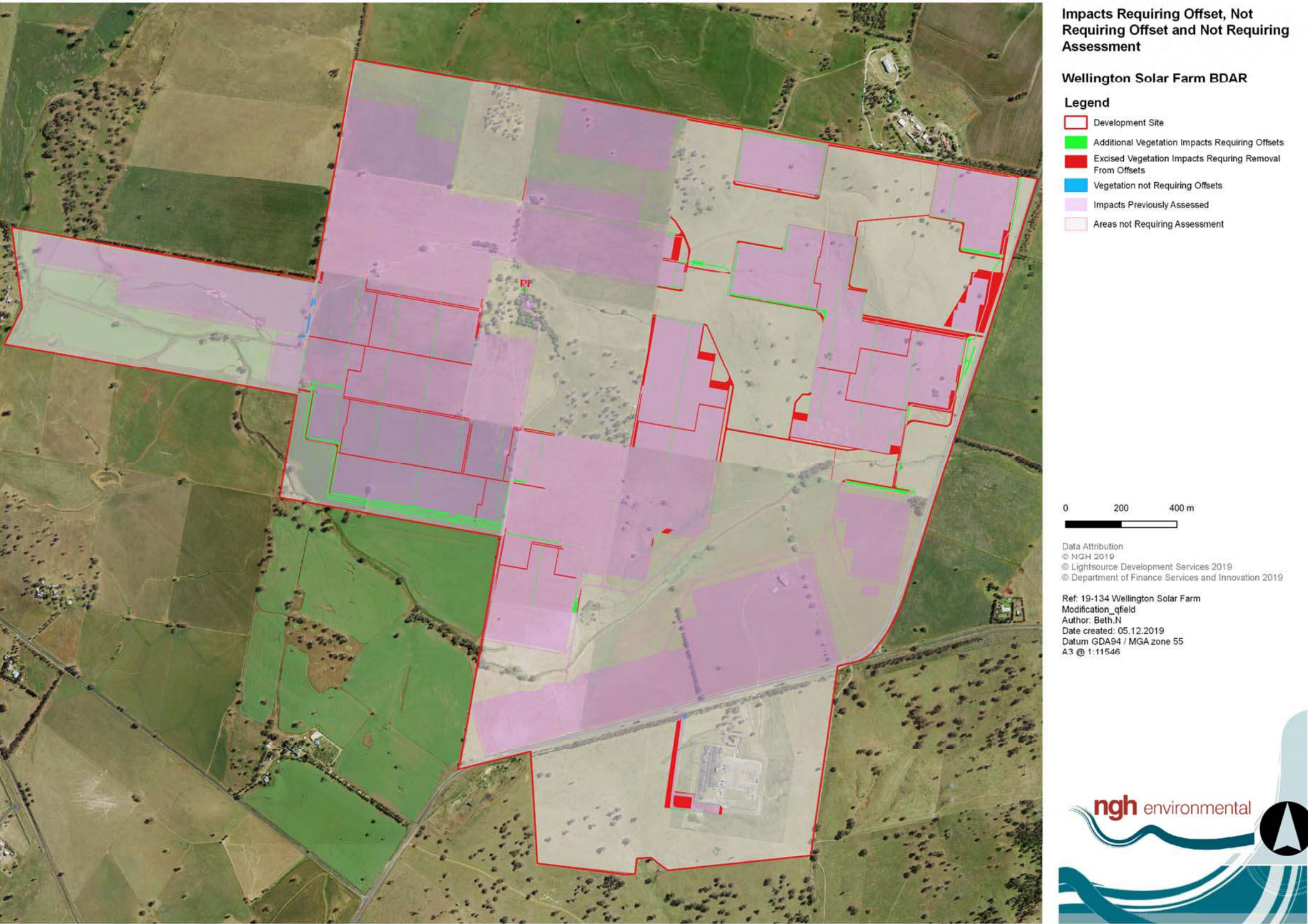


Figure 10-1 Impacts requiring offset, not requiring offset and not requiring assessment



## 11 CONCLUSION

This Biodiversity Assessment Report (BDAR) has been prepared by NGH on behalf of the proponent, Lightsource BP, who has proposed changes to Wellington Solar Farm, originally approved in May 2018 (SSD 8573). The first Modification Application for the substation extension – MOD 1 Substation Extension (NGH 2019) was approved by the Department of Planning Industry and Environment (DPIE) in December 2019. The approved SSD project has a credit requirement calculated under the 'Framework for Biodiversity Assessment' and subsequently converted using an application for reasonable equivalence to credits under the *Biodiversity Conservation Act* (BC Act). It also has a supplementary credit requirement calculated under the BC Act for an expansion to the existing Wellington substation under MOD 1.

A second Modification Application (MOD 2), this report, has been lodged to alter the indicative solar panel layout presented in the EIS. However, the entire project has *not* been reassessed under the BC Act, as this would have led to unnecessary duplication of assessment for areas that remain impacted in the new layout. These areas are already included in the reasonable equivalence credit profile. To account for new areas to be impacted and areas where impacts would now be avoided, the Biodiversity Assessment Method (BAM), pursuant to the BC Act, was applied to these 'additional' and 'excised' areas only. The *net* impact therefore becomes the updated project credit requirement.

Specifically, pursuant to the BC Act, the aim of this BDAR is to:

- identify, assess and derive the credit number for the additional areas now being impacted by the solar farm footprint, that were not impacted by the approved footprint.
- identify, assess and derive the credit number for the areas that will now be removed from the approved solar farm footprint (areas that *were* impacted but are now excised from the approved footprint).
- Reconcile the credit requirement of the original SSD approvals, MOD 1 and this proposed MOD 2 to give one updated credit requirement for the Wellington Solar Farm project.

This BDAR has been prepared to support the MOD 2 submission to Department of Planning Infrastructure and Environment.

### Key results

#### *Ecosystem credits*

In terms of the impacts on vegetation and the generation of ecosystem credits, the changes proposed in MOD 2 compared with the approved footprint are summarised as follows:

- An overall additional impact of 0.02 ha of PCT 277 White Box Yellow Box Blakely's Red Gum woodland. Zone 1, this generates no credits;
- An overall reduced impact of 6.90 ha of PCT 266 – White Box grassy woodland in the upper slopes sub-region of NSW South Western Slopes. Zones 2 and 4, together now generate 3 credits for the project. For Zones 3, 5 and 6, the net effect is zero credits;
- An overall additional impact of 15.43 ha of exotic vegetation. This generates no credits.

The changes to the development footprint have resulted in an overall reduction in native vegetation being impacted and therefore a reduced credit requirement. Even though there is an overall increase in clearing, the impacts to exotic/planted areas did not generate credits. This has resulted in the footprint increasing in size but the biodiversity impacts and offset requirement being reduced.

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The following details the ecosystem credits generated for the additional and excised areas for each vegetation zone for MOD 2. The net credit requirement that now applies to the project is summarised in the righthand column. Note: as the areas that are now being excised in Zones 3, 5 and 6 represent more credits than the areas now being added, the net result is that there will be no ecosystem credits required to be retired in these zones.

Zone	PCT and structure	Condition	Approved Credit Requirements		Credits Requirements Mod 2 (this report)		Updated credit requirement
			Original Approval SSD8573 (converted via reasonable equivalence)	Mod 1	Additional area credits	Excised area credits	(Net)
PCT 277							
Zone 1	PCT 277 woodland	low condition	0	0	0	0	0
PCT 266							
Zone 2	PCT 266 planted woodland	moderate to good condition	0	1	0	0	1
Zone 3	PCT 266 woodland	low condition	1	0	+1	-2	0
Zone 4	PCT 266 woodland	moderate to good condition (hollow bearing trees present)	1	0	+1	0	2
Zone 5	PCT 266 derived grassland	moderate to good condition	0	0	+1	-5	0 (-4)
Zone 6	PCT 266 derived grassland	low condition	0	0	+64	-129	0 (-65)

#### *Species credits*

In completing the site assessment for MOD 2, only the additional and excised areas were assessed on site. Targeted surveys were undertaken for candidate flora species where habitat elements were known to exist onsite. Of the flora species surveyed, none were found during targeted surveys. The majority of fauna candidate species identified in the BAM calculator were excluded from further assessment due to a lack of suitable habitat available onsite. For the remainder, due to time constraints, fauna surveys were not conducted for species that had not been previously assessed such as the Bush Stone-curlew, Gang-gang Cockatoo, White-bellied Sea-eagle, Square-tailed Kite, Little Eagle and Superb Parrot. These were all assumed to be present and appropriate credits generated. Other fauna surveyed in 2016 and 2017 had sufficient data to exclude them.

In regard to Species Credit Species for MOD 2 there is one additional credit required for the Gang-gang Cockatoo and one additional credit required for the Superb Parrot, otherwise there are no additional impacts



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to species credit species due to less impacted areas than excised areas. Note: as the areas that are now being excised represent more species credits than the areas now being added for the White-bellied Sea-Eagle, Square-tailed Kite and Little Eagle, the net result is that there will be no credits required to be retired for these species.

The following details the updated (and net) species credit species generated for the project:

Species	Approved Credit Requirements		Change in credits Mod 2 (this report)		
	Original Approval	Mod 1	Additional areas	Excised areas	Updated project requirement (net)
Gang-gang Cockatoo	0	0	+1	0	1
White-bellied Sea-Eagle	0	0	+1	-2	0 (-1)
Square-tailed Kite	0	0	0	-2	0 (-2)
Little Eagle	0	0	0	-2	0 (-2)
Superb Parrot	0	0	+1	0	1
Pink-tailed Legless Lizard	0	2	0	0	2

The net credit requirement for the Wellington Solar Farm is:

- 1 ecosystem credit for PCT 266 planted woodland
- 2 ecosystem credits for PCT 266 woodland moderate to good (with hollow bearing trees)
- 1 species credit for Gang Gang
- 1 species credit for Superb Parrot
- 2 species credit for Pink-tailed Legless Lizard

Mitigation and management measures are proposed to adequately address impacts associated with the proposal, both directly and indirectly. The retirement of the updated credit requirement is proposed to be carried out in accordance with the NSW Biodiversity Offsets Scheme and will be achieved by either:

- d) Retiring credits under the Biodiversity Offsets Scheme, or
- e) Making payments into the Biodiversity Conservation Fund using the offset payments calculator, or
- f) Funding a biodiversity action that benefits the threatened entity impacted by the development.

## 12 REFERENCES

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## **APPENDIX A PLOT FIELD DATA**

BAM Site Field Survey							
Project:	Wellington Solar Farm	Plot Identifier	W-1	Pic 20x20		Pic 20x50	yes
Survey date:	8/11/2019	Compass Orientation (head of 20x20 plot)			East		
Recorders	Lesley Peden	PCT:			277	Box Gum Woodland Derived Native Grassland	
GPS Easting	32.513141	GPS Northing	148.946634		Datum		Zone
Landform		Soils			Drainage & Slope		
Morphology		Cowra Trough Red Soils - Wellington	Soil Texture	Heavy		Slope	Flat
LandF Element			Soil Colour	Red		Aspect	West
LandF Pattern			Soil Depth	Shallow		Drainage	Good
Microrelief			Geology			Watercourses	100 m to trough
Plot Disturbance							
	Severity	Age	Observational Evidence				
Clearing	3	NR					
Cultivation	3	R					
Soil erosion	2	R					
Firewood	3	NR					
Grazing	3	R	Sheep, macropods				
Fire Damage	0						
Storm Damage	0						
Weediness	3	NR					
Other							
Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)							
Additional information							
Current land use							
Agriculture. Grazing and cropping							
Age class of trees (DBH range) , Condition of Vegetation, Hollows							
N/A							
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)							
Grazing, weeds							
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)							
Adjacent to Box Gum Woodland with exotic understorey							
Dominant Species outside Plot							

Eucalyptus albens, Eucalyptus melliodora  
Bothriochloa macra  
Hordeum leporinum  
FUNCTION

Function attributes for			W-1	BAM Attributes (1 x 1m Plots)				
BAM Attribute (20x20m plot)								
Count of Native Richness	Stratum	Sum		Litter Cover	Tape length	% cover	46.00%	Photos
	Tree (TG)	0			5m	90%		
	Shrub (SG)	1			15m	35%		
	Forb (FG)	8			25m	20%		
	Grass & grasslike (GG)	2			35m	60%		
	Fern (EG)	0			45m	25%		
	Other (OG)	0		Bare ground cover	5m	7%	38%	
	TOTAL	11			15m	55%		
BAM Attribute (20x20m plot)					25m	70%		
Count of cover abundance (native vascular plants)	Stratum	Sum			35m	30%		
	Tree (TG)	0			45m	30%		
	Shrub (SG)	0.1		Cryptogam cover	5m	0%	0%	
	Forb (FG)	0.08			15m	0%		
	Grass & grasslike (GG)	2.1			25m	0%		
	Fern (EG)	0			35m	0%		
	Other (OG)	0			45m	0%		
	TOTAL Native	2.28		Rock Cover	5m	0%	0%	
	TOTAL 'HTE'	0.1			15m	0%		
BAM Attribute (20 x 50m plot) Tree Stem Counts					25m	0%		
DBH (cm)	Euc	Non Euc	Hollows		35m	0%		
>80					45m	0%		
50-79								
30-49								
20-29								
10-19								
5-9								
<5			N/A					
Length of logs (m)								

## COMPOSITION & STRUCTURE

Species recorded for									
Abbreviation	Scientific Name	Common Name	Family	% Cover	Abundance	Exotic	Growth Form	High Threat?	EPBC Status
Hirs inca	<i>Hirschfeldia incana</i>	Buchan Weed	Brassicaceae	0.1	50	*		No	
Hord lepo	<i>Hordeum leporinum</i>	Barley Grass	Poaceae	1	300	*		No	
medi poly	<i>Medicago polymorpha</i>	Burr Medic	Fabaceae (Fat)	1	500	*		No	
medi sati	<i>Medicago sativa</i>	Lucerne	Fabaceae (Fat)	0.3	30	*		No	
eina nuta	<i>Einodia nutans</i>	Climbing Saltbush	Chenopodiaceae	0.01	10		Forb (FG)	No	
sisy erys	<i>Sisymbrium erysimoides</i>	Smooth Mustard	Brassicaceae	0.01	5	*		No	
sida corr	<i>Sida corrugata</i>	Corrugated Sida	Malvaceae	0.01	4		Forb (FG)	No	
chen mela	<i>Chenopodium melanocarpum</i>	Black Crumbweed	Chenopodiaceae	0.01	50		Forb (FG)	No	
lyci fero	<i>Lycium ferocissimum</i>	African Boxthorn	Solanaceae	0.1	2	*		HTE	
sola opac	<i>Solanum opacum</i>	Green-berry Nightshade	Solanaceae	0.01	1		Forb (FG)	No	
evol als	<i>Evolvulus alsinoides</i>	Bindweed	Convolvulaceae	0.01	1		Forb (FG)	No	
scle muri	<i>Sclerolaena muricata</i>	Black Rolypoly	Chenopodiaceae	0.1	1		Shrub (SG)	No	
poly avic	<i>Polygonum aviculare</i>	Wireweed	Polygonaceae	0.5	15	*		No	
malv negl	<i>Malva neglecta</i>	Dwarf Mallow	Malvaceae	0.01	8	*		No	
boer domi	<i>Boerhavia dominii</i>	Tarvine	Nyctaginaceae	0.01	1		Forb (FG)	No	
cyno dact	<i>Cynodon dactylon</i>	Common Couch	Poaceae	2	50		Grass & grasslike (GG)	No	
lepi afri	<i>Lepidium africanum</i>	Common Peppergrass	Brassicaceae	0.01	10	*		No	
chlo trun	<i>Chloris truncata</i>	Windmill Grass	Poaceae	0.1	2		Grass & grasslike (GG)	No	
cham drum	<i>Chamaesyce drummondii</i>	Caustic Weed	Euphorbiaceae	0.01	2		Forb (FG)	No	
dysp pumi	<i>Dysphania pumilio</i>	Small Crumbweed	Chenopodiaceae	0.01	1		Forb (FG)	No	
trib terr	<i>Tribulus terrestris</i>	Cat-head	Zygophyllaceae			*		No	



BAM Site Field Survey							
Project:	Wellington Solar	Plot Identifier	W-2	Pic 20x20		Pic 20x50	
Survey date:	9/11/2019		Compass Orientation (head of 20x20 plot)				
Recorders	Lesley Peden		PCT:	266	Box Gum Woodland Derived Native Grassland		
GPS Easting	-32.52531007	GPS Northing	148.96131		Datum		Zone
Landform			Soils		Drainage & Slope		
Morphology			Soil Texture	Heavy	Slope	Flat	
LandF Element			Soil Colour	Red Chromosil	Aspect	South East	
LandF Pattern			Soil Depth	Shallow	Drainage	Good	
Microrelief			Geology		Watercourses	800 m to dam	
Plot Disturbance							
	Severity	Age	Observational Evidence				
Clearing	3	NR					
Cultivation	3	NR					
Soil erosion	2	NR					
Firewood	3	NR					
Grazing	3	R	Macropods, sheep				
Fire Damage							
Storm Damage							
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)							
Additional information							
Current land use							
Agriculture/Grazing							
Age class of trees (DBH range) , Condition of Vegetation, Hollows							
N/A							
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)							
Grazing, weeds							
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)							
Box Gum Woodland Derived Native Grassland							
Dominant Species outside Plot							

#### FUNCTION

Function attributes for			W-2	BAM Attributes (1 x 1m Plots)				
BAM Attribute (20x20m plot)				Litter Cover	Tape length	% cover	Average %	Photos
Count of Native Richness	Stratum	Sum		5m	20%		29.00%	
	Tree (TG)	0		15m	50%			
	Shrub (SG)	0		25m	40%			
	Forb (FG)	4		35m	10%			
	Grass & grasslike (GG)	6		45m	25%			
	Fern (EG)	0		5m	70%		50%	
	Other (OG)	1		15m	10%			
	TOTAL	11		25m	25%			
BAM Attribute (20x20m plot)				35m	80%			
Count of cover abundance (native vascular plants)	Stratum	Sum		45m	65%		0%	
	Tree (TG)	0		5m	0%			
	Shrub (SG)	0		15m	0%			
	Forb (FG)	0.4		25m	0%			
	Grass & grasslike (GG)	5.61		35m	0%			
	Fern (EG)	0		45m	0%		1%	
	Other (OG)	0.1		5m	1%			
	TOTAL Native	6.11		15m	0%			
	TOTAL 'HTE'	0.11		25m	0%			
BAM Attribute (20 x 50m plot) Tree Stem Counts				35m	1%			
DBH (cm)	Euc	Non Euc	Hollows	45m	1%			
>80								
50-79								
30-49								
20-29								
10-19								
5-9								
<5			N/A					
Length of logs (m)								

#### COMPOSITION & STRUCTURE

Species recorded for										
W-2										
Abbreviation	Scientific Name	Common Name	Family	% Cover	Abundance	Exotic	Growth Form	High Threat?	EPBC Status	BCA Status
aust aris	<i>Austrostipa aristiglumis</i>	Plains Grass	Poaceae	3	40		Grass & grasslike (GG)	No		
Eina nuta	<i>Einadia nutans</i>	Climbing Saltbush	Chenopodiaceae	0.1	30		Forb (FG)	No		
alte pung	<i>Alternanthera pungens</i>	Khaki Weed	Amaranthaceae	0.01	1	*		HTE		
dysp pumi	<i>Dysphania pumila</i>	Small Crumbweed	Chenopodiaceae	0.01	1			No		
ryti	<i>Rytidosperma spp.</i>		Poaceae	1	50		Grass & grasslike (GG)	No		
ryti caes	<i>Rytidosperma caespitosus</i>	Ringed Wallaby Grass	Poaceae	1	20		Grass & grasslike (GG)	No		
them tria	<i>Themeda triandra</i>		Poaceae	0.1	5		Grass & grasslike (GG)	No		
Hord lepo	<i>Hordeum leporinum</i>	Barley Grass	Poaceae	0.1	30	*		No		
trif dubi	<i>Trifolium dubium</i>	Yellow Suckling Clover	Fabaceae (Fat	0.1	2	*		No		
aust scab	<i>Austrostipa scabra</i>	Speargrass	Poaceae	0.5	20		Grass & grasslike (GG)	No		
enne nigr	<i>Enneapogon nigricans</i>	Niggerheads	Poaceae	0.01	1		Grass & grasslike (GG)	No		
sisy erys	<i>Sisymbrium erysimoides</i>	Smooth Mustard	Brassicaceae	0.01	2	*		No		
sida corr	<i>Sida corrugata</i>	Corrugated Sida	Malvaceae	0.1	5		Forb (FG)	No		
rume brow	<i>Rumex brownii</i>	Swamp Dock	Polygonaceae	0.1	5		Forb (FG)	No		
malv negl	<i>Malva neglecta</i>	Dwarf Mallow	Malvaceae	0.1	2	*		No		
dich repe	<i>Dichondra repens</i>	Kidney Weed	Convolvulaceae	0.1	10		Forb (FG)	No		
glyc taba	<i>Glycine tabacina</i>	Variable Glycine	Fabaceae (Fat	0.1	3		Other (OG)	No		
trib terr	<i>Tribulus terrestris</i>	Cat-head	Zygophyllaceae	0.1	5	*		No		
cart lana	<i>Carthamus lanatus</i>	Saffron Thistle	Asteraceae	0.1	2	*		HTE		
salv verb	<i>Salvia verbenaca</i>	Vervain	Lamiaceae	0.1	15	*		No		

BAM Site Field Survey							
Project:	Wellington Solar	Plot Identifier	W-3	Pic 20x20		Pic 20x50	Yes
Survey date:	8/11/2019	Compass Orientation (head of 20x20 plot)			North		
Recorders				PCT:	266		
GPS Easting	-32.511365	GPS Northing	148.95503	Datum	Zone		
Landform		Soils		Drainage & Slope			
Morphology		Soil Texture	Heavy	Slope	4 degrees		
LandF Element		Soil Colour	Red	Aspect	North		
LandF Pattern		Soil Depth	Shallow	Drainage	Good		
Microrelief		Geology		Watercourses	Troughs within 500 m		
Plot Disturbance							
	Severity	Age	Observational Evidence				
Clearing	3	NR	Cleared farmland				
Cultivation	3	NR					
Soil erosion	2	NR					
Firewood	3	NR					
Grazing	3	R	Rabbits, sheep and macropods				
Fire Damage							
Storm Damage							
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)							
Additional information							
Current land use							
Agricultural, grazing							
Age class of trees (DBH range) , Condition of Vegetation, Hollows							
N/A							
Disturbances (i.e. fire, grazing, ferals, clearing, logging, soil degradation, pollution, weeds, dieback)							
Grazing, weeds							
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)							
Box Gum Woodland Derived Native Grassland							
Dominant Species outside Plot							
Eucalyptus albens, E. melliodora							

#### FUNCTION

Function attributes for			W-3	BAM Attributes (1 x 1m Plots)				
BAM Attribute (20x20m plot)								
Count of Native Richness	Stratum	Sum		Litter Cover	Tape length	% cover	Average %	Photos
	Tree (TG)	0			5m	60%		
	Shrub (SG)	0			15m	60%		
	Forb (FG)	7			25m	85%		
	Grass & grasslike (GG)	9			35m	45%		
	Fern (EG)	1		Bare ground cover	45m	80%	66.00%	
	Other (OG)	2			5m	15%		
	TOTAL	19			15m	20%		
BAM Attribute (20x20m plot)					25m	5%	12%	
Count of cover abundance (native vascular plants)	Stratum	Sum		Cryptogam cover	35m	15%		
	Tree (TG)	0			45m	7%		
	Shrub (SG)	0			5m	0%	0%	
	Forb (FG)	0.9			15m	0%		
	Grass & grasslike (GG)	7.8			25m	0%		
	Fern (EG)	0.1		Rock Cover	35m	0%		
	Other (OG)	0.2			45m	0%		
	TOTAL Native	9			5m	10%	7%	
	TOTAL 'HTE'	0			15m	3%		
BAM Attribute (20 x 50m plot) Tree Stem Counts					25m	2%		
DBH (cm)	Euc	Non Euc	Hollows		35m	10%		
>80					45m	12%		
50-79								
30-49								
20-29								
10-19								
5-9								
<5			N/A					
Length of logs (m)								

#### COMPOSITION & STRUCTURE

Species recorded for									
W-3									
Abbreviation	Scientific Name	Common Name	Family	% Cover	Abundance	Exotic	Growth Form	High Threat?	EPBC Status
Them tria	<i>Themeda triandra</i>		Poaceae	5	200		Grass & grasslike (GG)	No	
Both macr	<i>Bothriochloa macra</i>	Red Grass	Poaceae	0.3	30		Grass & grasslike (GG)	No	
Eina nuta	<i>Einadia nutans</i>	Climbing Saltbush	Chenopodiaceae	0.3	200		Forb (FG)	No	
sida corr	<i>Sida corrugata</i>	Corrugated Sida	Malvaceae	0.1	20		Forb (FG)	No	
cirs vulg	<i>Cirsium vulgare</i>	Spear Thistle	Asteraceae	0.1	1	*		No	
conv angu	<i>Convolvulus angustissim</i>		Convolvulaceae	0.1	8		Other (OG)	No	
trif subt	<i>Trifolium subterraneum</i>	Subterranean Clover	Fabaceae (Fab)	0.1	4	*		No	
micr stip	<i>Microloaena stipoides</i>	Weeping Grass	Poaceae	0.1	5		Grass & grasslike (GG)	No	
trag porr porr	<i>Tragopogon porrifolius</i>	Salsify	Asteraceae	0.1	5	*		No	
cyno dact	<i>Cynodon dactylon</i>	Common Couch	Poaceae	0.1	5		Grass & grasslike (GG)	No	
chlo trun	<i>Chloris truncata</i>	Windmill Grass	Poaceae	0.1	30		Grass & grasslike (GG)	No	
aust bige	<i>Austrostipa bigeniculata</i>	Yanganbil	Poaceae	1	50		Grass & grasslike (GG)	No	
glyc taba	<i>Glycine tabacina</i>	Variable Glycine	Fabaceae (Fab)	0.1	1		Other (OG)	No	
pani effu	<i>Panicum effusum</i>	Hairy Panic	Poaceae	0.1	6		Grass & grasslike (GG)	No	
aven	<i>Avena spp.</i>	Oats	Poaceae	0.1	4	*		No	
dich repe	<i>Dichondra repens</i>	Kidney Weed	Convolvulaceae	0.1	30		Forb (FG)	No	
comy bona	<i>Coryza bonariensis</i>	Flaxleaf Fleabane	Asteraceae	0.1	1	*		No	
sida corr	<i>Sida corrugata</i>	Corrugated Sida	Malvaceae	0.1	10		Forb (FG)	No	
medi poly	<i>Medicago polymorpha</i>	Burr Medic	Fabaceae (Fab)	0.1	5	*		No	
vitt grac	<i>Vittadinia gracilis</i>	Woolly New Holland	Asteraceae	0.1	1		Forb (FG)	No	
aust scab	<i>Austrostipa scabra</i>	Speargrass	Poaceae	1	40		Grass & grasslike (GG)	No	
chon junc	<i>Chondrilla juncea</i>	Skeleton Weed	Asteraceae	0.1	5	*		No	
trif dubi	<i>Trifolium dubium</i>	Yellow Suckling Clove	Fabaceae (Fab)	0.1	4	*		No	
chei	<i>Cheilanthes spp.</i>	Cloak Fern, Mulga Fern	Pteridaceae	0.1	1		Fern (EG)	No	
erod	<i>Erodium</i>	Crowfoot	Geraniaceae	0.1	3	*		No	
lepi afri	<i>Lepidium africanum</i>	Common Peppergrass	Brassicaceae	0.1	3	*		No	
erag brow	<i>Eragrostis brownii</i>	Brown's Lovegrass	Poaceae	0.1	1		Grass & grasslike (GG)	No	
cham drum	<i>Chamaesyce drummondii</i>	Caustic Weed	Euphorbiaceae	0.1	1		Forb (FG)	No	
vitt cune	<i>Vittadinia cuneata</i>	A Fuzzweed	Asteraceae	0.1	3		Forb (FG)	No	



BAM Site Field Survey							
Project:	Wellington Solar Farm	Plot Identifier	W-4	Pic 20x20	Yes	Pic 20x50	Yes
Survey date:	8/11/2019	Compass Orientation (head of 20x20 plot)					
Recorders	Lesley Peden	PCT:	266	Box Gum			
GPS Easting	32.50492	GPS Northing	148.95447	Datum		Zone	
Landform			Soils		Drainage & Slope		
Morphology		Soil Texture	Heavy	Slope	Flat		
LandF Element		Soil Colour	Red	Aspect	Nth		
LandF Pattern		Soil Depth	Shallow	Drainage	Good		
Microrelief		Geology		Watercourses	1 km + to troughs		
Plot Disturbance							
	Severity	Age	Observational Evidence				
Clearing	2	NR	Sparse upper canopy, no midstorey				
Cultivation	0						
Soil erosion	1	NR	Topsoil blown off				
Firewood	2	NR	Minimal fallen timber				
Grazing	2	R	Rabbits, Macropods, Sheep				
Fire Damage	0						
Storm Damage	0						
Weediness	0						
Other							
Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)							
Additional information							
Current land use							
Residential/semi rural							
Age class of trees (DBH range) , Condition of Vegetation, Hollows							
50- 80cm DBH							
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)							
Grazing							
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)							
Box Gum Woodland							
Dominant Species outside Plot							
Eucalyptus albens,							

#### FUNCTION

Function attributes for			W-4
BAM Attribute (20x20m plot)			
Count of Native Richness	Stratum	Sum	
	Tree (TG)	1	
	Shrub (SG)	0	
	Forb (FG)	3	
	Grass & grasslike (GG)	8	
	Fern (EG)	0	
	Other (OG)	0	
	TOTAL	12	
BAM Attribute (20x20m plot)			
Count of cover abundance (native vascular plants)	Stratum	Sum	
	Tree (TG)	5	
	Shrub (SG)	0	
	Forb (FG)	0.13	
	Grass & grasslike (GG)	4.2	
	Fern (EG)	0	
	Other (OG)	0	
	TOTAL Native	9.33	
	TOTAL 'HTE'	0	

BAM Attributes (1 x 1m Plots)				
Litter Cover	Tape length	% cover	Average %	Photos
	5m	80%	39.60%	
	15m	20%		
	25m	90%		
	35m	5%		
45m	3%			
Bare ground cover	5m	10%	54%	
	15m	70%		
	25m	5%		
	35m	90%		
Cryptogam cover	45m	95%	0%	
	5m	0%		
	15m	0%		
	25m	0%		
	35m	0%		
Rock Cover	45m	0%	2%	
	5m	1%		
	15m	5%		
	25m	2%		
	35m	1%		
45m	1%			

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)		14	

#### COMPOSITION & STRUCTURE

Species recorded for									
W-4									
Abbreviation	Scientific Name	Common Name	Family	% Cover	Abundance	Exotic	Growth Form	High Threat?	EPBC Status
Eina nuta	<i>Einadia nutans</i>	Climbing Saltbush	Chenopodiaceae	0.02	50		Forb (FG)	No	
Micr stip	<i>Microlaena stipoides</i>	Weeping Grass	Poaceae	0.2	20		Grass & grasslike (GG)	No	
chlo trun	<i>Chloris truncata</i>	Windmill Grass	Poaceae	0.1	5		Grass & grasslike (GG)	No	
euca albe	<i>Eucalyptus albens</i>	White Box	Myrtaceae	5	1		Tree (TG)	No	
trif arve	<i>Trifolium arvense</i>	Haresfoot Clover	Fabaceae (Fab)	0.01	3	*		No	
both macr	<i>Bothriochloa macra</i>	Red Grass	Poaceae	0.1	5		Grass & grasslike (GG)	No	
aust scab	<i>Austrostipa scabra</i>	Speargrass	Poaceae	2	200		Grass & grasslike (GG)	No	
medi poly	<i>Medicago polymorpha</i>	Burr Medic	Fabaceae (Fab)	0.1	10	*		No	
aust bige	<i>Austrostipa bigeniculata</i>	Yanganbil	Poaceae	1	50		Grass & grasslike (GG)	No	
dich repe	<i>Dichondra repens</i>	Kidney Weed	Convolvulaceae	0.1	200		Forb (FG)	No	
malv negl	<i>Malva neglecta</i>	Dwarf Mallow	Malvaceae	0.01	1	*		No	
sida corr	<i>Sida corrugata</i>	Corrugated Sida	Malvaceae	0.01	5		Forb (FG)	No	
ryti caes	<i>Rytidosperma caespitosum</i>	Ringed Wallaby Grass	Poaceae	0.2	20		Grass & grasslike (GG)	No	
cent eryt	<i>Centaurium erythraea</i>	Common Centaury	Gentianaceae	0.01	1	*		No	
aust aris	<i>Austrostipa aristiglumis</i>	Plains Grass	Poaceae	0.1	5		Grass & grasslike (GG)	No	
cyno dact	<i>Cynodon dactylon</i>	Common Couch	Poaceae	0.5	20		Grass & grasslike (GG)	No	
hord lepo	<i>Hordeum leporinum</i>	Barley Grass	Poaceae	0.1	5	*		No	
cirs vulg	<i>Cirsium vulgare</i>	Spear Thistle	Asteraceae	0.01	1	*		No	

BAM Site Field Survey							
Project:	Wellington Solar	Plot Identifier	W-5	Pic 20x20	Yes	Pic 20x50	Yes
Survey date:	8/11/2019	Compass Orientation (head of 20x20 plot)					
Recorders	PCT:						
GPS Easting	-4.75398E-05	GPS Northing	148.961589/6399330.91	Datum	Zone		
Landform		Soils		Drainage & Slope			
Morphology		Soil Texture	fine	Slope	5 degrees		
LandF Element		Soil Colour	orange	Aspect	SW		
LandF Pattern		Soil Depth	Shallow	Drainage	good		
Microrelief		Geology		Watercourses	dam 10m		
Plot Disturbance							
	Severity	Age	Observational Evidence				
Clearing	3	NR					
Cultivation	3	NR					
Soil erosion	2	NR					
Firewood	3	NR					
Grazing	3	R	Cows and macropods				
Fire Damage	0						
Storm Damage	0						
Weediness	1						
Other							
Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)							
Additional information							
Current land use							
Grazing/ transgrid infrastructure nearby							
Age class of trees (DBH range) , Condition of Vegetation, Hollows							
Disturbances (i.e. fire, grazing, ferals, clearing, logging, soil degradation, pollution, weeds, dieback)							
Grazing, weeds							
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)							
Box Gum Derived Woodland							
Dominant Species outside Plot							

#### FUNCTION

Function

Function attributes for			W-5
BAM Attribute (20x20m plot)			
Count of Native Richness	Stratum	Sum	
	Tree (TG)	0	
	Shrub (SG)	0	
	Forb (FG)	8	
	Grass & grasslike (GG)	9	
	Fern (EG)	0	
	Other (OG)	0	
	TOTAL	17	
BAM Attribute (20x20m plot)			
Count of cover abundance (native vascular plants)	Stratum	Sum	
	Tree (TG)	0	
	Shrub (SG)	0	
	Forb (FG)	0.8	
	Grass & grasslike (GG)	13.5	
	Fern (EG)	0	
	Other (OG)	0	
	TOTAL Native	14.3	
	TOTAL 'HTE'	0.1	

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
Litter Cover	Tape length	% cover	Average %	Photos
	5m	60%	63.00%	
	15m	40%		
	25m	70%		
	35m	70%		
Bare ground cover	45m	75%	29%	
	5m	35%		
	15m	50%		
	25m	25%		
	Cryptogam cover	35m	15%	0%
45m		20%		
5m		0%		
15m		0%		
25m		0%		
35m		0%		
45m		0%		
Rock Cover		5m	1%	
	15m	0%		
	25m	0%		
	35m	1%		
	45m	1%		

#### COMPOSITION & STRUCTURE

Species recorded for									
W-5									
Abbreviation	Scientific Name	Common Name	Family	% Cover	Abundance	Exotic	Growth Form	High Threat?	EPBC Status
trib terr	<i>Tribulus terrestris</i>	Cat-head	Zygophyllaceae	0.1	1	*		No	
rume brow	<i>Rumex brownii</i>	Swamp Dock	Polygonaceae	0.1	5		Forb (FG)	No	
aust aris	<i>Austrostipa aristigulmis</i>	Plains Grass	Poaceae	5	15		Grass & grasslike (GG)	No	
both macr	<i>Bothriochloa macra</i>	Red Grass	Poaceae	5	80		Grass & grasslike (GG)	No	
chlo trun	<i>Chloris truncata</i>	Windmill Grass	Poaceae	0.1	30		Grass & grasslike (GG)	No	
unknown creeper	#N/A	#N/A	#N/A	0.1	20	#N/A		FALSE	#N/A
Ryti caes	<i>Rytidosperma caespitosu</i>	Ringed Wallaby Grass	Poaceae	0.1	15		Grass & grasslike (GG)	No	
Aila alti	<i>Ailanthus altissima</i>	Tree of Heaven	Simaroubaceae	0.1	1	*		HTE	
aust scab	<i>Austrostipa scabra</i>	Speargrass	Poaceae	2	50		Grass & grasslike (GG)	No	
chon junc	<i>Chondrilla juncea</i>	Skeleton Weed	Asteraceae	0.2	100	*	Forb (FG)	No	
micr stip	<i>Microlaena stipoides</i>	Weeping Grass	Poaceae	0.1	50		Grass & grasslike (GG)	No	
cham drum	<i>Chamaesyce drummond</i>	Caustic Weed	Euphorbiaceae	0.1	60		Forb (FG)	No	
malv negl	<i>Malva neglecta</i>	Dwarf Mallow	Malvaceae	0.1	8	*		No	
vitt grac	<i>Vittadinia gracilis</i>	Woolly New Holland	Asteraceae	0.1	2		Forb (FG)	No	
vitt cune	<i>Vittadinia cuneata</i>	A Fuzzweed	Asteraceae	0.1	6		Forb (FG)	No	
aust bige	<i>Austrostipa bigeniculata</i>	Yanganbil	Poaceae	1	40		Grass & grasslike (GG)	No	
trif	<i>Trifolium spp.</i>	A Clover	Fabaceae (Fab	0.1	5	*		No	
lepi afri	<i>Lepidium africanum</i>	Common Peppergrass	Brassicaceae	0.1	5	*		No	
eina nuta	<i>Einadia nutans</i>	Climbing Saltbush	Chenopodiaceae	0.1	5		Forb (FG)	No	
hord lepo	<i>Hordeum leporinum</i>	Barley Grass	Poaceae	0.1	10	*		No	
aven	<i>Avena spp.</i>	Oats	Poaceae	0.1	20	*		No	
Ryti carp	<i>Rytidosperma carphaide</i>	Short Wallaby Grass	Poaceae	0.1	15		Grass & grasslike (GG)	No	
trif dubi	<i>Trifolium dubium</i>	Yellow Suckling Clover	Fabaceae (Fab	0.1	5	*		No	
medi poly	<i>Medicago polymorpha</i>	Burr Medic	Fabaceae (Fab	0.1	10	*		No	
brom hord	<i>Bromus hordeaceus</i>	Soft Brome	Poaceae	0.1	5	*		No	
vitt cune	<i>Vittadinia cuneata</i>	A Fuzzweed	Asteraceae	0.1	3		Forb (FG)	No	
wahl	<i>Wahlenbergia spp.</i>	Bluebell	Campanulaceae	0.1	5		Forb (FG)	No	
elym scab	<i>Elymus scaber</i>	Common Wheatgrass	Poaceae	0.1	3		Grass & grasslike (GG)	No	
sida corr	<i>Sida corrugata</i>	Corrugated Sida	Malvaceae	0.1	2		Forb (FG)	No	



BAM Site Field Survey							
Project:	Wellington Solar	Plot Identifier	W-6-1	Pic 20x20	Yes	Pic 20x50	Yes
Survey date:	8/11/2019	Compass Orientation (head of 20x20 plot)					
Recorders	LP	PCT:	YES				
GPS Easting		GPS Northing	266	Datum		Zone	
Landform		Soils		Drainage & Slope			
Morphology		Soil Texture	Fine	Slope	1 degree		
LandF Element		Soil Colour	Orange	Aspect			
LandF Pattern		Soil Depth	Shallow	Drainage	Good		
Microrelief		Geology		Watercourses	100 m to dam		
Plot Disturbance							
	Severity	Age	Observational Evidence				
Clearing	3	NR					
Cultivation	3	NR					
Soil erosion	2	NR					
Firewood	3	NR					
Grazing	3	R	Macropods, cows, sheep				
Fire Damage	0						
Storm Damage	0						
Weediness	2	NR					
Other							
Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)							
Additional information							
Current land use							
Agriculture: grazing							
Age class of trees (DBH range) , Condition of Vegetation, Hollows							
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)							
Grazing, weeds							
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)							
Box Gum Woodland Derived Grassland							
Dominant Species outside Plot							

#### FUNCTION

Function attributes for			W-6-1							
BAM Attribute (20x20m plot)										
Count of Native Richness	Stratum	Sum	Litter Cover	Tape length	% cover	Average %	Photos			
	Tree (TG)	0		5m	70%					
	Shrub (SG)	0		15m	70%					
	Forb (FG)	4		25m	65%					
				35m	50%					
	Grass & grasslike (GG)	6	45m	75%	66.00%					
	Fern (EG)	0	5m	10%						
	Other (OG)	0	15m	5%						
TOTAL	10	25m	20%	18%						
		35m	40%							
		45m	15%							
BAM Attribute (20x20m plot)			Cryptogam cover		5m	0%		0%		
Count of cover abundance (native vascular plants)	Stratum	Sum			15m	0%				
	Tree (TG)	0		25m	0%					
	Shrub (SG)	0		35m	0%					
	Forb (FG)	0.4		45m	0%					
	Grass & grasslike (GG)	4.4	5m	3%	1%					
	Fern (EG)	0	15m	1%						
	Other (OG)	0	25m	1%						
	TOTAL Native	4.8	35m	1%						
	TOTAL 'HTE'	0.1	45m	1%						
BAM Attribute (20 x 50m plot) Tree Stem Counts			BAM Attributes (1 x 1m Plots)							
DBH (cm)	Euc	Non Euc	Hollows	Litter Cover	Tape length	% cover	Average %	Photos		
>80					5m	70%			66.00%	
50-79					15m	70%				
30-49					25m	65%				
20-29					35m	50%				
10-19				45m	75%					
5-9				Bare ground cover	5m	10%	18%			
<5					15m	5%				
Length of logs (m)					25m	20%				
					35m	40%				
					45m	15%				
				Cryptogam cover	5m	0%	0%			
					15m	0%				
					25m	0%				
					35m	0%				
					45m	0%				
				Rock Cover	5m	3%	1%			
					15m	1%				
					25m	1%				
					35m	1%				
					45m	1%				

#### COMPOSITION & STRUCTURE

Species recorded for W-6-1									
Abbreviation	Scientific Name	Common Name	Family	% Cover	Abundance	Exotic	Growth Form	High Threat?	EPBC Status
medi poly	<i>Medicago polymorpha</i>	Burr Medic	Fabaceae (Fa)	0.1	1	*		No	
cham drum	<i>Chamaesyce drummondii</i>	Caustic Weed	Euphorbiaceae	0.1	15		Forb (FG)	No	
chon junc	<i>Chondrilla juncea</i>	Skeleton Weed	Asteraceae	0.2	100	*		No	
aust aris	<i>Austrostipa aristiglumis</i>	Plains Grass	Poaceae	1	35		Grass & grasslike (GG)	No	
trif	<i>Trifolium spp.</i>	A Clover	Fabaceae (Fa)	0.1	45	*		No	
lepi afri	<i>Lepidium africanum</i>	Common Peppercrest	Brassicaceae	0.1	3	*		No	
sida corr	<i>Sida corrugata</i>	Corrugated Sida	Malvaceae	0.1	6		Forb (FG)	No	
eina nuta	<i>Einadia nutans</i>	Climbing Saltbush	Chenopodiaceae	0.1	15		Forb (FG)	No	
hord lepo	<i>Hordeum leporinum</i>	Barley Grass	Poaceae	10	500	*		No	
aust scab	<i>Austrostipa scabra</i>	Speargrass	Poaceae	2	200		Grass & grasslike (GG)	No	
aust bige	<i>Austrostipa bigeniculata</i>	Yangambil	Poaceae	1	100		Grass & grasslike (GG)	No	
rume brow	<i>Rumex brownii</i>	Swamp Dock	Polygonaceae	0.1	1		Forb (FG)	No	
trif subt	<i>Trifolium subterraneum</i>	Subterranean Clover	Fabaceae (Fa)	1	200	*		No	
ryti caes	<i>Rytidosperma caespitosum</i>	Ringed Wallaby Grass	Poaceae	0.1	10		Grass & grasslike (GG)	No	
ryti carp	<i>Rytidosperma carphoides</i>	Short Wallaby Grass	Poaceae	0.2	50		Grass & grasslike (GG)	No	
trag porr porr	<i>Tragopogon porrifolius</i>	Salsify	Asteraceae	0.1	5	*		No	
cart lana	<i>Carthamus lanatus</i>	Saffron Thistle	Asteraceae	0.1	2	*		HTE	
chlo trun	<i>Chloris truncata</i>	Windmill Grass	Poaceae	0.1	5		Grass & grasslike (GG)	No	

BAM Site Field Survey							
Project:	Wellington Solar Farm	Plot Identifier	W-6-2	Pic 20x20	Yes	Pic 20x50	Yes
Survey date:	7/11/2019	Recorder	Lesley Peden	Compass Orientation (head of 20x20 plot)		East	
Recorders	Lesley Peden	PCT:	266	White Box Grassy Woodland- Derived Grassland			
GPS Easting	-32.510832	GPS Northing	148.97312	Datum		Zone	
Landform			Soils		Drainage & Slope		
Morphology		Soil Texture	Fine	Slope			
LandF Element		Soil Colour	orange/brown	Aspect		East	
LandF Pattern		Soil Depth	shallow	Drainage			
Microrelief		Geology		Watercourses			
Plot Disturbance							
	Severity	Age	Observational Evidence				
Clearing	3	NR					
Cultivation	3	NR					
Soil erosion	0	NR					
Firewood	0	NR					
Grazing	2	R	cattle/ macropods/sheep				
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)							
Additional information							
Current land use							
Agriculture: Grazing							
Age class of trees (DBH range) , Condition of Vegetation, Hollows							
Disturbances (i.e. fire, grazing, ferals, clearing, logging, soil degradation, pollution, weeds, dieback)							
Grazing, weeds							
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)							
Box Gum Woodland							
Dominant Species outside Plot							
Eucalyptus albens							

### FUNCTION

Function attributes for W-6-2			BAM Attributes (1 x 1m Plots)				
BAM Attribute (20x20m plot)			Litter Cover	Tape length	% cover	Average %	Photos
Count of Native Richness	Stratum	Sum		5m	60%	40.00%	
	Tree (TG)	0		15m	50%		
	Shrub (SG)	0		25m	40%		
	Forb (FG)	7		35m	20%		
	Grass & grasslike (GG)	10	Bare ground cover	45m	30%	22%	
BAM Attribute (20x20m plot)	Fern (EG)	0		5m	20%		
	Other (OG)	0		15m	15%		
	TOTAL	17		25m	10%		
	Stratum	Sum		35m	40%		
Count of cover abundance (native vascular plants)	Tree (TG)	0	Cryptogam cover	45m	25%	0%	
	Shrub (SG)	0		5m	0%		
	Forb (FG)	0.7		15m	0%		
	Grass & grasslike (GG)	26.7		25m	0%		
	Fern (EG)	0		35m	0%		
BAM Attribute (20 x 50m plot) Tree Stem Counts	Other (OG)	0	Rock Cover	45m	0%	3%	
	TOTAL Native	27.4		5m	2%		
	TOTAL 'HTE'	0.2		15m	3%		
	DBH (cm)	Euc		25m	2%		
		Non Euc		35m	5%		

DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

### COMPOSITION & STRUCTURE

Species recorded for W-6-2										
Abbreviation	Scientific Name	Common Name	Family	% Cover	Abundance	Exotic	Growth Form	High Threat?	EPBC Status	BCA Status
vitt grac	<i>Vittadinia gracilis</i>	Woolly New Holland	Asteraceae	0.1	30		Forb (FG)	No		
chon junc	<i>Chondrilla juncea</i>	Skeleton Weed	Asteraceae	0.5	200	*		No		
Vulp	<i>Vulpia spp.</i>	Rat's-tail Fescue	Poaceae	0.1	10	*		No		
trif	<i>Trifolium spp.</i>	A Clover	Fabaceae (Fab	0.1	40	*		No		
Trif subt	<i>Trifolium subterraneum</i>	Subterranean Clover	Fabaceae (Fab	0.1	40	*		No		
lepi afri	<i>Lepidium africanum</i>	Common Peppergrass	Brassicaceae	0.1	50	*		No		
them tria	<i>Themeda triandra</i>		Poaceae	0.2	10		Grass & grasslike (GG)	No		
cham drum	<i>Chamaesyce drummondii</i>	Caustic Weed	Euphorbiaceae	0.1	2		Forb (FG)	No		
pani effu	<i>Panicum effusum</i>	Hairy Panic	Poaceae	0.2	40		Grass & grasslike (GG)	No		
Alte nana	<i>Alternanthera nana</i>	Hairy Joyweed	Amaranthaceae	0.1	1		Forb (FG)	No		
salv verb	<i>Salvia verbenaca</i>	Vervain	Lamiaceae	0.1	5	*		No		
hord lepo	<i>Hordeum leporinum</i>	Barley Grass	Poaceae	5	10	*		No		
sonc aspe	<i>Sonchus asper</i>	Prickly Sowthistle	Asteraceae	0.1	5	*		No		
cart lana	<i>Carthamus lanatus</i>	Saffron Thistle	Asteraceae	0.1	5	*		HTE		
medi poly	<i>Medicago polymorpha</i>	Burr Medic	Fabaceae (Fab	0.2	40	*		No		
cirs vulg	<i>Cirsium vulgare</i>	Spear Thistle	Asteraceae	0.1	3	*		No		
ryti caes	<i>Rytidosperma caespitosum</i>	Ringed Wallaby Grass	Poaceae	25	500		Grass & grasslike (GG)	No		
ryti carp	<i>Rytidosperma carphoides</i>	Short Wallaby Grass	Poaceae	0.2	20		Grass & grasslike (GG)	No		
hypo radi	<i>Hypochaeris radicata</i>	Catsear	Asteraceae	0.1	5	*		No		
eina nuta	<i>Einadia nutans</i>	Climbing Saltbush	Chenopodiaceae	0.1	3		Forb (FG)	No		
malv negl	<i>Malva neglecta</i>	Dwarf Mallow	Malvaceae	0.1	10	*		No		
trif arve	<i>Trifolium arvense</i>	Haresfoot Clover	Fabaceae (Fab	0.1	5	*		No		
chlo trun	<i>Chloris truncata</i>	Windmill Grass	Poaceae	0.5	50		Grass & grasslike (GG)	No		
both macr	<i>Bothriochloa macra</i>	Red Grass	Poaceae	0.2	5		Grass & grasslike (GG)	No		
erag brow	<i>Eragrostis brownii</i>	Brown's Lovegrass	Poaceae	0.1	1		Grass & grasslike (GG)	No		
Sida corr	<i>Sida corrugata</i>	Corrugated Sida	Malvaceae	0.1	4		Forb (FG)	No		
enne nigr	<i>Enneapogon nigricans</i>	Niggerheads	Poaceae	0.1	1		Grass & grasslike (GG)	No		
trif dubi	<i>Trifolium dubium</i>	Yellow Suckling Clover	Fabaceae (Fab	0.1	10	*		No		
aila alti	<i>Ailanthus altissima</i>	Tree of Heaven	Simaroubaceae	0.1	2	*		HTE		

BAM Site Field Survey							
Project:	Wellington Solar	Plot Identifier	W-6-3	Pic 20x20	Yes	Pic 20x50	Yes
Survey date:	8/11/2019	Compass Orientation (head of 20x20 plot)			East		
Recorders	Lesley Peden	PCT:	266	White Box Grassy Woodland- Derived Grassland			
GPS Easting	32.51083	GPS Northing	148.97313	Datum	Zone		
Landform			Soils		Drainage & Slope		
Morphology		Soil Texture	Dry	Slope			
LandF Element		Soil Colour	Red	Aspect		West	
LandF Pattern		Soil Depth	Shallow	Drainage			
Microrelief		Geology		Watercourses		1 km to dam	
Plot Disturbance							
	Severity	Age	Observational Evidence				
Clearing	3	NR					
Cultivation	3	NR					
Soil erosion	1	NR	Wind blown topsoil				
Firewood	3	NR					
Grazing	3	R	Macropods (R), Cattle (NR)				
Fire Damage							
Storm Damage							
Weediness	1	R/NR					
Other							
Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)							
Additional information							
Current land use							
Agriculture, grazing							
Age class of trees (DBH range) , Condition of Vegetation, Hollows							
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)							
Grazing, weeds							
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)							
Box Gum Woodland							
Dominant Species outside Plot							
Brachychiton populneus near road							

#### FUNCTION

Function attributes for		W-6-3	BAM Attributes (1 x 1m Plots)				
BAM Attribute (20x20m plot)			Litter Cover	Tape length	% cover	Average %	Photos
Count of Native Richness	Stratum	Sum		5m	15%	44.00%	
	Tree (TG)	0		15m	70%		
	Shrub (SG)	0		25m	30%		
	Forb (FG)	6		35m	60%		
	Grass & grasslike (GG)	4		45m	45%		
	Fern (EG)	0	Bare ground cover	5m	75%	42%	
	Other (OG)	1		15m	20%		
	TOTAL	11		25m	50%		
BAM Attribute (20x20m plot)				35m	15%		
Count of cover abundance (native vascular plants)	Stratum	Sum	Cryptogam cover	45m	50%	0%	
	Tree (TG)	0		5m	0%		
	Shrub (SG)	0		15m	0%		
	Forb (FG)	0.6	Rock Cover	25m	0%		
	Grass & grasslike (GG)	0.4		35m	0%		
	Fern (EG)	0		45m	0%		
	Other (OG)	0.1		5m	0%	0%	
	TOTAL Native	1.1		15m	0%		
	TOTAL 'HTE'	0.2		25m	0%		
				35m	1%		
				45m	0%		

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

#### COMPOSITION & STRUCTURE

Species recorded for		W-6-3									
Abbreviation	Scientific Name	Common Name	Family	% Cover	Abundance	Exotic	Growth Form	High Threat?	EPBC Status	BCA Status	
Chon junc	<i>Chandrilla juncea</i>	Skeleton Weed	Asteraceae	1	1	*		No			
Medi poly	<i>Medicago polymorpha</i>	Burr Medic	Fabaceae (Fa)	0.1	4	*		No			
vitt grac	<i>Vittadinia gracilis</i>	Woolly New Holland	Asteraceae	0.1	10		Forb (FG)	No			
Eina nuta	<i>Einadia nutans</i>	Climbing Saltbush	Chenopodiaceae	0.1	4		Forb (FG)	No			
Sida corr	<i>Sida corrugata</i>	Corrugated Sida	Malvaceae	0.1	30		Forb (FG)	No			
conv angu	<i>Convolvulus angustissimus</i>	A Fuzzweed	Convolvulaceae	0.1	20		Other (OG)	No			
Pani effu	<i>Panicum effusum</i>	Hairy Panic	Poaceae	0.1	5		Grass & grasslike (GG)	No			
Malv negl	<i>Malva neglecta</i>	Dwarf Mallow	Malvaceae	0.1	2	*		No			
chlo trun	<i>Chloris truncata</i>	Windmill Grass	Poaceae	0.1	10		Grass & grasslike (GG)	No			
Sonc aspe	<i>Sonchus asper</i>	Prickly Sowthistle	Asteraceae	0.1	1	*		No			
trif dubi	<i>Trifolium dubium</i>	Yellow Suckling Clover	Fabaceae (Fa)	0.1	1	*		No			
ryti caes	<i>Rytidosperma caespitosum</i>	Ringed Wallaby Grass	Poaceae	0.1	10		Grass & grasslike (GG)	No			
medi sati	<i>Medicago sativa</i>	Lucerne	Fabaceae (Fa)	0.1	1	*		No			
cirs vulg	<i>Cirsium vulgare</i>	Spear Thistle	Asteraceae	0.1	2	*		No			
cart lana	<i>Carthamus lanatus</i>	Saffron Thistle	Asteraceae	0.1	5	*		HTE			
vitt cune	<i>Vittadinia cuneata</i>	A Fuzzweed	Asteraceae	0.1	10		Forb (FG)	No			
trif subt	<i>Trifolium subterraneum</i>	Subterranean Clover	Fabaceae (Fa)	0.1	10	*		No			
salv verb	<i>Salvia verbenaca</i>	Vervain	Lamiaceae	0.1	6	*		No			
wahl	<i>Wahlenbergia spp.</i>	Bluebell	Campanulaceae	0.1	1		Forb (FG)	No			
lepi afri	<i>Lepidium africanum</i>	Common Peppergrass	Brassicaceae	0.1	3	*		No			
cham drum	<i>Chamaesyce drummondii</i>	Caucstic Weed	Euphorbiaceae	0.1	1		Forb (FG)	No			
both macr	<i>Bothriochloa macra</i>	Red Grass	Poaceae	0.1	4		Grass & grasslike (GG)	No			
vulp	<i>Vulpia spp.</i>	Rat's-tail Fescue	Poaceae	0.1	50	*		No			
sida	<i>Sida spp.</i>		Malvaceae	0.1	3	*		No			
hirs inca	<i>Hirschfeldia incana</i>	Buchan Weed	Brassicaceae	0.1	1	*		No			
heli ampl	<i>Heliotropium amplexicaule</i>	Blue Heliotrope	Boraginaceae	0.1	1	*		HTE			



## APPENDIX B EPBC ASSESSMENT OF SIGNIFICANT IMPACT

The *Environment Protection and Biodiversity Conservation Act 1999* specifies factors to be considered in deciding whether a development is likely to significantly affect Endangered Ecological Communities, threatened species and migratory species, listed at the Commonwealth level. The following assessment assesses the significance of the likely impacts associated with the proposed works on:

- White Box – Yellow Box – Blakely’s Red Gum grassy woodland and derived native grasslands. (Critically Endangered Ecological Community)
- Regent Honeyeater (*Anthochaera phrygia*) – Critically Endangered EPBC Act.
- Swift Parrot (*Lathamus discolor*) – Critically Endangered EPBC Act.
- Superb Parrot (*Polytelis swainsonii*) – Vulnerable EPBC Act.
- Koala (*Phascolarctos cinereus*) – Vulnerable EPBC Act.
- Corben’s Long-eared Bat (*Nyctophilus corbeni*) – Vulnerable EPBC Act.
- Large-eared Pied Bat (*Chalinolobus dwyeri*) – Vulnerable EPBC Act.
- Small Purple Pea (*Swainsona recta*) – Endangered EPBC Act.
- Euphrasia arguta (*Euphrasia arguta*) - Endangered EPBC Act.
- Painted Honey-eater (*Grantiella picta*) – Vulnerable EPBC Act.
- Spotted-tailed Quail (*Dasyurus maculatus*) – Endangered EPBC Act.
- Brush-tailed Rock-Wallaby (*Petrogale penicillata*) – Vulnerable EPBC Act.
- Grey-headed Flying-fox (*Pteropus poliocephalus*) – Vulnerable EPBC Act.
- Pink-tailed Legless-lizard (*Aprasia parapulchella*) – Vulnerable EPBC Act.
- Striped Legless Lizard (*Delma impar*) – Vulnerable EPBC Act.

Surveys in 2017 and flora surveys and assessment in 2019, (NGH 2017) demonstrate that the Swift Parrot, Regent Honeyeater, Koala, Euphrasia arguta, Painted Honey-eater, Large-eared Pied Bat, Spotted-tailed Quoll, Brush-tailed Rock-wallaby, Grey-headed Flying-fox and Small Purple-pea are unlikely to occur within the development footprint presented in this report. Therefore, the following species and communities will be addressed here:

- White Box – Yellow Box – Blakely’s Red Gum grassy woodland and derived native grasslands. (Critically Endangered Ecological Community)
- Corben’s Long-eared Bat (*Nyctophilus corbeni*) – Vulnerable EPBC Act.
- Superb Parrot (*Polytelis swainsonii*) – Vulnerable EPBC Act.

Different significant impact criteria apply depending on the level at which a species or community is listed (i.e. vulnerable, endangered, critically endangered etc.). The appropriate criteria have been applied to the entities listed above in the assessment below.

### **WHITE BOX – YELLOW BOX – BLAKELY’S RED GUM GRASSY WOODLAND AND DERIVED NATIVE GRASSLANDS (CRITICALLY ENDANGERED ECOLOGICAL COMMUNITY)**

No EPBC listed Box Gum Woodland exists within the current development footprint. Therefore, there is not going to be an impact upon this TEC due to this development.

### **CORBEN'S LONG-EARED BAT (VULNERABLE)**

***An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:***

***lead to a long-term decrease in the size of an important population of a species***

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

No known records of this species occur within the locality of the proposal area. A *Nyctophilus* species was detected through the ANABAT in 2017 however the species could not be identified from calls alone. Suitable habitat for this species occurs within the proposal area. The consented solar farm layout will remove a total of 16 hollow-bearing trees, suitable for roosting for Corben's Long-eared Bat this proposal will not contribute to additional HBTs being removed. The foraging habitat contained within the development site is considered to be sub-optimal, with no shrub or small tree layers present, and would likely only be utilised on occasion. The species is considered likely, were it to occur within the development site not to be reliant on the trees within development footprint but may utilise the larger Solar Farm development site as a roosting resource. The higher quality remnants of vegetation containing similar densities of hollow-bearing trees and higher-quality understory and foraging habitat have been avoided by the larger Solar Farm proposal, thus the species is considered likely to remain viable within the proposal area, were it present. The proposal is not considered likely to lead to a long-term decrease in the size of an important population of the species.

***reduce the area of occupancy of an important population,***

There will be a reduction of approximately 0.06 ha of moderate to good quality woodland vegetation. The species is highly mobile and is considered likely to use a number of woodland areas surrounding the larger Solar Farm area, including the higher quality habitats within the proposal area, that have been avoided. The proposal area will continue to contain suitable areas of roosting and foraging habitat of a sufficient size and quality to maintain a population of the species within the proposal area and the wider locality.

***fragment an existing important population into two or more populations***

Vegetative connectivity within the proposal area will be maintained and improved through planting and avoidance of impacts to vegetation. As the species is highly mobile, roosts singly or in pairs and relocates between multiple roost locations over successive nights (TSSC, 2015), the proposal will not impact on its movement within or across the proposal area.

***adversely affect habitat critical to the survival of a species***

No habitat critical to the survival of the species exists within the development site. Suitable foraging and roosting habitats represented within the proposal area have been avoided by the proposal and will be retained, thus ensuring that these habitats are not adversely affected.

***disrupt the breeding cycle of an important population***

The species is known to roost in large dead stags in NSW (DoE, 2015). No additional hollow bearing trees are to be removed within the proposed Development Footprint, therefore breeding is unlikely to be disrupted.

***modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline***

The proposal will remove approximately 0.06 ha of moderate to good quality woodland vegetation containing native canopy and native understorey species. The vegetation to be removed as a result of the proposal is considered to constitute low quality foraging habitat and no potential roosting and breeding habitat. However, the modification and removal of this habitat is not considered likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, as higher quality areas of suitable habitat have been avoided and will be retained within the proposal area, ensuring that areas of suitable habitat remain. As such, the impacts to habitat are not considered likely to be such that the species is likely to decline, were it present within the development site.

***result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat***

*Nyctophilus* species are typically impacted by cats due to their slow flight and ground foraging habits. The proposal will modify the current land use, potentially creating additional shelter habitat for predatory invasive species such as foxes and cats, which are considered likely to be locally prevalent regardless of the proposal. A management plan will be prepared and implemented which will monitor and manage these species within the proposal area and offset area.

***introduce disease that may cause the species to decline***

The proposal is not considered likely to introduce any diseases that would impact the species.

***interfere substantially with the recovery of the species***

Considering the small areas of potential foraging and minimal potential roosting habitat to be removed, the mitigation measures in place to avoid impacts to individuals and that substantial habitat will remain within the broader proposal area and locality, the proposal is unlikely to interfere with the recovery of Corben's Long-eared Bat.

**Conclusion:**

The proposal will remove 0.06 ha of moderate to good quality woodland vegetation. The habitat to be impacted is considered to constitute low-quality foraging habitat and would likely only be utilised on occasion. Roosting is unlikely to be impacted as there are no additional hollow bearing trees proposed for removal within the development footprint; however. It is likely that within the larger solar farm this species will utilise multiple roost hollows over successive nights, up to 4km apart (TSSC, 2015). As such, it is likely that any individuals utilising the larger solar farm site would only do so on occasion. Significant areas of better-quality habitat have been avoided by the proposal and will be retained within the larger Solar Farm area. It is considered likely that, were the species present within the development site, the population would remain viable within the broader proposal area. As such, the proposal is unlikely to significantly impact the species, and a referral under the EPBC Act is not required.

***Superb Parrot (vulnerable)***



***An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:***

***lead to a long-term decrease in the size of an important population of a species***

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

The breeding population of Superb Parrots *Polytelis swainsonii* is approximately 6500. The species is somewhat mobile, and typically utilises foraging habitat within 10km of breeding habitat (SPRAT, 2017). No records of the Superb Parrot occur within the development footprint. No known population of Superb Parrot occurs within the development site.

The development site is not part of a core breeding area for the Superb Parrot. Nonetheless, the proposal will remove approximately 0.08 ha of woodland vegetation in addition to the clearing of 16 hollow-bearing trees. Additionally, the potential foraging area for the species would be reduced as cropping would no longer occur within the development site. However the majority of the hollow bearing trees are not being impacted by the development proposal, maintaining habitat for the species onsite. The proposal is not considered likely to lead to a long-term decrease in the size of the population, as the development would likely constitute only a small portion of the population's foraging and breeding range within the NSW South West Slopes.

***reduce the area of occupancy of an important population,***

As an important population is not considered to occur within the development site, the proposal is not considered to reduce the area of occupancy of an important population. The broader proposal area will continue to contain suitable areas of breeding and foraging habitat of a sufficient size and quality to maintain individuals of the species within the proposal area and the wider locality.

***fragment an existing important population into two or more populations***

As the individuals of the species are not considered to form an important population, the proposal is not considered to fragment an existing important population. Vegetative connectivity within the Proposal Area will be maintained and improved through planting and avoidance of impacts to vegetation. As the species is highly mobile, the proposal will not impact on its movement within or across the development site.

***adversely affect habitat critical to the survival of a species***

No habitat critical to the survival of the species exists within the development site. Suitable breeding, foraging and roosting habitats represented within the proposal area have been avoided by the proposal and will be retained, thus ensuring that these habitats are not adversely affected.

***disrupt the breeding cycle of an important population***

No known important population occurs within the proposal area. Three main breeding areas for the superb parrot occur in NSW. The nearest known breeding area to the proposal area occurs in the South West Slopes near Molong, approximately 65km south of Wellington. Within the South West Slopes, the Superb Parrot breeds in hollows in River Red Gum, Blakely's Red Gum, Apple Box, Grey Box, White Box and Red Box species. The nests are usually located near water and the same nest hollows are used in successive years. the individuals of the species are not considered to form an important population, the proposal is not

considered likely to disrupt the breeding cycle of an important population. The superb parrot could potentially utilise the development site as a breeding resource, however the use of isolated paddock trees for breeding is considered unlikely. Suitable woodland habitat has been avoided and will be retained throughout the Development Site, thus ensuring that individuals could continue to utilise the Development Site, and the breeding cycle of the broader population is not disrupted.

***modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline***

The proposal will remove approximately 0.08 ha of moderate to good quality woodland vegetation. Additionally, the potential foraging area for the species would be reduced as cropping would no longer occur within the development site. This modification and removal of habitat is not considered likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, as habitat has been avoided and will be retained within the proposal area, ensuring that large areas of suitable habitat remain. The areas being removed and modified would likely only constitute occasional foraging habitat.

***result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat***

The proposal is not considered likely to result in invasive species becoming established within the Superb Parrot's habitat. Competition with Noisy Miners for breeding and foraging habitat and resources is a major threat to the species and cause for the decline in population numbers. Noisy Miners are already present at the development site. The proposal is unlikely to result in an increase in invasive species such as these that are harmful to the habitat of the Superb Parrot.

The proposal will modify the current land use, potentially creating additional shelter habitat for predatory invasive species such as foxes and cats, which are considered likely to be locally prevalent regardless of the proposal. Management protocols will be prepared and implemented as part of the Biodiversity Management Plan for the proposal which will monitor and manage these species within the development site.

***introduce disease that may cause the species to decline***

Beak and Feather Disease has been proven to impact the Superb Parrot (DoE, 2017), however the proposal is not considered likely to act as a vector for the disease.

***interfere with the recovery of the species***

Core breeding areas and surrounding habitat are considered important to the recovery of the species. The nearest known breeding area to the proposal area occurs in the South West Slopes near Molong, approximately 65km south of Wellington and the species typically utilises foraging habitat within 10km of breeding habitat. Habitats across the broader proposal area will remain available to the species and given its mobility, the proposal would not restrict the movements of the species across the development site. The proposal is unlikely to interfere with the recovery of the Superb Parrot.

**Conclusion:**

As the individuals of the species that could potentially utilise the development site are not considered to constitute an important population of the species, the proposal is not considered likely to impact on an important population. Though there will be the removal of 0.08 ha of moderate to good quality woodland vegetation, and 16 paddock trees containing hollows, the extent of vegetation removal is not considered likely to impact the species to the degree that they would no longer utilise the proposal area as habitat.

***Biodiversity Development Assessment Report***  
***Wellington Solar Farm BDAR: Revised Project Layout***

Areas of vegetation where the species was detected have been avoided throughout the project design phase, and areas of higher quality native vegetation will be retained within the Development Site, thus ensuring that suitable habitat continues to occur within the proposal area. As such, impacts to the Superb Parrot are unlikely to be significant, and a referral under the EPBC Act is not required.



## **APPENDIX C    BAM CALCULATOR CREDIT REPORTS**

### **C.1        ADDITIONAL AREAS**

# BAM Credit Summary Report

## Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00018234/BAAS19015/20/00018235	Wellington BDAR - infrastructure movement within proposal area	26/11/2019
Assessor Name	Report Created	BAM Data version *
	04/02/2020	22
Assessor Number	BAM Case Status	Date Finalised
	Open	To be finalised
Assessment Revision	Assessment Type	
1	Major Projects	

\* 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.

## 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	Potential SAIL	Ecosystem credits
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## BAM Credit Summary Report

Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion								
3	277_Zone1_excised	6.1	0.0	0.25	High Sensitivity to Potential Gain	2.00	TRUE	0
							<b>Subtotal</b>	<b>0</b>
White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion								
1	266_Zone2_excised	12.3	0.0	0.25	High Sensitivity to Potential Gain	2.00	TRUE	0
2	266_Zone3_excised	21.4	0.2	0.25	High Sensitivity to Potential Gain	2.00	TRUE	2
4	266_Zone5_excised	29.9	0.3	0.25	High Sensitivity to Potential Gain	2.00	TRUE	5
5	266_Zone6_excised	24.4	10.6	0.25	High Sensitivity to Potential Gain	2.00	TRUE	129
							<b>Subtotal</b>	<b>136</b>
							<b>Total</b>	<b>136</b>

### Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAIL	Species credits
<b>Burhinus grallarius / Bush Stone-curlew ( Fauna )</b>						
266_Zone2_excised	12.3	0	0.25	2	False	0
266_Zone3_excised	21.4	0	0.25	2	False	0
277_Zone1_excised	6.1	0	0.25	2	False	0



## BAM Credit Summary Report

266_Zone5_excised	29.9	0	0.25	2	False	0
266_Zone6_excised	24.4	0	0.25	2	False	0
					<b>Subtotal</b>	<b>0</b>
<b><i>Callocephalon fimbriatum / Gang-gang Cockatoo ( Fauna )</i></b>						
266_Zone2_excised	12.3	0	0.25	2	False	0
266_Zone3_excised	21.4	0	0.25	2	False	0
277_Zone1_excised	6.1	0.01	0.25	2	False	0
266_Zone5_excised	29.9	0	0.25	2	False	0
266_Zone6_excised	24.4	0	0.25	2	False	0
					<b>Subtotal</b>	<b>0</b>
<b><i>Haliaeetus leucogaster / White-bellied Sea-Eagle ( Fauna )</i></b>						
266_Zone2_excised	12.3	0.03	0.25	2	False	0
266_Zone3_excised	21.4	0.22	0.25	2	False	2
277_Zone1_excised	6.1	0.01	0.25	2	False	0
266_Zone5_excised	29.9	0	0.25	2	False	0
266_Zone6_excised	24.4	0	0.25	2	False	0
					<b>Subtotal</b>	<b>2</b>
<b><i>Hieraaetus morphnoides / Little Eagle ( Fauna )</i></b>						
266_Zone2_excised	12.3	0.03	0.25	1.5	False	0
266_Zone3_excised	21.4	0.22	0.25	1.5	False	2
277_Zone1_excised	6.1	0.01	0.25	1.5	False	0

## BAM Credit Summary Report

266_Zone5_excised	29.9	0	0.25	1.5	False	0
266_Zone6_excised	24.4	0	0.25	1.5	False	0
					<b>Subtotal</b>	<b>2</b>
<b><i>Lophoictinia isura / Square-tailed Kite ( Fauna )</i></b>						
266_Zone2_excised	12.3	0.03	0.25	1.5	False	0
266_Zone3_excised	21.4	0.22	0.25	1.5	False	2
277_Zone1_excised	6.1	0.01	0.25	1.5	False	0
266_Zone5_excised	29.9	0	0.25	1.5	False	0
266_Zone6_excised	24.4	0	0.25	1.5	False	0
					<b>Subtotal</b>	<b>2</b>
<b><i>Polytelis swainsonii / Superb Parrot ( Fauna )</i></b>						
266_Zone2_excised	12.3	0	0.25	2	False	0
266_Zone3_excised	21.4	0	0.25	2	False	0
277_Zone1_excised	6.1	0.01	0.25	2	False	0
266_Zone5_excised	29.9	0	0.25	2	False	0
266_Zone6_excised	24.4	0	0.25	2	False	0
					<b>Subtotal</b>	<b>0</b>

## **C.2      EXCISED AREAS**



# BAM Credit Summary Report

## Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00018234/BAAS19015/20/00018235	Wellington BDAR - infrastructure movement within proposal area	26/11/2019
Assessor Name	Report Created	BAM Data version *
	04/02/2020	22
Assessor Number	BAM Case Status	Date Finalised
	Open	To be finalised
Assessment Revision	Assessment Type	
0	Major Projects	

\* 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.

## 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	Potential SAIL	Ecosystem credits
------	----------------------	----------------------------------	-----------	----------	---	-----------------------------	----------------	-------------------

## BAM Credit Summary Report

Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion								
2	277_Zone1_addition	6.1	0.0	0.25	High Sensitivity to Potential Gain	2.00	TRUE	0
							<b>Subtotal</b>	<b>0</b>
White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion								
1	266_Zone3_addition	21.4	0.1	0.25	High Sensitivity to Potential Gain	2.00	TRUE	1
3	266_Zone4_addition	26.5	0.0	0.25	High Sensitivity to Potential Gain	2.00	TRUE	1
4	266_Zone5_addition	30.0	0.1	0.25	High Sensitivity to Potential Gain	2.00	TRUE	1
5	266_Zone6_addition	31.3	4.1	0.25	High Sensitivity to Potential Gain	2.00	TRUE	64
							<b>Subtotal</b>	<b>67</b>
							<b>Total</b>	<b>67</b>

### Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAIL	Species credits
<b>Burhinus grallarius / Bush Stone-curlew ( Fauna )</b>						
266_Zone3_addition	21.4	0	0.25	2	False	0
277_Zone1_addition	6.1	0	0.25	2	False	0
266_Zone4_addition	26.5	0.01	0.25	2	False	0

## BAM Credit Summary Report

266_Zone5_addition	30.0	0	0.25	2	False	0
266_Zone6_addition	31.3	0	0.25	2	False	0
					<b>Subtotal</b>	<b>0</b>
<b><i>Callocephalon fimbriatum / Gang-gang Cockatoo ( Fauna )</i></b>						
266_Zone3_addition	21.4	0.06	0.25	2	False	1
277_Zone1_addition	6.1	0.03	0.25	2	False	0
266_Zone4_addition	26.5	0	0.25	2	False	0
266_Zone5_addition	30.0	0	0.25	2	False	0
266_Zone6_addition	31.3	0	0.25	2	False	0
					<b>Subtotal</b>	<b>1</b>
<b><i>Haliaeetus leucogaster / White-bellied Sea-Eagle ( Fauna )</i></b>						
266_Zone3_addition	21.4	0.06	0.25	2	False	1
277_Zone1_addition	6.1	0.03	0.25	2	False	0
266_Zone4_addition	26.5	0.01	0.25	2	False	0
266_Zone5_addition	30.0	0	0.25	2	False	0
266_Zone6_addition	31.3	0	0.25	2	False	0
					<b>Subtotal</b>	<b>1</b>
<b><i>Hieraaetus morphnoides / Little Eagle ( Fauna )</i></b>						
266_Zone3_addition	21.4	0.06	0.25	1.5	False	0
277_Zone1_addition	6.1	0.03	0.25	1.5	False	0
266_Zone4_addition	26.5	0.01	0.25	1.5	False	0



## BAM Credit Summary Report

266_Zone5_addition	30.0	0	0.25	1.5	False	0
266_Zone6_addition	31.3	0	0.25	1.5	False	0
<b>Subtotal</b>						<b>0</b>
<b><i>Lophoictinia isura / Square-tailed Kite ( Fauna )</i></b>						
266_Zone3_addition	21.4	0.06	0.25	1.5	False	0
277_Zone1_addition	6.1	0.03	0.25	1.5	False	0
266_Zone4_addition	26.5	0.01	0.25	1.5	False	0
266_Zone5_addition	30.0	0	0.25	1.5	False	0
266_Zone6_addition	31.3	0	0.25	1.5	False	0
<b>Subtotal</b>						<b>0</b>
<b><i>Polytelis swainsonii / Superb Parrot ( Fauna )</i></b>						
266_Zone3_addition	21.4	0.06	0.25	2	False	1
277_Zone1_addition	6.1	0.03	0.25	2	False	0
266_Zone4_addition	26.5	0	0.25	2	False	0
266_Zone5_addition	30.0	0	0.25	2	False	0
266_Zone6_addition	31.3	0	0.25	2	False	0
266_Zone2_excised	12.3		0.25	2	False	0
266_Zone3_excised	21.4		0.25	2	False	0
277_Zone1_excised	6.1		0.25	2	False	0
266_Zone5_excised	29.9		0.25	2	False	0
266_Zone6_excised	24.4		0.25	2	False	0



## BAM Credit Summary Report

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					<b>Subtotal</b>	<b>1</b>
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### **C.3 STATEMENT OF HERITAGE IMPACT – NARRAWA HOMESTEAD**





**NGH**

# **STATEMENT OF HERITAGE IMPACT**

## **Narrawa Homestead**

**October 2019**

**Project Number: 19-600**



## DOCUMENT VERIFICATION

Project Title: Narrawa Homestead

Project Number: 19-600

Project File Name: Statement of Heritage Impact

Revision	Date	Prepared by	Reviewed by	Approved by
Draft	1/10/2019	Ingrid Cook	Ali Byrne	Ali Byrne
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## ACRONYMS AND ABBREVIATIONS

AHD	Australian Heritage Database
BCD	(NSW) Biodiversity and Conservation Division, formerly the Office of Environment and Heritage.
<i>Burra Charter</i>	Refers to <i>The Burra Charter</i> prepared by Australia ICOMOS
<i>Cultural Significance</i>	Aesthetic, historical, scientific, social or spiritual value for past, present or future generations
CHL	Commonwealth Heritage List
CMP	Conservation Management Plan
DCP	Development Control Plan
EP&A Act	Environmental Planning & Assessment Act 1979
EPBC Act	Legal framework for the protection and management of places of national environmental significance
<i>Fabric</i>	Physical material of the <i>place</i> including components, fixtures, contents, and objects
HA	Heritage Assessment
<i>Heritage Significance</i>	A term used to describe the inherent cultural and historical value of an item
HIA	Heritage Impact Assessment
HCA	Heritage Conservation Area
ICOMOS	International Council on Monuments and Sites
<i>Interpretation</i>	All the ways of representing the <i>cultural significance</i> of a <i>place</i>
LEP	Local Environment Plan
LGA	Local Government Area
NHL	National Heritage List
NPW Act	<i>National Parks &amp; Wildlife Act 1974</i> (NSW)
NSW	New South Wales

OEH	(NSW) Office of Environment and Heritage (now the Biodiversity and Conservation Division (BCD), formerly Department of Environment, Climate Change and Water
<i>Place</i>	Site, area, land, landscape, building or other works, and may include components, contents, spaces and views
<i>Reconstruction</i>	Means returning a <i>place</i> to a known earlier state and is distinguished from <i>restoration</i> by the introduction of a new material into the <i>fabric</i>
<i>Restoration</i>	Means returning the existing <i>fabric</i> of a <i>place</i> to a known earlier state by removing by removing accretions or by assembling existing components without the introduction of a new material
SHR	State Heritage Register
RNE	Register of the National Estate
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WHL	World Heritage List



# EXECUTIVE SUMMARY

## BACKGROUND ASSESSMENT

NGH has been commissioned by Lightsource BP to prepare a Statement of Heritage Impact (SOHI) for the proposed adaptive reuse of the locally listed Narrawa Homestead in Montefiores, close to the town of Wellington NSW.

Lightsource BP have gained approvals for a State Significant Development (SSD) solar farm surrounding the Narrawa Homestead that will not have a physical impact on the homestead and surrounding buildings. As a Condition of consent for the approval of the Wellington Solar Farm (Condition 8 Schedule 2) the SSD approval states that the Narrawa Homestead should be repurposed as an Operations & Maintenance (O&M) Building. Condition 18 of Schedule 3 of the SSD approval states that as a condition of the development consent, impacts on the Homestead must be minimised during the works.

This SOHI report aims to determine if the adaptive reuse of the homestead is an acceptable outcome for the heritage significance of the site, or if the construction of another building in the vicinity of the homestead would provide a more suitable option.

## PROPOSAL OBJECTIVE AND RATIONALE

It has been identified that as a requirement of developmental consent for the Wellington Solar Farm, Narrawa Homestead should be repurposed as an O&M Building. The proposed adaptive reuse of the Homestead as an O&M Building will ensure the continued use and maintenance of the structure into the future.

The proposed program of works to upgrade the homestead into an O&M building includes both internal and external structural changes. A brief summary of the works includes (but is not limited to):

- Removal of elements of the roof; removal of old hot water unit, removal of some foliage, and removal of the architraves and cover moulds encasing asbestos in the laundry and verandah;
- Changes to electrical wiring;
- Disconnection of plumbing to abandoned fixtures;
- Removal of floorboards and asbestos cement ceiling on the southern wrap around verandah;
- Modify existing kitchen and eastern lounge room;
- Modify existing ensuite and walk-in robe by removing existing fixtures, fittings, tiles, internal door and shelving;
- Modify the existing laundry, shower and external water Closet (WC) with the removal of internal fixings as well as removal of architraves and doors; and
- Remove the carpet in sections of the house.

## STATEMENT OF SIGNIFICANCE

Built in 1908 Narrawa Homestead is a typical large Federation country home with Federation features in its ceilings, joinery and detail. The homestead has been sympathetically restored with additions that are similar in form and style to the original homestead and do not detract from the significance of the original house. The homestead is set in a complimentary garden setting in keeping with the ambience of the house.

The homestead is historically significant as an example of a type of residence erected on prosperous country properties pre WWI, as well as being aesthetically and representatively significant as a well-maintained federation style building.

## IMPACT ASSESSMENT CONCLUSION

The assessment of heritage impacts for the proposal to adaptively re-use Narrawa Homestead as an O&M Building for the Wellington Solar Farm has found that the overall impact is minor and that any significant heritage impact is unlikely. This is due to:

- The works aim to keep the homestead in use as a working building and will result in the homestead being maintained to a safe and occupiable level;
- The proposed works do not aim to significantly alter the original layout of the homestead;
- The proposed works aim to primarily update areas of the homestead that have previously undergone renovations;
- The proposed works will require some ground disturbance however it has been identified that the archaeological potential at the site is limited to potential residential and agricultural deposits. An unexpected finds procedure will be utilised during the works in the event of encountering any deposits that may hold heritage significance.
- The replacement of the existing roof is aimed at ensuring the homestead is waterproof and serviceable into the future. The new roof will be completed in the same colour, form, detail and style as the existing roof; and
- The repainting of the homestead internally and externally will be completed in sympathetic colours to the existing homestead and will be aimed at sealing and protecting the homestead from damage and decay.

In summary, the cumulative impact of the proposed adaptive reuse of Narrawa Homestead is assessed to be low. The intention to make the Narrawa Homestead building structurally sound and safe while maintaining the character of the building may result in a positive heritage outcome in the future, in particular where parts of the house previously in poor condition such as the former kitchen are better maintained.

## RECOMMENDATIONS

The following recommendations are made for the proposal:

1. In the event any unexpected archaeological heritage finds are identified, works must cease temporarily and the 'Unexpected Finds Procedure' described in Appendix A should be adhered to;
2. The proposed painting of the homestead should be completed in complementary palette to the existing surfaces. "Colour schemes for Old Australian Houses" by Evans, Lucas and Stapleton (1984) should be used as a guideline for the works;
3. The replacement of the roof should be completed in sympathetic colours and style to the original and will maintain the overall form of the original roof. "Colour schemes for Old Australian Houses" by Evans, Lucas and Stapleton (1984) should be used as a guideline for the works;
4. Original elements of the house that are in good condition should be carefully removed during works and reused where possible;
5. The proposed works should aim to maintain the overall character of the homestead and be completed in complimentary colours and styles to the existing;
6. The external elements of the air conditioning units should be placed at the rear of the house to avoid a visual impact on the façade of the homestead;

7. Changes to the internal flooring should not include the removal of any of the original hardwood flooring unless it is identified that the boards are in a significantly deteriorated condition. If any of the boards cannot be repaired then a specialist heritage architect and/or builder should be engaged to determine the type of hardwood in order to replace like for like;
8. The existing gardens should be maintained through regular gardening to ensure the views to and from the property are maintained;
9. The proposed works should not impact on the existing fireplaces within the building and not include the removal of the existing mantles or hearth tiling; and
10. The original kitchen stove located in the old kitchen should be retained in situ.



# 1. INTRODUCTION

## 1.1. BACKGROUND

NGH has been commissioned by Lightsource BP to prepare a Statement of Heritage Impact (SOHI) for the proposed adaptive reuse of the locally listed Narrawa Homestead in Montefiores, close to the town of Wellington NSW.

Lightsource BP have gained approvals for a State Significant Development (SSD) solar farm surrounding the Narrawa Homestead that will not have a physical impact on the homestead and surrounding buildings. As a Condition of consent for the approval of the Wellington Solar Farm (Condition 8 Schedule 2) the SSD approval states that the Narrawa Homestead should be repurposed as an Operations & Maintenance (O&M) Building. Condition 18 of Schedule 3 of the SSD approval states that as a condition of the development consent, impacts on the Homestead must be minimised during the works.

It has been identified that as a requirement of developmental consent for the Wellington Solar Farm, Narrawa Homestead should be repurposed as an O&M Building. The proposed adaptive reuse of the Homestead as an O&M Building will ensure the continued use and maintenance of the structure into the future.

This SOHI report aims to determine if the adaptive reuse of the homestead is an acceptable outcome for the heritage significance of the site, or if the construction of another building in the vicinity of the homestead would provide a more suitable option.

The heritage and future development of Wellington is currently controlled by the Wellington Council Development Control Plan (2013) (DCP) and Local Environment Plan (2012) (LEP). This document has been prepared in accordance with these planning instruments.

Background historical information regarding the sites was mostly obtained through a synthesis of existing heritage listings and heritage studies.

This SOHI assessment assesses the potential impact of the proposed works and has been prepared in accordance with the following guidelines:

- NSW Heritage Division (formerly Heritage Office) (Office of Environment and Heritage) publication *Statements of Heritage Impact* (2002);
- NSW Heritage Division (formerly Heritage Office) (Office of Environment and Heritage) publication *Assessing Heritage Significance* (2001); and
- Australia's ICOMOS *Burra Charter*. The Charter sets the standard of practice for providing advice or making decisions about undertaking works at places of heritage or cultural significance, including owners, managers and custodians (ICOMOS 1999).

A site visit was carried out by NGH Heritage consultant, Ingrid Cook, on 12 September 2019, in order to determine the existing physical aspects of the proposal site, the heritage items within proximity, and any conservation areas.

## 1.2. LOCATION

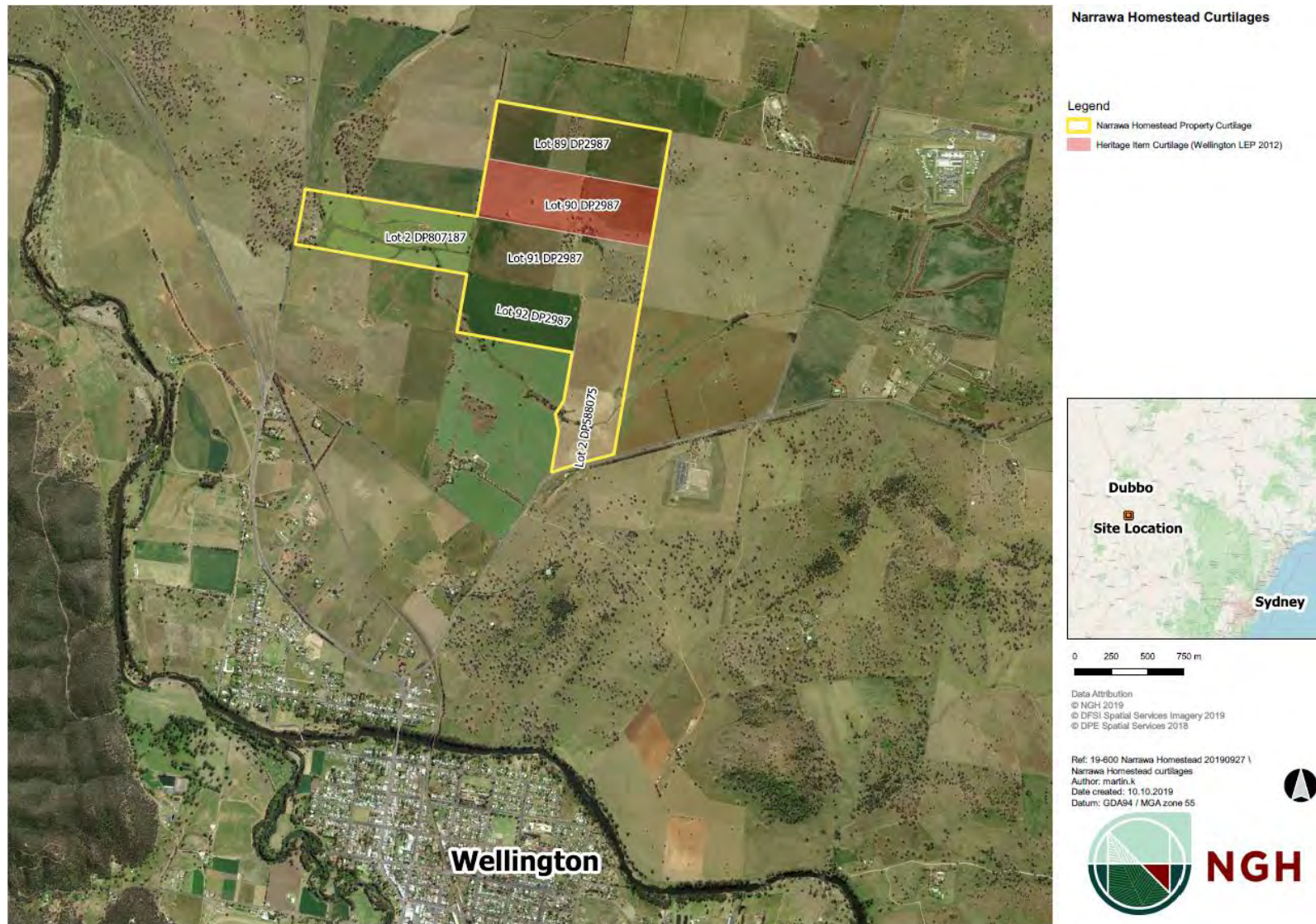
Wellington, NSW, is located approximately 260km to the north-west of Sydney and 43km to the south-east of Dubbo.

Narrawa Homestead is located at 6916 Goolma Road, Montefiores NSW, approximately 3km north of the town of Wellington. The property is comprised of a number of lots including Lot 90 DP2987 (the

location of the Homestead), Lot 89 DP2987, Lot 91 DP2987, Lot 92 DP2987, Lot 1 DP520396, Lot 2 DP807187

The homestead is located within the Dubbo Regional Council Local Government Area and falls within the jurisdiction of the Wellington LEP which came into force on 23 November 2012.

**Statement of Heritage Impact**  
*Narrawa Homestead*



**Figure 1. Narrawa Homestead and curtilage location.**



### 1.3. PROPOSAL OBJECTIVE AND RATIONALE

It has been identified that as a requirement of developmental consent for the Wellington Solar Farm, Narrawa Homestead should be repurposed as an O&M Building. The proposed adaptive reuse of the Homestead as an O&M Building will ensure the continued use and maintenance of the structure into the future.

The proposed program of works to upgrade the homestead into an O&M building includes both internal and external structural changes. A brief summary of the works includes (but is not limited to):

- Removal of elements of the roof; removal of old hot water unit, removal of some foliage, and removal of the architraves and cover moulds encasing asbestos in the laundry and verandah;
- Changes to electrical wiring;
- Disconnection of plumbing to abandoned fixtures;
- Removal of floorboards and asbestos cement ceiling on the southern wrap around verandah;
- Modify existing kitchen and eastern lounge room;
- Modify existing ensuite and walk-in robe by removing existing fixtures, fittings, tiles, internal door and shelving;
- Modify the existing laundry, shower and external WC with the removal of internal fixings as well as removal of architraves and doors; and
- Remove the carpet in sections of the house.

### 1.4. APPROACH

The purpose of this study is to assess the potential impact upon the heritage sites, listed in Table 1, and its values as a result of the proposed works. Narrawa Homestead is listed as an item of local heritage significance on the Wellington LEP (2012) (listing ID: I49), and therefore requires a SOHI for the proposed works to the locally listed building.

**Table 1. Heritage sites subject to this heritage impact assessment**

Heritage Item	Proximity to the proposal location	Rationale for inclusion in this report
<b>Narrawa Homestead</b>	Narrawa Homestead is the site of the proposed works.	The proposed works aim to adaptively reuse the locally listed Narrawa Homestead site as an O&M Building for the Lightsource BP solar farm that will surround the homestead.

The assessment has been prepared in accordance with the NSW Heritage Division's guideline *Statements of Heritage Impact* (2002) and *Assessing Heritage Significance* (2002), in addition to any further requirements that need to be considered in order to satisfy legislative and management obligations.

The report specifically includes the following:

- Review of existing heritage assessments and condition of the heritage items.
- Searches of national and state heritage databases. This includes the Australian Heritage Database (National and Commonwealth Heritage Lists), and the NSW Heritage Division State Heritage Inventory.
- Search of the Wellington Council LEP and DCP.
- Review of relevant literature.
- Site visit to determine character and condition of the site.

- Assessment of the heritage significance of the site and heritage items (if not done previously), and determination of the impacts on these items and if they are acceptable.
- Recommendations are provided accordingly that would help to avoid, minimise or mitigate against impacts to the identified cultural heritage values of the heritage items.

## **1.5. REPORT STRUCTURE**

This report:

- Outlines the background of the current study/proposal (Section 1).
- Discusses issues such as statutory heritage listings and legislative requirements (Section 2).
- Provides a brief summary in terms of an historical and physical overview of the place (Section 3).
- Provides a description and evaluates the significance of affected items (Section 4).
- Provides a description of the proposed works and assesses the potential impacts from the proposal (Section 5).
- Makes recommendations regarding the items in regard to those impacts (Section 6).

Note, it is outside of the scope of this report to provide a detailed historical account of the area. We have relied upon previous historical information in secondary sources.

## 2. LEGISLATIVE AND NON-STATUTORY CONSIDERATIONS

Places of heritage value can be subject to different levels of recognition and protection. This protection (at local, state and national levels) includes specific measures for the protection of heritage items. The text below provides a summary of the legislative framework at each level of government.

### 2.1. NSW HERITAGE ACT

#### State Heritage Register

Natural, cultural and built heritage is protected in NSW under the *Heritage Act 1977*. The Act is administered by the Heritage Division, a State government agency within the Department of Premier and Cabinet.

The Act creates the State Heritage Register (SHR) which provides permanent protection for a State Significant heritage item or place. Items of State heritage significance are defined as a place, building, work, relic, moveable object or precinct which is of historical, scientific, cultural, social, archaeological or natural significance to the State (Section 4A(1) of the Act). The effect of SHR listing is that a person cannot damage, destroy, alter or move an item, building or land without approval from the Heritage Council.

The Heritage Council of NSW, constituted under the *Heritage Act 1977*, is appointed by the Minister for Heritage (currently the Minister for Energy and Environment) and is responsible for heritage in NSW. The Council reflects a cross-section of community, government and conservation expertise with the Heritage Division being the operational arm of the Council.

The 2001 NSW Heritage Manual Update, published by the NSW Heritage Office (now the 'Heritage Division') provides guidelines for 'Assessing Heritage Significance'. The Manual includes specific criteria for assessing heritage significance and the significance assessment within this report has been completed in accordance with these guidelines.

When items are listed on the State Heritage Register (SHR) applications to carry out works on those items need to be made to the Heritage Council under Section 60 of the Act.

A search of the study area and surrounds indicated four items listed on the SHR in Wellington. None of these items are within close proximity to Narrawa Homestead and will therefore not be considered as part of this report as there is no assessed heritage impact to any of the State listed sites.

Table 2. Places listed under the NSW Heritage Act.

<u>Item name</u>	<u>Location and proximity to the proposal site</u>	<u>LGA</u>	<u>SHR Listing ID</u>
<b>Blacks Camp</b>	University Road – Approximately 5.4km south of Narrawa Homestead.	Wellington	01865
<b>John Fowler 7nhp Steam Road Locomotive</b>	9 Amaroo Drive – Approximately 6.9km south of Narrawa Homestead.	Wellington	01867
<b>Wellington Convict and Mission Site - Maynggu Ganai</b>	Curtis Street – Approximately 7.4km south of Narrawa Homestead.	Wellington	01859



Wellington Post Office

21 Maughan Street – Approximately 5km south of Narrawa Homestead.

Wellington

01415

## State Agency Heritage Registers

Under Section 170 of the *Heritage Act 1977*, State agencies and authorities in NSW are required to keep a register of heritage places for which they are responsible. These registers, known as the Section 170 Heritage and Conservation Registers (s.170 registers), are also held in the NSW Heritage Division's State Heritage Inventory (SHI), an electronic database of statutory listed heritage items in NSW.

There are five listings within the suburb of Wellington on the s.170 register. None of these items are located within close proximity to Narrawa Homestead and will therefore not be considered as part of this report as there is no assessed impact to their heritage significance.

**Table 3. Locations listed on the State Agency Heritage Register**

Item Name	Address	Suburb	LGA
<b>Wellington Courthouse</b>	Arthur Street and Maughan Street – Approximately 4.9km south of Narrawa Homestead.	Wellington	Wellington
<b>Wellington Fire Station</b>	78 Warne Street – Approximately 4.5km south of Narrawa Homestead.	Wellington	Wellington
<b>Wellington Railway Precinct (listed twice within the SHI Database)</b>	Swift Street – Approximately 4.7km south of Narrawa Homestead.	Wellington	Wellington
<b>Wellington, Macquarie River Underbridge</b>	412.847km Orange to Dubbo Railway	Wellington	Wellington

## 2.2. NSW ENVIRONMENTAL PLANNING & ASSESSMENT ACT

The *Environmental Planning and Assessment Act 1979* (EP&A Act) controls land use planning in NSW. The planning system established by the EP&A Act requires that local authorities prepare an LEP and associated DCP under Part 3. These planning instruments include provisions relating to the management and protection of heritage and in particular, the LEP contains a schedule of all known heritage items within an LGA which are subject to these protections.

Heritage items are added to the heritage schedule of a LEP often following identification and assessment from a local shire heritage study. The SHI also holds local heritage items listed by local councils in NSW. These items are then given protection by the heritage provisions within the relevant plan, which will then require consent of Council for certain developments.

### 2.2.1. Wellington Local Environmental Plan 2012

The Wellington LEP (2012) identifies and protects heritage conservation areas and listed buildings/items, identifies environmentally sensitive land, and prescribes land use practices. Heritage items (if any) are listed and described in Schedule 5. Heritage conservation areas are shown on the Heritage Map as well as being described in Schedule 5.

There are a number of local heritage items in the town of Wellington, two are within 2kms of Narrawa Homestead, and Narrawa Homestead itself is listed as an item of local heritage significance on the Wellington LEP. Items located in proximity to Narrawa Homestead are:

**Table 4. LEP listed heritage items within close proximity to the proposal site**

<u>Item name</u>	<u>Location and proximity to the proposal site</u>	<u>Listing ID</u>
<b>Narrawa Homestead</b>	6916 Goolma Road, Montefiores.	I49
<b>Keston homestead</b>	6938 Goolma Road, Montefiores – Approximately 1.7km to the south of Narrawa Homestead.	I50
<b>Noonee Nyrang homestead</b>	6444 Goolma Road, Montefiores – Approximately 2.4km to the north-east of Narrawa Homestead.	I11
<b>Nanima homestead</b>	7009 Goolma Road, Montefiores – Approximately 1.7km to the south of Narrawa Homestead.	I51

Local heritage items that will be specifically addressed within this report will be limited to the Narrawa Homestead. Due to the distance to the two other locally listed homesteads, there is no assessed impact on their heritage significance.



**Figure 2. The curtilage of locally listed items within the suburb of Wellington, NSW.**



## **Heritage Conservation - LEP Clause 5.10**

Clause 5.10 of the LEP stipulates that heritage is to be conserved and managed. The objectives of Clause 1 are particularly pertinent to this report and are as follows:

- (a) to conserve the environmental heritage of Wellington,
- (b) to conserve the heritage significance of heritage items and heritage conservation areas, including associated fabric, settings and views,
- (c) to conserve archaeological sites,
- (d) to conserve Aboriginal objects and Aboriginal places of heritage significance.

### **Heritage assessment**

The consent authority may, before granting consent to any development:

- (a) on land on which a heritage item is located, or
- (b) on land that is within a heritage conservation area, or
- (c) on land that is within the vicinity of land referred to in paragraph (a) or (b),

require a heritage management document to be prepared that assesses the extent to which the carrying out of the proposed development would affect the heritage significance of the heritage item or heritage conservation area concerned.

The Wellington LEP is supported by the Wellington DCP, which provides more detailed standards and controls for specific types of development.

## **2.3. THE BURRA CHARTER**

The Australia ICOMOS (International Council on Monuments and Site) Charter for the conservation of places of cultural significance (the Burra Charter) (current edition 2013) sets a standard of practice for those who provide advice, make decisions about, or undertake works to places of cultural significance including owners, managers and custodians. The Charter is not a statutory document, but does provide specific guidance for physical and procedural actions that should occur in relation to significant places. A copy of the charter can be accessed at <http://icomos.org/australia>. This SOHI has been prepared in accordance with the Burra Charter.

An appreciation of landscape is highlighted in the 1999 revision of the Burra Charter of Australia ICOMOS, placing greater emphasis on 'setting'. Article 8 of the Burra Charter now reads:

*"Conservation requires the retention of an appropriate visual setting and other relationships that contribute to the cultural significance of the place. New construction, demolition, intrusions or other changes which would adversely affect the setting or relationships are not appropriate".*

### 3. HISTORICAL & PHYSICAL OVERVIEW

The scope of works for this SOHI did not require extensive historical research on the study area. The brief summary below and assessment of significance (Section 4) is sufficient for the purposes of providing a historical context for this particular assessment.

#### 3.1. LOCAL AREA

##### **History of Wellington**

Five years after the crossing of the Blue Mountains, explorers ventured down the lower reaches of the Macquarie River. Surveyor General John Oxley was the first European to describe the Dubbo region, with his first expedition to the Macquarie River Valley in 1817, and a second in 1818. Four years earlier George Evans had ventured along the river as far as present day Wellington, but it was Oxley who named the valley, Wellington Valley, after the Duke of Wellington who had defeated Napoleon at Waterloo in 1812. A Colonial government outpost was established in Wellington in 1819 (Porter 1947).

In 1823, Governor Brisbane sent Lieutenant Percy Simpson to establish a camp with convicts and soldiers (Gribbin 2017). It was situated about 3 km south of the present townsite of Wellington on the high ground above the Bell River (on the eastern side of the Mitchell Highway). The initial population of the camp comprised approximately 50 convicts and 30 soldiers. As the settlement became more established, the convicts were divided and designated to live in separate areas. The educated convicts were located on the Wellington side whereas the 'normal convicts' were located on the Montefiores side. Whenever the Macquarie River flooded transport of supplies to the other side proved difficult (Gass and Hiatt 2003). Simpson directed the construction of convict huts using bark and plaster as well as the construction of timber cattle yards (Gribbin 2017). By 1825, several public buildings had been constructed including the Commandment's house, a weatherboard gaol, a brick office and several other buildings (McDonald 1965). The literature also makes reference to a number of burials associated with the camp, the location of which was described as an area which was originally enclosed by wooden railings and including a pine slab which recorded the deaths of soldiers and a child dated to 1825. Good relations with the local Aboriginal community were maintained by Simpson and established in the early stages of the settlement of the area. Simpson severely punished the mistreatment of the Aboriginal people and gift exchanges for the locating of runaways or cattle were utilised (McDonald 1965; Gribbin 2017). By 1835 the prisoners were relocated, and the buildings were given to the Church Missionary Society (Porter 1947).

The camp was intended as an agricultural and penal settlement within the Wellington Valley (Gass and Hiatt 2003). The labour of the convicts provided the subsistence to satisfy the entire camp (Gribbin 2017). Rations issued from government stores were required up until the settlement became independent (Gass and Hiatt 2003). Although wheat was successfully grown, the settlement was abandoned in 1831, becoming a government stock station. The abandoned government buildings were given to the Church Missionary Society for the opening of a mission for the local Aboriginal people. When a town was later proposed, the society objected on the grounds that this would interfere with its work and its mission. It was not until after the mission closed in the 1842 that a township developed on the site and was proclaimed as the town of Wellington in 1846. Early settlement transport consisted of the weekly stage coach. It wasn't until June of 1880 that Wellington Railway Station had been built and officially opened (Gass and Hiatt 2003:127).

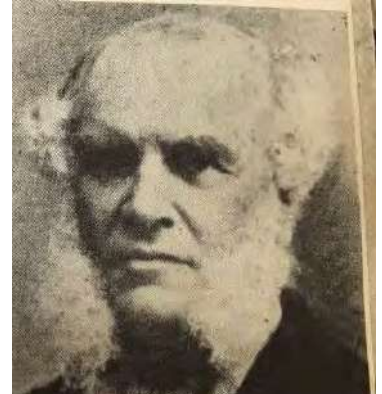
Towards the end of the 19th century, wheat farming was widespread in the Dubbo districts, fuelled by population growth and the opening up of export markets at the time of world-wide wheat shortages during 1896-7. The Central Western Slopes wheat area trebled from 1897-1906 with the greatest expansion occurring in the Wellington, Dubbo and Narromine areas.

The village of Wellington was gazetted in 1846, then in 1879 was declared an official municipal district and in 1949 declared as the Shire of Wellington (Gass and Hiatt 2003:147).

### **The Parish of Nanima and Joseph Barrow Montefiore and Joseph Aarons**

The archaeological character of the study area is summarised as an area of minimal change since early establishment, with the earliest cartographic record being the Parish of Nanima map dated 1886 located with the county of Bligh. This map details the entire proposal area as being owned by a single landowner, Joseph Barrow Montefiore.

Joseph Barrow Montefiore (1803-1893) was a financier and merchant who emigrated from London to Sydney in 1829 with his family and his business partner's family. The J.B. Montefiore & Co trading firm was then established in O'Connell Street. By 1838, Montefiore had acquired over 5059ha of land including Namina Station near Wellington (Getzler 1967). The Namina Estate is located to the north of Narrawa Homestead (covering the area where the stone culvert, stone trough and Noonee Nyrang Homestead are located). A 1952 newspaper article references the division of the Montefiore land in 1840 (The Wellington Times 1952). Namina was then leased to Dr.



**Figure 3. Joseph Barrow Montefiore - first owner of "Namina" and founder of the village of Montefiores 1840 (Gass and Hiatt 2003).**



**Figure 4. Joseph Aarons – first mayor of Wellington and owner of "Namina" (Gass and Hiatt 2003).**

Rygate, Templer and Cornish in 1839 but then sold in 1849 as part of 16,000 acres and 14,000 sheep to Joseph Aarons (Gass and Hiatt 2003).

Joseph Aarons was the first mayor of Wellington. During the drought of 1889, Aarons had to mortgage Namina but was unable to repay his loan. By 1893, half of the property was auctioned off to C.H. Barton and the new Namina homestead was then built in 1901 (Gass and Hiatt 2003).

With the use of the land being largely attributed to agricultural activities since, there is no evidence of any other structures or permanent features being constructed within the bounds of the proposal area bar the documented Narrawa Homestead.

### **Narrawa Homestead**

References to the Narrawa estate date back to 1847 (New South Wales Government Gazette 1832-1900 :534). Narrawa Homestead was built in 1908 as a large Federation Queen Anne style structure and is a reflection of the prosperity of this pre-WWI period. Since its establishment, Narrawa Homestead has been used to farm wheat,

sheep, cattle and more recently canola. Previous owners include the Katers, the Quirks and the Camerons who sold the property to the current owners, the Whites (NGH 2018). Narrawa Homestead once formed part of a group of properties which included "Kelvin", "Keston" and "Narrawa". The Inventory sheet for the homestead describes that "the Cameron family bought Narrawa, then called Kelvin, from Egelabra Stud. Keston was owned by Joe Quick. Jon White bought Kelvin from the Cameron's in 1990 and changed the name back to Narrawa". This indicates Narrawa was known as Kelvin for a short period.

The building has been classified as Queen Anne during the 1998 heritage study but that on inspection it was noted that there are few elements which could be considered Queen Anne; rather it is a Federation Vernacular house with typically federation elements such as the transom windows, pressed metal ceilings and tiled fireplaces in the interior, and red brick construction. The vernacular elements such as the broad sloped corrugated roof are reminiscent of the Colonial architecture of the earliest homesteads.



### **The Federation “Queen Anne” Architectural Style**

The term implies that the aesthetic ideas are somehow connected to the reign of Queen Anne (1702-1714). However, it is actually based on much earlier English buildings, mainly those constructed during the Elizabethan and Jacobean eras (Elizabeth I reigned 1558–1603; James I, 1603–1625).

Characteristics:

- steeply pitched visible red tiled or slate roofs,
- dormers, (attic windows),
- red brick construction (Australia),
- jettied (over-hanging) construction, (Tudor Style),
- small-paned mullioned (vertical trim) and transomed (horizontal) windows,
- windows often fitted with leaded 'lights' (Lead-light windows, not stained glass),
- tile-hung walls, (made of terracotta in England or shingle in USA and Australia),
- tall chimneys (often of the Tudor type in carved and moulded brick), and
- carefully contrived asymmetrical compositions (usually one room projects forward).

As noted above, the building has been identified as Federation Queen Anne style in the 1988 heritage study for the LEP. It is however noted that there are few elements to the building that classify the structure as Queen Anne style. Characteristics of the structure that fit within the Queen Anne style include the red brick, transom windows, and the fireplaces, however other elements including the symmetrical roof, absence of elaborate fretwork, curvature in the architecture, lack of dormer windows in the roof, and the use of corrugated iron instead of terracotta or slate suggests that the building does not fit within the Queen Anne style.

## **3.2. HISTORICAL PARISH MAPS**

Analysis of the historical parish maps surrounding the Narrawa Homestead area shows the area has remained rural and that significant development has not occurred on the property. Archaeological potential across the site is therefore associated with the current homestead and surrounding buildings and would be a reflection of domestic rural life and agricultural uses of the land.

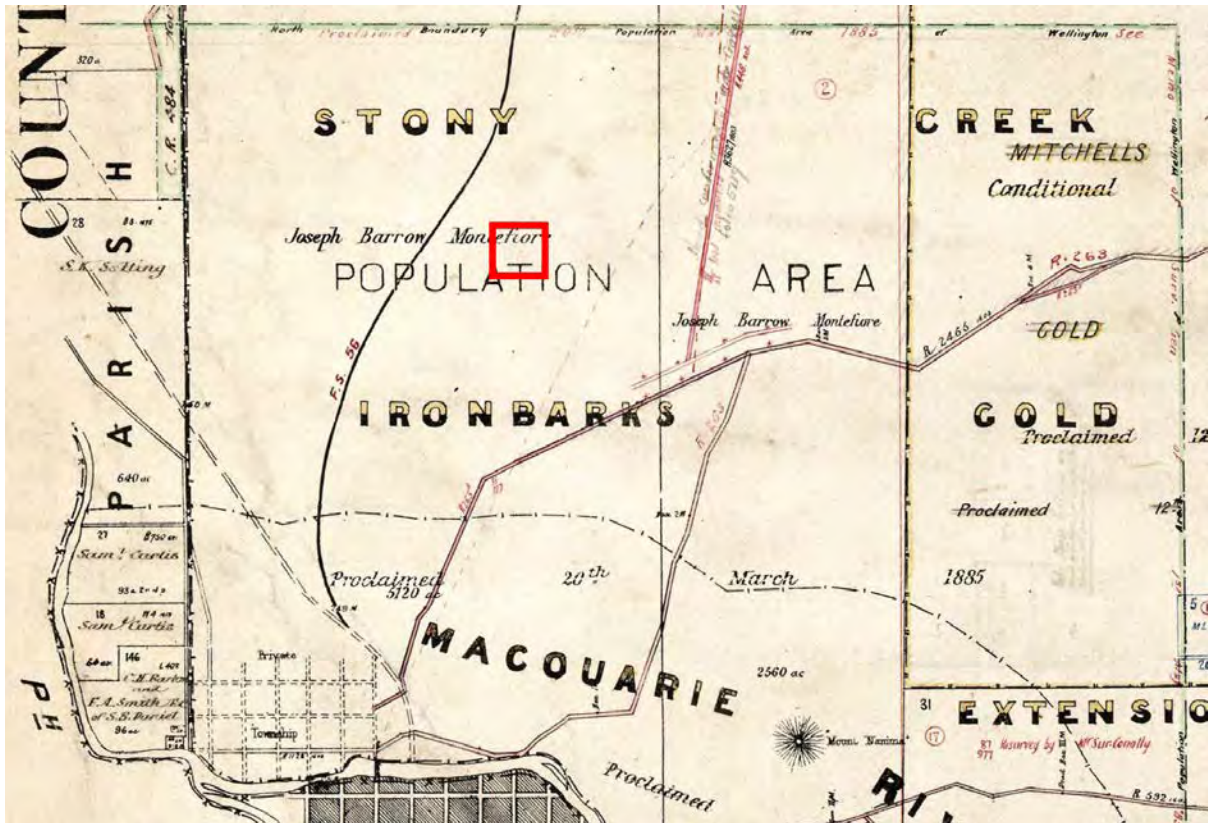


Figure 5. Historical Parish Map, County Bligh, Parish Nanima, Edition number 1, Sheet reference 1, 1886.

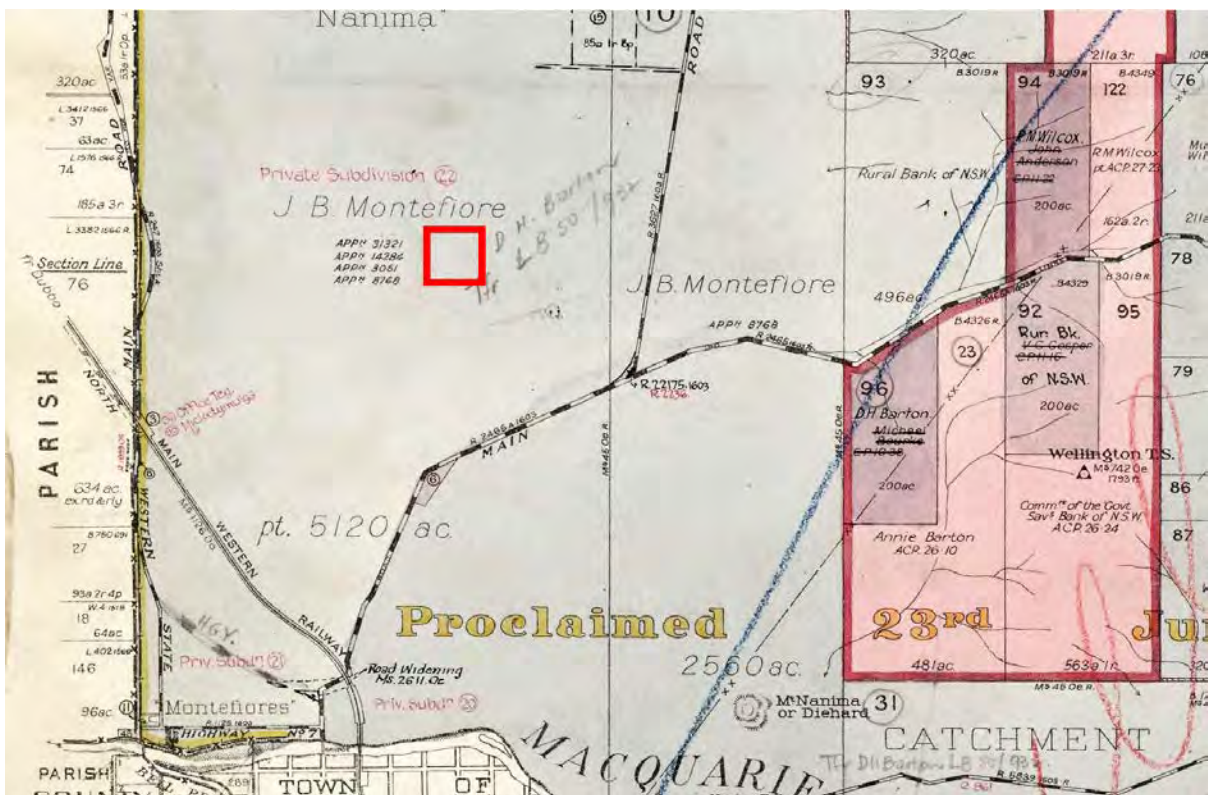


Figure 6. Historical Parish Map, County Bligh, Parish Nanima, Edition number 7, Sheet reference 1, 1937.



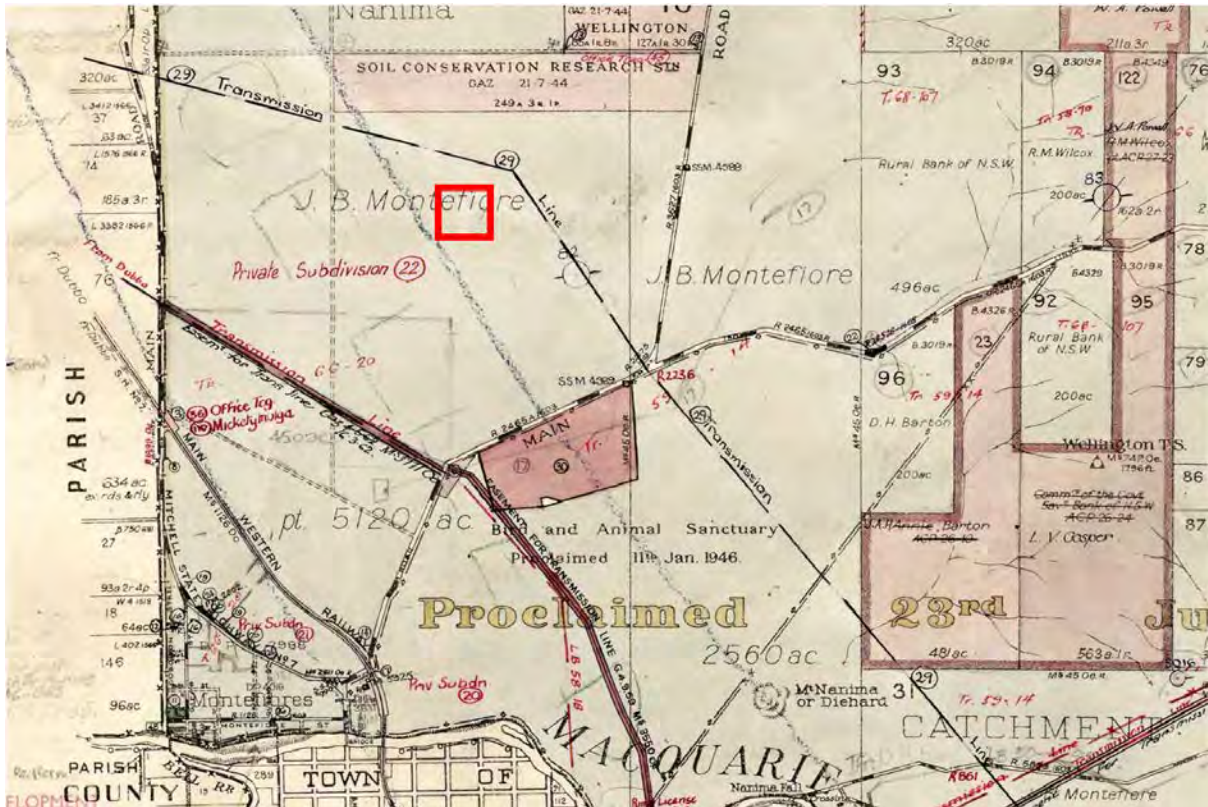


Figure 7. Historical Parish Map, County Bligh, Parish Nanima, Edition number 8, Sheet reference 1, 1956.



Figure 8. Status Branch Charting Map, County Bligh, Parish Nanima, Edition number 9, Sheet reference 1, 1970.



### **3.3. COMPARATIVE ANALYSIS**

An assessment of heritage significance, in particular rarity and representativeness, can be aided by undertaking a comparative analysis of a subject site with other similar items. A comparative analysis of the Narrawa Homestead with other homesteads in the area surrounding Wellington has therefore been undertaken.

Two other homesteads have been selected for the comparative analysis with Narrawa Homestead: Keston Homestead (aka Bella Vista), and Nanima Homestead. These homesteads were selected as they are located in close proximity to Narrawa Homestead and are listed on the Wellington LEP, and all were built within 15 years of one another.

#### **3.3.1. Keston Homestead**

Keston Homestead is located at 6938 Goolma Road, Wuuluman, approximately 1.7km to the south of Narrawa Homestead. The homestead is listed on the Wellington LEP (2012) as item 150.

##### **Description**

Keston Homestead is a locally listed property consisting of a Victorian Italianate style house, which was a common architectural style in the late Victorian period, prior to the turn of the century and the advent of Federation. Historically the homestead was built in 1897 by Henry Nancarrow who was prominent in the town and district of Wellington at the time.

The property was originally purchased from JB Montefiore by Nancarrow in 1894 when a portion of the nearby Nanima Homestead property was subdivided. The name of Keston most likely came from a village in Kent, England, the ancestral home of Nancarrow's wife.

The homestead was designed and constructed in the Victorian Italianate style which includes a decorative façade, bracketed eaves and an asymmetrical form. The internal aspect of the house has undergone significant renovations in the 1970s however it continues to retain its original features including high ceilings, double hung windows, marble fireplaces and a cellar.

A barn with an upstairs loft, a small cottage and a three privy closet are also located in the garden, all constructed of basalt stone.

##### **Statement of Significance (SHI Database Listing)**

*Keston is significantly important due to its aesthetic qualities as an example of Victorian Italianate style. Historically it was built by Nancarrow, prominent in the development of the town & district of Wellington.*

##### **Comparison with Narrawa Homestead**

Both Keston and Narrawa Homesteads were constructed around the turn of the century in the Wellington countryside and both represent the prosperity of the town at the time. Both buildings are in good condition with aesthetic gardens surrounding the homesteads, and both places have undergone significant sympathetic renovations to update them for modern usage. The structures represent the changing architecture of the time, with Keston having been constructed in the late Victorian style, while eleven years later, Narrawa was constructed in a Federation Vernacular style.

Similar to Narrawa Homestead, Keston is also listed on the Wellington Council LEP (2012) as an item of local heritage significance.

### 3.3.2. Nanima Homestead

Nanima Homestead is located at 7009 Goolma Road, Wuuluman, approximately 1.7km to the south of Narrawa Homestead. The Homestead is listed on the Wellington LEP (2012) as item I51.

#### **Description**

Constructed in 1907, Nanima Homestead is a large single storey Bungalow homestead with verandah in the Federation Queen Anne style. The homestead is situated on a prominent hill overlooking the town of Wellington and holds aesthetic qualities. The homestead is planned around a large central living hall that is lit by a lantern, with the majority of the rooms containing the original decoration and furniture in the Edwardian style. The homestead also contains a detached stable coach house and two underground tanks in good condition.

#### **Statement of Significance (SHI Database Listing), 17 May 2004**

*One of the most interesting and intact Edwardian homesteads in New South Wales. The interior is distinguished by the amount of original decoration and the large top lit central living hall. House remained in possession of the Barton family who built it in the 1970s. (The Commission is in the process of developing and/or upgrading official statements for places listed prior to 1991. The above data was mainly provided by the nominator and has not yet been revised by the Commission.)*

#### **Comparison with Narrawa Homestead**

Nanima Homestead was constructed in 1907 in the Federation Queen Anne style, one year before Narrawa Homestead was built less than 2km to the north. Both buildings are constructed in the same architectural style with both sites being in good condition, however Nanima Homestead was constructed with greater detail than Narrawa, with architectural elements such as the dormer windows, the asymmetrical composition of the structure and the extremely tall chimneys. Both houses contain interior transom windows, however the arched doorways are not present at Narrawa.

Similar to Narrawa Homestead, Nanima Homestead is also listed on the Wellington Council LEP (2012) as an item of local heritage significance. Nanima Homestead is additionally listed on the Register of the National Estate and recognised by the National Trust.

### 3.3.3. Comparative Analysis Conclusions

Narrawa Homestead is a well maintained and sympathetically restored Homestead from the pre-WWI era. Whilst in good condition, a comparative analysis of other homesteads within the Wellington region have revealed that Narrawa Homestead is not locally rare and the structure does not possess any extraordinary characteristics that differentiate it from other local homesteads in the region.

The importance of Narrawa Homestead lies within its historical, aesthetic and representative values but the site is not locally rare.

## 3.4. SITE VISIT

A site visit was carried out by NGH Heritage consultant, Ingrid Cook on 12 September 2019. This site visit involved inspection of the current internal and external condition of the homestead.

It was noted whilst on site that the current owners have undertaken significant renovations to the homestead in the early 1990s and have sympathetically reconstructed the site to a good condition. The original homestead structure included a wraparound balcony that has subsequently been partially enclosed and used to create more internal floor space in the house. Extensions have been added to the house on the north-eastern side for a master bedroom suite, as well as on the eastern side for a

kitchen and family room. An art studio has been added to the north-western corner of the building for the use of the current owners, and part of the original verandah has been enclosed and is used as an art gallery room.

The building is generally in good condition and has been well maintained and restored. The original kitchen remained untouched during the recent renovation works and maintains the original stove in situ. This area of the house displays significant deterioration of the paint and cracking within the walls that requires repairs.

### **Kitchen/Family Rooms:**



**Plate 1. Entrance to pantry from the kitchen extension.**



**Plate 2. Current kitchen island counter and benchtop. Low rise partition between the kitchen and living room. Knee-wall**



**Plate 3. Kitchen island bench and double doors out**



**Plate 4. Kitchen corner bench and terracotta tile floors.**





**Plate 5. Low partition separating the kitchen and living rooms.**



**Plate 6. Modern fireplace located in the living room.**



**Plate 7. High vaulted ceiling with scissor truss.**



**Plate 8. Large floor to ceiling sliding doors, terracotta tiling and brick wall with fireplace centred in the wall.**



**Plate 9.** External doors into front yard of house from kitchen area.



**Plate 10.** Hallway towards the formal dining room and original section of the house.

### Formal Dining Room:



**Plate 11.** Door leading towards the modern kitchen extension.



**Plate 12.** Picture rail present around the entirety of the room.



**Plate 13. Picture rail and pressed tin ceilings. Pressed metal ceilings are an element of the Federation style of building.**



**Plate 14. Original fireplace that has been refurnished.**



**Plate 15. Fireplace with hearth and flue.**



**Plate 16. View towards the original front door of the house through the formal lounge room.**





**Plate 17.** View into bedroom 2 from the dining room.



**Plate 18.** Flooring from dining room into the living room. Note the change in direction of the floor boards.

### **Formal Lounge Room:**



**Plate 19.** External door from the living room.



**Plate 20.** Original front door to the homestead.



**Plate 21.** Door through to the front bedroom 1.



**Plate 22.** Door through to the dining room from the formal lounge room.



**Plate 23.** Original fireplace refurbished. This fireplace backs onto the one in the dining room and shares the same flue.



**Plate 24.** Third external door leading to the exterior of the house from the formal lounge room.



**Plate 25.** Refurnished fireplace.



**Plate 26.** Decorative hearth in front of fireplace.



**Plate 27. Pressed tin ceilings.**



**Plate 28. Floorboards internally within the room placed perpendicular to the others. Originally the room would have included an internal wall for a hallway.**

### **Bedroom 1:**



**Plate 29. Original door leading externally to the front verandah of the house.**



**Plate 30. Original door leading externally to the side verandah of the house.**





**Plate 31. Pressed tin ceiling inside Bedroom 1.**



**Plate 32. Picture rail and high ceilings.**



**Plate 33. Picture rail and original door.**



**Plate 34. Door to bedroom would have originally led into a hallway. This internal wall has been removed during renovations to the house and the formal lounge room extended.**



**Plate 35. Picture rail and pressed tin ceilings. Pressed metal ceilings are an element of the Federation style of building.**

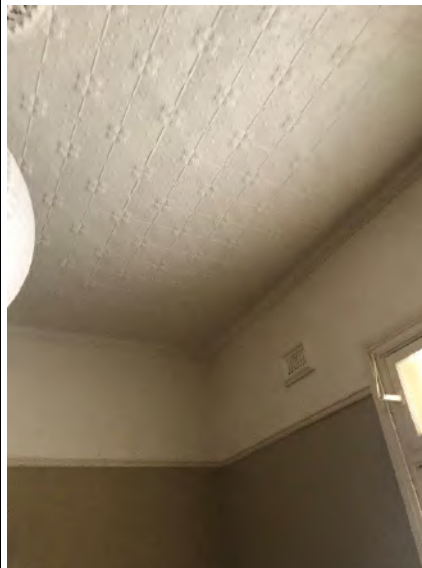


**Plate 36. Wooden floorboards.**

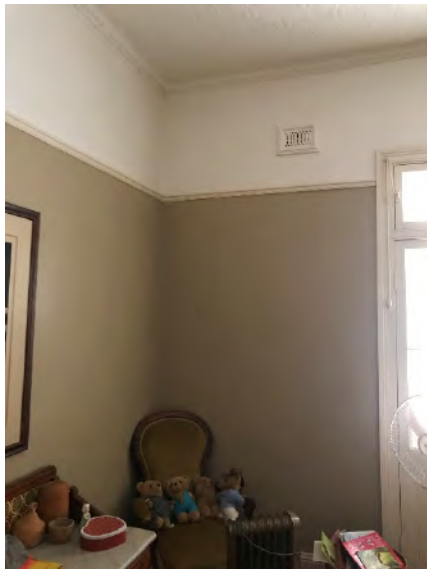
## **Bedroom 2:**



**Plate 37. Picture rail and original door**



**Plate 38. Pressed metal ceiling. Pressed metal ceilings are an element of the Federation style of building.**



**Plate 39. Wall vent and picture rail.**



**Plate 40. One door in bedroom leading externally onto the side balcony.**



**Plate 41. Picture rail and pressed tin roof.**



**Plate 42. Picture rail and original doorway.**





**Plate 43. Original door.**



**Plate 44. Hardwood flooring in the bedroom carries through from the dining room.**

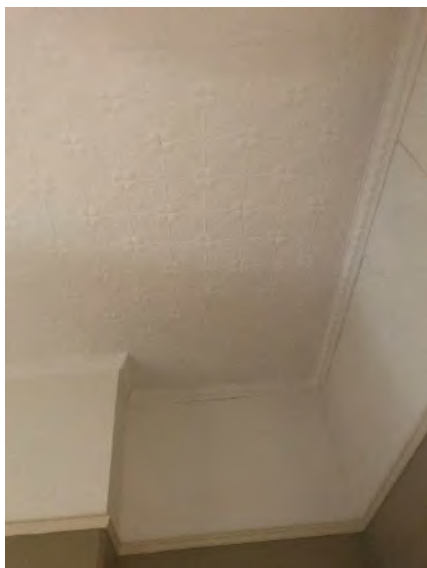
### **Bedroom 3 and small enclosed verandah ante-chamber:**



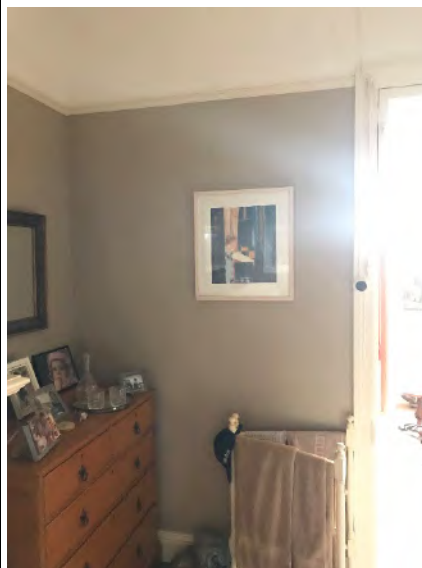
**Plate 45. Original fireplace and flue that has been restored.**



**Plate 46. Internal wall next to the fireplace.**



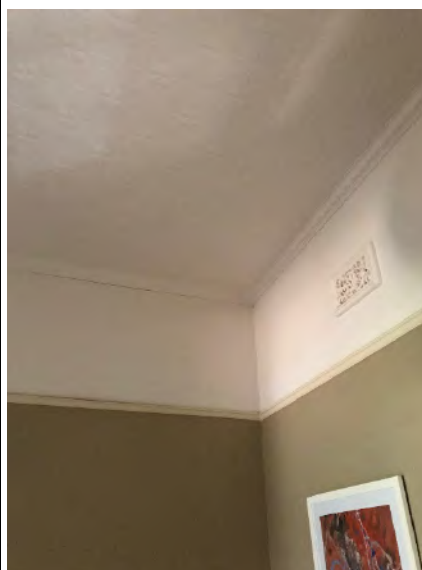
**Plate 47. Picture rail and pressed tin roof.**



**Plate 48. Picture rail and doorway towards the current art gallery.**



**Plate 49. Minor cracking near the wall vent.**



**Plate 50. Pressed tin roof. Pressed metal ceilings are an element of the Federation style of building.**



**Plate 51.** Original door that would have originally led onto the external verandah but that currently leads onto a small ante-chamber storage room.



**Plate 52.** Original external door and original (refurbished) fireplace.



**Plate 53.** Polished wooden floors of bedroom led into rough floorboards in the ante-chamber, formerly part of the verandah.



**Plate 54.** Door in ante-chamber leading to the outside verandah.





**Plate 55. Fibro walls of the ante-chamber room.** This area would have been originally part of the wrap around verandah of the house. The area was subsequently enclosed to provide additional floorspace internally.



**Plate 56. Windows that were installed during the enclosure of the verandah.**



**Plate 57. Slanted roof within the ante-chamber following the original verandah roofline.**



**Plate 58. The original external brick wall of the house.**



**Plate 59. Original external doorway.**



**Plate 60. Doorway leading into the bedroom and externally onto the side verandah.**

**Bedroom 4 (former kitchen) and small enclosed verandah ante-chamber:**



**Plate 61. Checked lino in the original homestead kitchen.**



**Plate 62. Wall shelving and original fireplace.**



**Plate 63.** Original kitchen fireplace. This fireplace backs onto the fireplace in bedroom 3 and shares the same flue.



**Plate 64.** Substantial cracking present on the doorway arch originally leading externally onto the verandah. The verandah off the original kitchen has been enclosed and is now a small bedroom.



**Plate 65.** Original fireplace with original stove in situ.



**Plate 66.** Original fireplace with original stove in situ.





**Plate 67. Substantial cracking over the door arch leading to bedroom 4.**



**Plate 68. Pressed tin ceilings. Pressed metal ceilings are an element of the Federation style of building.**



**Plate 69. Cracked concrete step leading from lino-lined kitchen onto the rough hardwood floor of bedroom 4.**



**Plate 70. Peeling ceiling and wall paint in bedroom 4 off the original kitchen.**



**Plate 71. Windows that were installed with the enclosure of the balcony.**



**Plate 72. Peeling ceiling paint.**



**Plate 73. Original brick external wall and slanting roof of the verandah enclosed to create additional internal floorspace in the homestead.**



**Plate 74. Original external doorway to the verandah removed and replaced with a wider doorframe.**

**Art Gallery and Bathroom:**



**Plate 75.** Original external brick wall of the homestead with external door and window. The original wrap-around balcony has subsequently been enclosed and used for an art gallery.



**Plate 76.** Original external wall vent partially covered by the new fibro ceiling installed in the gallery.



**Plate 77.** Weatherboard bathroom extension.



**Plate 78.** Verandah was originally enclosed in fibro sheeting. The current owners removed the fibro and replaced it with floor to ceiling windows.





**Plate 79.** Fibro ceilings, floor to ceiling windows and carpeted floors.



**Plate 80.** Slanted roof indicative of the original use of the area as a verandah.



**Plate 81.** Slanted roof indicative of the original use of the area as a verandah.



**Plate 82.** Original external door leading from bedroom 3 onto the original verandah.



**Plate 83.** Carpeted floor in the art gallery with a step up towards the hardwood floor of the dining room.



**Plate 84.** Hallway leading towards the study and master bedroom wing.



**Plate 85.** Bathroom extension.



**Plate 86.** Tiled floors of the bathroom extension.



**Plate 87. Bathroom extension**



**Plate 88. Countertop in bathroom extension.**

**Study:**



**Plate 89. Sliding door leading into the laundry and door towards art studio.**



**Plate 90. Fibro study with hardwood floors.**





**Plate 91. Fibro study.**



**Plate 92. Doorway into the art gallery and the master bedroom suite.**

### Laundry:



**Plate 93. Laundry extension.**



**Plate 94. Laundry extension.**



**Plate 95. External door.**



**Plate 96. Internal laundry windows.**



**Plate 97. Cracked concrete floor.**

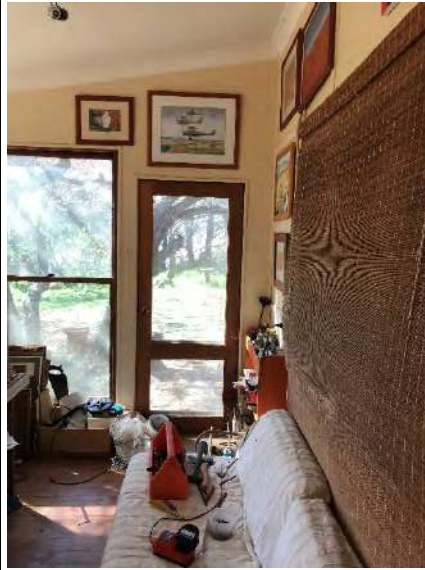


**Plate 98. Wooden door leading externally.**

**Art Studio:**



**Plate 99. Art studio from the study.**



**Plate 100. Door leading externally towards the back garden.**



**Plate 101. Slanted roof of the art studio.**



**Plate 102. Floor to ceiling windows.**





**Plate 103. Fibro walls and floor to ceiling windows.**



**Plate 104. Doorway into the homestead study.**

### **Master Bedroom:**



**Plate 105. Brick walled bedroom extension from the original house.**



**Plate 106. Wooden roof slats and brick walls.**



**Plate 107. High vaulted ceilings and large doors leading to the external gardens.**



**Plate 108. Doorway towards the hallway from the Master bedroom.**

### **Master Bedroom Ensuite/ Walk-in Wardrobe:**



**Plate 109. Ensuite bathroom.**



**Plate 110. Door leading externally from ensuite bathroom.**



**Plate 111. Tiled bathroom floor.**



**Plate 112. Shelving in walk-in-wardrobe.**

### **External Photographs of the House:**



**Plate 113. Western façade of Narrawa Homestead.**  
The short chimney on this side of the homestead is not in line with the traditional Queen Anne style.



**Plate 114. Stairs leading onto the verandah. Facing Along the southern (front) façade of the house.**  
Queen Anne style architecture usually includes considerable decorative elements along the balcony.



Of H



**Plate 115.** Western side of the house with part of the verandah enclosed to create more internal floor space. Note the absence of decorative woodwork. The posts supporting the verandah are square and do not contain any specific wood patterns. In contrast Nanima homestead has some carving work on its verandah posts and some decorative wood patterns on the protruding gable at the front.



**Plate 116.** Deteriorated section of some of the hardwood decking on the verandah surrounding the house.



**Plate 117.** Facing along the western verandah towards the enclosed section of the verandah.



**Plate 118.** External original window along western façade of the house. Decorative brick arch above the window.



**Plate 119.** Door leading into a section of the enclosed verandah.



**Plate 120.** View south along the western verandah from the enclosed section. No decorative elements along the balcony.



**Plate 121.** View east along southern (front) façade of the house.



**Plate 122.** Meter box situated on the southern (front) façade of the house.





**Plate 123. Current electrical wiring along the southern (front) façade of the homestead.**



**Plate 124. Original southern (front) façade of the house. An additional extension has been added to the eastern side of the house (not pictured).**

The taller chimney is an element of the Queen Anne style architecture, however the height of the chimney is still not comparable to the height of the chimneys at Nanima.



**Plate 125. Southern (front) façade of Narrawa Homestead facing north-west. Modern extension on the eastern façade of the house, set back from the original.**



**Plate 126. Facing north along the eastern façade of the original house towards the modern kitchen and living room extension.**





**Plate 127. Facing north along the eastern façade of the original house towards the modern kitchen and living room extension.**



**Plate 128. Decking along the southern verandah. Some areas of deterioration and splintering.**



**Plate 129. Decking along the southern verandah has deteriorated and begun splintering apart**



**Plate 130. Section of the deck along the southern (front) façade that has required replacement due to deterioration. Lack of decorative elements along the verandah.**



**Plate 131.** Deteriorated section of the timber verandah decking.



**Plate 132.** Fibro roof sheeting along the verandah requires replacement due to deterioration.



**Plate 133.** Kitchen extension on the eastern façade of the building. The sandstock bricks used in the extension were sourced from a property on Dubbo.



**Plate 134.** Southern façade of kitchen extension.





**Plate 135. Bricks creating a step up onto the timber verandah.**



**Plate 136. Eastern façade of the homestead with the kitchen extension.**



**Plate 137. Kitchen extension.**



**Plate 138. Eastern façade of the homestead.**





**Plate 139. Courtyard between the kitchen extension, master bed extension, and art gallery.**



**Plate 140. Courtyard facing west towards the art gallery.**



**Plate 141. Awning outside of the kitchen extension in the courtyard.**



**Plate 142. Courtyard facing west towards the art gallery.**





**Plate 143. Art gallery and master bedroom extension.**



**Plate 144. Art gallery from the courtyard.**



**Plate 145. Eastern façade of the house featuring both the kitchen and master bedroom extensions.**



**Plate 146. Northern façade of the master bedroom extension.**



**Plate 147. Fibro laundry next to brick master bedroom extension and weatherboard art studio.**



**Plate 148. Weatherboard art studio.**





**Plate 149. Northern façade of weatherboard art studio**



**Plate 150. The weatherboard art studio situated in the north-western corner of the homestead. Note the differing roofline to the original house.**



**Plate 151. Bricks placed around the edge of the art studio extension.**



**Plate 152. Awning outside of the art gallery extension on the western façade.**





**Plate 153. Western façade of the weatherboard art gallery extension. Note the change in the roofline. Art studio is situated just to the north of the enclosed verandah area.**



**Plate 154. Enclosed verandah area along western façade of homestead.**



**Plate 155. Deteriorated windows within the enclosed verandah section of the homestead.**



**Plate 156. Awning outside of the enclosed verandah area on the western façade of the homestead.**



**Plate 157. Enclosed verandah along the western façade of the homestead.**



**Plate 158. Western façade of the homestead.**



**Plate 159. Corrugated metal shed (shed 1) in proximity to the homestead.**



**Plate 160. Corrugated metal shed (shed 2) in proximity to the homestead.**



**Plate 161. Corrugated metal shed (shed 2) in proximity to the homestead.**



**Plate 162. Corrugated metal shed (shed 2) in proximity to the homestead.**





**Plate 163. Stone wall in proximity to the homestead building.**



**Plate 164. Facing north-east towards the homestead. The palm tree is a classic planting for homesteads in this period.**



**Plate 165. Corrugated metal shed located outside of the immediate vicinity of the homestead building.**



**Plate 166. Corrugated metal shed located outside of the immediate vicinity of the homestead building.**



**Plate 167. Corrugated metal shed located outside of the immediate vicinity of the homestead building.**



**Plate 168. Corrugated metal shed located outside of the immediate vicinity of the homestead building.**





**Plate 169. Corrugated metal shed located outside of the immediate vicinity of the homestead building.**



**Plate 170. Corrugated metal shed located outside of the immediate vicinity of the homestead building.**



**Plate 171. Cattle yards and shed located outside of the immediate vicinity of the homestead building.**



**Plate 172. Corrugated metal shed located outside of the immediate vicinity of the homestead building.**



**Plate 173. Corrugated metal shed located outside of the immediate vicinity of the homestead building.**



**Plate 174. Corrugated metal shed located outside of the immediate vicinity of the homestead building.**



**Plate 175. Corrugated metal shed located outside of the immediate vicinity of the homestead building.**



**Plate 176. Cattle yards and shed in proximity to the homestead located outside of the immediate vicinity of the homestead building.**

## 4. HERITAGE SIGNIFICANCE

### 4.1. INTRODUCTION

'Heritage significance' is a term used to describe the inherent cultural and historical value of an item. Significance may be contained within the fabric of a building or other place, in its setting and its relationship with other nearby items.

The main aim in assessing significance is to produce a succinct statement of significance, which summarises an item's heritage values. The statement is the basis for policies and management structures that will affect the item's future (NSW Heritage 2001).

The NSW Heritage Division recommends assessment of heritage items in a number of situations, which include:

- Making decisions about whether to retain an item.
- Considering changes to an item.
- Preparing a heritage study.
- Preparing a conservation management plan.
- Considering an item for listing on the State Heritage Register or on the schedule of heritage items in a local environmental plan.
- Preparing a statement of environmental effects or a heritage impact statement as part of the development and building approval process.

The following assessment of significance is based on the NSW heritage assessment criteria. The criteria encompass the four values in the Australia ICOMOS Burra Charter (1999), which are commonly accepted as generic values by Australian heritage agencies and professional consultants:

- Historical significance.
- Aesthetic significance.
- Scientific significance.
- Social significance.

The above are expressed as criteria in a more detailed form than this to:

- Maintain consistency with the criteria of other Australian heritage agencies.
- Minimise ambiguity during the assessment process.
- Avoid the legal misinterpretation of the completed assessments of listed items.

### 4.2. HERITAGE ASSESSMENT CRITERIA

#### ***Assessments of Significance***

The following assessment follows the guidelines set out by the NSW Heritage Division and the principles of the Australia's ICOMOS Burra Charter.

The guideline '*Assessing Heritage Significance*' (Heritage Office (former), 2001) states that an item will be considered to be of state and/or local heritage significance if it meets one or more of the NSW Heritage Assessment Criteria, below:



Table 5. NSW Heritage Assessment Criteria

Criteria	Description
<b>Criterion (a)</b>	An item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area);
<b>Criterion (b)</b>	An item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area);
<b>Criterion (c)</b>	An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area);
<b>Criterion (d)</b>	An item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons;
<b>Criterion (e)</b>	An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area);
<b>Criterion (f)</b>	An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area);
<b>Criterion (g)</b>	An item is important in demonstrating the principal characteristics of a class of NSW's <ul style="list-style-type: none"> <li>• cultural or natural places; or</li> <li>• cultural or natural environments.</li> </ul> (or a class of the local area's <ul style="list-style-type: none"> <li>• cultural or natural places; or</li> <li>• cultural or natural environments.)</li> </ul>

In order to undertake an assessment of an item against the NSW heritage assessment criteria, the OEH guidelines recommend that the following steps be undertaken:

- Investigate the historical context of the item or study area;
- Investigate the community's understanding of the item;
- Establish local historical themes and relate them to the State themes;
- Investigate the history of the item; and
- Investigate the fabric of the item.

### 4.3. NSW HISTORICAL THEMES

An historical theme is a way of describing a major force or process which has contributed to history. Historical themes provide a context within which the heritage significance of an item can be understood, assessed and compared. In using themes to assess heritage items and places it is useful to identify both local or regional themes applying to the item and the broader state theme to which the local or regional theme relates.

The following table shows the correlation between national and state heritage themes with those relating to Narrawa Homestead. This table has been adapted from a document produced by the Heritage Council of NSW in 2001: *New South Wales Historical Themes*.

**Table 6. NSW Historic Themes and Narrawa Homestead.**

Australian Theme	NSW Theme	Description	Examples	Narrawa Homestead
<b>3 Developing local, regional and national economies</b>	Agriculture	Activities relating to the cultivation and rearing of plant and animal species, usually for commercial purposes, can include aquaculture	Hay barn, wheat harvester, silo, dairy, rural landscape, plantation, vineyard, farmstead, shelterbelt, silage pit, fencing, plough markings, shed, fish farm, orchard, market garden, piggery, common, irrigation ditch, Aboriginal seasonal picking camp.	Narrawa Homestead includes a residential structure as well as surrounding farm buildings for storage of farming equipment. Built in 1908, Narrawa Homestead has been a working farm associated with agriculture and pastoralism.
<b>3 Developing local, regional and national economies</b>	Environment - cultural Landscape	Activities associated with the interactions between humans, human societies and the shaping of their physical surroundings	A landscape type, bushfire fighting equipment, soil conservation structures, national park, nature reserve, market garden, land clearing tools, evidence of Aboriginal land management, avenue of trees, surf beach, fishing spot, plantation, place important in arguments for nature or cultural heritage conservation.	The driveway entrance to Narrawa Homestead includes an impressive planting of trees on either side of the private road. These trees frame the entrance to the homestead and provide a notable entrance to the property.  This reflects the social and economic standing of the owner of the homestead at the time of the planting.

<p><b>3</b> <b>Developing local, regional and national economies</b></p>	<p>Pastoralism</p>	<p>Activities associated with the breeding, raising, processing and distribution of livestock for human use</p>	<p>Pastoral station, shearing shed, slaughter yard, stud book, photos of prizewinning stock, homestead, pastoral landscape, common, fencing, grassland, well, water trough, freezer boat shipwreck, wool store.</p>	<p>Narrawa Homestead includes a residential structure as well as surrounding farm buildings for storage of farming equipment. Built in 1908, Narrawa Homestead has been a working farm associated with agriculture and pastoralism.</p> <p>The majority of Narrawa Homestead has been historically utilised for agricultural purposes, with a large portion of this being in association with the breeding, raising, processing and distribution of livestock for human use. There is also evidence of stock yards and a possible 'separation' shed for dairying associated with the Narrawa Homestead.</p>
<p><b>4</b> <b>Building settlements, towns and cities</b></p>	<p>Accommodation</p>	<p>Activities associated with the provision of accommodation, and particular types of accommodation – does not include architectural styles – use the theme of Creative Endeavour for such activities.</p>	<p>Terrace, apartment, semi-detached house, holiday house, hostel, bungalow, mansion, shack, house boat, caravan, cave, humpy, migrant hostel, homestead, cottage, house site (archaeological).</p>	<p>Narrawa Homestead is a significant pre-war homestead in the rural countryside. The original layout of the house can still be easily identified and demonstrates the original character of the house.</p> <p>Narrawa Homestead is one of a number of surviving early 20<sup>th</sup> century homes that were built during a period of prosperity within the region.</p>
<p><b>8</b> <b>Culture – Developing cultural institutions and ways of life</b></p>	<p>Domestic life</p>	<p>Activities associated with creating, maintaining, living in and working around houses and institutions.</p>	<p>Domestic artefact scatter, kitchen furnishings, bed, clothing, garden tools, shed, arrangement of interior rooms, kitchen garden, pet grave, chicken coop, home office, road camp, barrack, asylum.</p>	<p>Narrawa Homestead underwent significant renovations and extensions in the early 1990s, however the original layout of the house continues to remain clearly identifiable. The original kitchen room has not been altered by the update works and contains the original stove in situ.</p>



## 4.4. HERITAGE ASSESSMENT

In this section, the Narrawa Homestead is assessed against the seven NSW Heritage Significance criteria listed in Section 4.2 (Table 5) per the guidelines provided below. No other items of heritage significance are located within the impact zone of proposed works.

### 4.4.1. Criterion (a) – Historical:

**An item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area)**

**Guidelines for the inclusion or exclusion of an item as being of state or local heritage significance against criterion (a)**

**Guidelines for INCLUSION:**

- shows evidence of a significant human activity
- is associated with a significant activity or historical phase
- maintains or shows the continuity of a historical process or activity

**Guidelines for EXCLUSION:**

- has incidental or unsubstantiated connections with historically important activities or processes
- provides evidence of activities or processes that are of dubious historical importance
- has been so altered that it can no longer provide evidence of a particular association

### Narrawa Homestead:

Narrawa Homestead was constructed in 1908 in the Federation Style. The homestead has been restored in the 1990s with sympathetic additions and is in overall good condition.

The homestead is historically important as an example of a type of residence erected on prosperous country properties pre WWI.

*Narrawa Homestead meets criterion (a) at a local level.*

### 4.4.2. Criterion (b) – Associative:

**An item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area)**

**Guidelines for the inclusion or exclusion of an item as being of state or local heritage significance against criterion (b)**

**Guidelines for INCLUSION:**

- shows evidence of a significant human occupation
- is associated with a significant event, person, or group of persons

**Guidelines for EXCLUSION:**

- has incidental or unsubstantiated connections with historically important people or events
- provides evidence of people or events that are of dubious historical importance
- has been so altered that it can no longer provide evidence of a particular association

**Narrawa Homestead:**

Whilst Narrawa Homestead was owned by a locally well-known artist (Jon White) prior to its acquisition by Lightsource BP, Narrawa Homestead does not have any significant associations with historically important people or events and does therefore not hold any specific associative significance.

*Narrawa Homestead does not meet criterion (b) at a local or State level.*

**4.4.3. Criterion (c) – Aesthetic/Technical:**

*An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area)*

**Guidelines for the inclusion or exclusion of an item as being of state or local heritage significance against criterion (c)**
**Guidelines for INCLUSION:**

- shows or is associated with, creative or technical innovation or achievement
- is the inspiration for a creative or technical innovation or achievement
- is aesthetically distinctive
- has landmark qualities
- exemplifies a particular taste, style or technology

**Guidelines for EXCLUSION:**

- is not a major work by an important designer or artist
- has lost its design or technical integrity
- its positive visual or sensory appeal or landmark and scenic qualities have been more than temporarily degraded
- has only a loose association with a creative or technical achievement

**Narrawa Homestead:**

Narrawa Homestead has been constructed in the Federation style which includes sympathetic additions to the house that were carried out using sandstone bricks sourced from an old building in Dubbo to match the original house (Narrawa Homestead Inventory Sheet).

The homestead has adopted architectural styles of the federation period while also utilising design elements from the past, including the use of corrugated iron for the roof.

The homestead is in good condition and has been well restored. The gardens surrounding the homestead were designed to complement the house and provide a good visual setting.

*Narrawa Homestead meets criterion (c) at a local level.*

#### 4.4.4. Criterion (d) – Social:

*An item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons*

**Guidelines for the inclusion or exclusion of an item as being of state or local heritage significance against criterion (d)**

**Guidelines for INCLUSION:**

- is important for its associations with an identifiable group
- is important to a community's sense of place

**Guidelines for EXCLUSION:**

- is only important to the community for amenity reasons
- is retained only in preference to a proposed alternative

#### **Narrawa Homestead:**

Narrawa Homestead is a private residential building and does not hold any specific associations with any identifiable group or community and does therefore not hold any identifiable social significance.

*Narrawa Homestead does not meet criterion (d) at a local or State level.*

#### 4.4.5. Criterion (e) – Research

*An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area)*

**Guidelines for the inclusion or exclusion of an item as being of state or local heritage significance against criterion (e)**

**Guidelines for INCLUSION:**

- has the potential to yield new or further substantial scientific and/or archaeological information
- is an important benchmark or reference site or type
- provides evidence of past human cultures that is unavailable elsewhere

**Guidelines for EXCLUSION:**

- the knowledge gained would be irrelevant to research on science, human history or culture
- has little archaeological or research potential
- only contains information that is readily available from other resources or archaeological sites

#### **Narrawa Homestead:**

It has not been identified that there have been additional substantial buildings surrounding the homestead that are no longer extant. Any archaeological potential around the Narrawa Homestead would therefore be associated with the residential use of the property from 1908. The agricultural



sheds surrounding the house also have potential to reveal farming or agricultural deposits associated with the working life of the farm.

The gardens immediately surrounding the house are well maintained and manicured and are unlikely to reveal any significant archaeological deposits. Beyond the maintained gardens there is greater potential for archaeological potential to occur.

As no remains of any significant buildings are expected to occur on site, and any potential archaeological deposits would be associated with the residential use of the house, research potential of the house is currently limited. Any archaeological remains that were unearthed during the works would require specific heritage assessment to determine their heritage significance.

*Narrawa Homestead does not meet criterion (e) at a local level.*

#### **4.4.6. Criterion (f) – Rarity**

***An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area)***

**Guidelines for the inclusion or exclusion of an item as being of state or local heritage significance against criterion (f)**

**Guidelines for INCLUSION:**

• provides evidence of a defunct custom, way of life or process • demonstrates a process, custom or other human activity that is in danger of being lost • shows unusually accurate evidence of a significant human activity • is the only example of its type • demonstrates designs or techniques of exceptional interest • shows rare evidence of a significant human activity important to a community

**Guidelines for EXCLUSION:**

• is not rare • is numerous but under threat

#### **Narrawa Homestead:**

Narrawa Homestead is one of 15 homesteads currently listed on the Wellington LEP (2012). The homestead is therefore not a rare example of a pre WWI homestead and does not meet this criterion at a local or State level.

*Narrawa Homestead does not meet criterion (f) at a local or State level.*

#### **4.5. CRITERION (G) – REPRESENTATIVE:**

***An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places; or cultural or natural environments. (or a class of the local area's)***

**Guidelines for the inclusion or exclusion of an item as being of state or local heritage significance against criterion (g)**

**Guidelines for INCLUSION:**

• is a fine example of its type • has the principal characteristics of an important class or group of items • has attributes typical of a particular way of life, philosophy, custom, significant process, design, technique or activity • is a significant variation to a class of items • is part of a group which collectively illustrates a representative type • is outstanding because of its setting, condition or size • is outstanding because of its integrity or the esteem in which it is held

**Guidelines for EXCLUSION:**

• is a poor example of its type • does not include or has lost the range of characteristics of a type • does not represent well the characteristics that make up a significant variation of a type

**Narrawa Homestead:**

Narrawa Homestead is a good representation of a pre WWI country homestead residence that has been sympathetically restored with complementary gardens. Whilst previously identified on the LEP inventory sheet as a Queen Anne style building, it has been determined that the homestead holds the architectural values of the Federation Vernacular style.

*Narrawa Homestead meets criterion (g) at a local level.*

## **4.6. STATEMENT OF SIGNIFICANCE**

The following statement of heritage significance is taken from the Narrawa Homestead Wellington LEP Heritage Inventory Sheet. The NGH assessment of Narrawa Homestead against the NSW Heritage Significance criteria in the preceding section supports the existing heritage significance statement for the homestead, and so no new assessment of significance is required for this report.

### **4.6.1. Narrawa Homestead**

Built in 1908 Narrawa Homestead is a typical large Federation country home with Federation features in its ceilings, joinery and detail. The homestead has been sympathetically restored with additions that are similar in form and style to the original homestead and do not detract from the significance of the original house. The homestead is set in a complimentary garden setting in keeping with the ambience of the house.

The homestead is historically significant as an example of a type of residence erected on prosperous country properties pre WWI, as well as being aesthetically and representatively significant as a well-maintained federation style building.



## 5. IMPACT ASSESSMENT

### 5.1. PROPOSED DEVELOPMENT

Lightsource BP is the proponent of the Wellington Solar Farm, which will require an Operations and Maintenance (O&M) building. Lighthouse BP is evaluating the option of adaptively reusing the homestead to be used as the O&M building.

The Scope of Works includes the alteration to the homestead for the purpose of a change of use to offices with amenities. This includes:

- External Demolition:
  - Remove hot water unit.
  - Remove corrugated iron roof sheeting, timber roof battens, flashings, gutters and downpipes.
  - Remove foliage to pergola to the Eastern Court Yard.
  - Remove foliage to the East of Bedroom 1.
  - Remove foliage to the North of Bedroom 1 & Ensuite.
  - Remove architraves, cover moulds and fascia/barge boards to asbestos cladding to the external face of the Laundry external WC walls and walls to Western enclosed verandah, in preparation for over-sheeting with fibrous cement sheeting.
  - Electrical:
    - Remove the asbestos backed switchboard to the Southern corner of the house.
    - Remove solar panels from roof.
    - Remove the overhead power supply to the Southern corner of the Verandah.
  - Plumbing:
    - Disconnect and remove hot water unit.
    - Disconnect and seal off water supply and plumbing to abandoned fixtures.
  - Verandah:
    - Remove floor boards to the Southern wrap around Verandah.
    - Remove raked asbestos cement ceiling to the Southern wrap around Verandah.
- Internal Demolition:
  - Kitchen & Eastern Lounge Room (modern extension).
    - Remove Kitchen benches, tops and appliances.
    - Remove pantry shelving.
    - Remove ceramic floor tiles to the Kitchen and adjacent Eastern Lounge Room.
  - Ensuite & Walk-in Robe.
    - Remove Ensuite fixtures and fittings.
    - Remove glass to external hinged door.
    - Remove floor and wall tiles.
    - Remove architraves to windows and doors
    - Remove internal door
    - Remove shelving to walk-in robe.
  - Laundry, Shower and External WC:
    - Remove Laundry tub, brick fireplace/chimney, shower partition wall, WC suite, fixtures and fittings.
    - Remove architraves to windows and doors.
    - Remove external doors and door frames to Laundry and External WC.

- Bedroom 1, Walk-in Robe and Hallway from Bedroom to Dining Room:
  - Remove and dispose of carpet.
- Bathroom Adjacent Dining Room:
  - Remove shower screen, WC suite, vanity unit, fixtures and fittings.
  - Remove floor and wall tiles.
- Carpet to Main Bedroom Hallway and Walk-in Robe:
  - Remove carpet to Main Bedroom, Hallway and Walk-in Robe.
- Original Kitchen:
  - Remove sheet vinyl flooring, which may contain asbestos.
- Enclosed Rooms to Verandah:
  - Carefully remove the decorative architraves and set aside for re-use to the 2No. enclosed rooms to the Western verandah, remove cover moulds to asbestos wall and ceiling linings, in preparation for over-sheeting with plasterboard sheeting.
- Concrete
  - Concrete to pads for isolated brick piers
  - Provide new pad footings to new brick piers as necessary to make good the Southern Verandah.
  - Excavate, pour and place 20Mpa concrete to give full compaction, to pad footings as necessary to support new floor framing in the area where the concrete hearth has been removed.
- Brickworks:
  - Pointing to Verandah sub-floor brickwork.
  - 230 x 230mm common brick isolated piers to the repair of the Southern Verandah.
  - Ant capping.
  - Brickwork shall be in stretcher bond with 10mm raked joints.
- Carpentry and Joinery
  - The extent of works are generally as described below, including incidental work not specifically mentioned but integral to the completion of the works: -
    - Roof battens
    - Floor Framing & Flooring Verandah
    - External Wall Linings
    - Skirtings and Architraves
    - Fascias & Bargeboards
    - External Doors & Frames
    - Internal Door & Frames
    - Door Furniture
    - Kitchen Cupboards & Tops
    - Vanity Cupboards & Top
    - Sink Cupboard to First Aid Room
    - Shelving to Stores.
- Roofing and roof plumbing
  - Extent of works shall include, but not be limited to the following: -
    - Colorbond corrugated iron hipped main roof.
    - Colorbond corrugated iron verandah roof.
    - Colorbond rolled top ridge and hip flashings.
    - Colorbond quad gutters and Colorbond downpipes.
    - Colorbond rainwater head.
- Wall and Ceiling finishes
  - Plasterboard ceiling linings to Ensuite, Walk-in Robe, Bathroom, Laundry External WC and Enclosed Rooms to Western Verandah.

- Fibrous cement wall linings to Ensuite, Bathroom, Laundry and External WC.
  - Coved cornice.
  - Insulation.
  - Ceramic wall tiles.
- Floor finishes
  - Ceramic floor tiles.
  - Threshold tiles.
  - Carpet.
  - Sheet vinyl flooring.
- Electrical
  - Provide and install a new underground single phase mains power supply, including connection to the new switchboard.
  - Supply and install a new wall mounted switchboard in and including an approved metal metre box, complete with all necessary circuit breakers, meter bases, etc., to the approval of the local supply authority.
  - Allow to test and replace as necessary, all faulty power points, new power and data points to suit workstation, light points, switches, wiring to light fittings, wiring and circuits back to the board.
  - Provide and install 4No. split reverse cycle air-conditioning units as necessary to provide adequate heating and cooling to the entire house,
- Plumbing and Drainage
  - Excavation and Backfilling.
  - Stormwater Drainage.
  - Sewer Drainage.
  - Existing Septic Tank.
  - Domestic Hot and Cold Water.
  - Sanitary Plumbing, Fixtures and Fittings.
  - Tapware.
- Painting
  - External
    - All existing and new painted surfaces.
  - New Verandah Flooring
    - Approved tongue oil applied as recommended by the manufacturer.
  - Internally
    - Paint all walls, ceilings, doors, doorframes, skirtings, architraves and trims to the entire house. Stain existing stained timber surfaces.
  - Internal Timber Floor.
    - Allow to sand and polish the existing tongue & grooved timber floors to Southern Lounge Room, Dining Room, Bedrooms 2, 3 and 4.



## **5.2. HERITAGE IMPACT CONSIDERATIONS**

The Heritage Office guideline, *Principles of Conservation Work on Heritage Places*, outlines the following principles that should be considered when planning work to a heritage item:

- **2.1 Continue to Use the Place**

The building should continue to be used, preferably for the purpose for which it was built, or for a use with which it has a long association.

- **2.2 Repair Rather than Replace**

Keep as much of the historic fabric as possible. Heritage items are by definition authentic examples of the architecture and lifestyle of previous generations and should be respected as evidence of our past.

- **2.3 Make Reversible Alterations**

If alterations must be made to significant building fabric, they should be as reversible as possible.

- **2.4 Make a Visual Distinction Between Old and New**

Whilst being sympathetic and respectful to old material, detail of new work should generally be distinguishable from the old.

- **2.5 Avoid Precise Imitation of Architectural Detail**

New additions should generally not imitate the precise architectural detail of historic buildings.

- **2.6 Ensure Alterations are Sympathetic**

Generally, new additions should be sympathetic to the existing building. In this context, "sympathetic" means that new work is compatible with the character of the earlier building and with its context.

- **2.7 Respect the Ageing Process**

There is no reason why old buildings, like old people, should not look old. There may be no reason to repair cracks that are structurally sound, to recoat worn surfaces, or to remove patina, or even to excessively clean surfaces where the coating of time is not destructive or concealing detail.

- **2.8 Respect Previous Alterations**

If there are previous alterations, these may also contribute to the building's significance and should be respected.

- **2.9 Discontinue Previous Unsound Practices**

Previous unsound practices or details should not be continued, whether in original work or subsequent repairs.

- **2.10 Stabilise Problem Areas**

The correction of severe structural problems, such as leaning walls, warped beams or uneven floors may cause damage which lessens the authenticity of the building. It is usually better to secure and stabilise the problem area, as this may be sufficient to restore the structural stability of the building.

- **2.11 Respect the Building's Context and Location**

The early context or setting is generally part of the building's significance. If the building is deprived of any of its early context, significance may be lost.

- **2.12 Ensure New Buildings fit into the Streetscape**

Where a gap in an existing streetscape or series of buildings is to be filled by a new building, the bulk and height should not exceed the height of buildings next door.

- **2.13 Maintain Views**

Significant views of the building should be identified and maintained.

- **2.14 Respect Contents**

The removal of significant contents of a heritage building, such as furniture and furnishings, should be avoided, unless this is the only way they can survive.

- **2.15 Seek Design Excellence**

These principles provide a safe, respectful approach to heritage buildings, but they cannot be guaranteed to produce fine architecture. They should not prevent inventive, interpretive, contemporary design solutions of high architectural quality. New work may be quite different in spirit and appearance from the existing fabric, but still sympathetic to its heritage values.

Table 8, below, provides an assessment of the proposed works against the considerations listed above.

**Table 7. Assessment of the proposed works to the Narrawa Homestead.**

Consideration	Proposed works to Narrawa Homestead
<b>2.1 Continued Use</b>	The adaptive reuse of the homestead to become the O&M Building will result in the building continuing to be used and occupied rather than abandoned.
<b>2.2 Repair rather than replace</b>	<p>The proposed works aim to replace a number of elements currently existing within the homestead.</p> <p>However, elements to be replaced include sections of the house that have deteriorated and require replacement (i.e. roof beams) as well as sections of the homestead that have been recent additions (i.e. the kitchen benches).</p> <p>The proposed works will aim to maintain and repair as much of the homestead as possible, with changes made to elements of the house that are not from the original homestead building. Other replacements are aimed at maintaining the homestead in a suitable working order.</p>
<b>2.3 Make reversible alterations</b>	Alterations to the Homestead will not be reversible as the works will include the removal of some sections of the structure and replacement of other elements. The removal or sealing over of asbestos elements of the house should not be reversible for safety reasons.
<b>2.4 Make a visual distinction between old and new</b>	The homestead has been sympathetically restored and includes modern materials that have designed in sympathy with the original Federation style. The proposed works will be distinguished by the use of modern materials during the proposed works.

<b>2.5 Avoid precise imitation of architectural detail</b>	The homestead has been sympathetically restored and includes modern materials that have been designed in sympathy with the original Federation style. The proposed works do not aim to precisely imitate the existing style of the house and are instead aimed at undertaking maintenance works on the homestead and making it suitable for an O&M Building.
<b>2.6 Ensure alterations are sympathetic</b>	Alterations to the homestead will involve only the works that are necessary to ensure the homestead can be adaptively reused as an O&M Building. The works will not involve the demolition of any major area of the original house and will involve an overall change to the use of the building.
<b>2.7 Respect the ageing process</b>	The proposed works aim to repair areas of significant decay that require addressing prior to the use of the house as an O&M Building. Areas which are considered unsafe for structural reasons or where asbestos is identified must be updated and altered for safety reasons.
<b>2.8 Respect previous alterations</b>	The proposed works will not significantly demolish the previous alterations undertaken on the homestead.
<b>2.9 Discontinue previous unsound practices</b>	NA.
<b>2.10 Stabilise problem areas</b>	The proposed works aim to stabilise the house with the removal and replacement of all areas of current decay to ensure the building is a safe and functional environment.
<b>2.11 Respect the buildings context and location</b>	The proposed works aim to adaptive re-use the existing homestead and aim to respect the buildings context and location.
<b>2.12 Ensure new buildings fit into the streetscape</b>	NA.
<b>2.13 Maintain views</b>	The proposed works aim to adaptively re-use the existing homestead, preserving the existing views and aesthetic values of the property. The existing gardens surrounding the homestead should be maintained to ensure the view to and from the homestead is not effected by the works.
<b>2.14 Respect contents</b>	The proposed works will not aim to significantly remove any integral elements of the homestead and does not include the removal of any of the original fireplaces or pressed tin ceilings.
<b>2.15 Seek design excellence</b>	The aim of the proposed works will be to adaptively re-use the homestead as a site for an O&M Office for the proposed Wellington Solar Farm. The design and scope of works will therefore focus on the need to ensure the homestead is in appropriate condition for use as offices.



### **5.3. HERITAGE IMPACT QUESTIONS**

The following questions are presented in the NSW Heritage Manual document *Statements of Heritage Impact* to address development proposals on heritage items (NSW Heritage Office 2002).

***What aspects of the proposal respect or enhance the heritage significance of the subject item?***

The proposed works to adaptively re-use Narrawa Homestead as an O&M Building respects the heritage significance of the subject item and aims to maintain the building into the future. The significance of the homestead lies in its historical, aesthetic and representative values as a sympathetically restored homestead from the pre-WWI period. Lightsource BP have acquired the homestead as part of their Wellington Solar Farm project, which will see hectares of solar panels installed (with a buffer) around the existing homestead. It has been identified that if the homestead is not adaptively re-used as an O&M Building for the solar farm, it will remain unoccupied and unmaintained for the life of the solar farm (minimum 30 year period).

By using the homestead as an office building, the structure will be maintained to a safe and occupiable level, and will have the potential to be returned to a residential building subsequent to the closure of the solar farm in the future.

***What aspects of the proposal could have a detrimental effect on the heritage significance of the subject item?***

The proposed works call for a change of use of the building from a residential homestead to an O&M Building. These changes will result in both internal and external alterations to the homestead that will not be reversible including the removal of some architectural elements such as the existing roof and associated elements, and the management of asbestos material by removing it or sealing it within fibrous cement or plasterboard sheeting.

***Have more sympathetic solutions been considered and discounted? Why?***

Lightsource BP have considered the option of the construction of a separate O&M Building adjacent to the existing homestead. By constructing a separate building, the homestead would remain untouched with no works or changes being undertaken on the structure. However, the construction of a separate building would result in a visual impact to the existing homestead and would encroach on the existing heritage structures. Any newly constructed building would be required to be located in the immediate vicinity of the existing homestead in order to utilise the existing electrical cabling.

The construction of a new structure for the O&M Building would also result in the current homestead being left unoccupied and unmaintained for the life of the solar farm (minimum 30 year period). Left unoccupied for such an extent of time would result in the building falling into disrepair. The adaptive reuse of the existing building will allow the structure to be continually maintained to a safe and occupiable standard and may result in the building being returned to a residential purpose post the closer of the solar farm.

#### **Change of use**

**Has the advice or a heritage consultant been sought? Have the consultant's recommendations been implemented? If not, why not?**

Yes, the advice of a heritage consultant has been sought (this document) and will be implemented. The adaptive reuse of the homestead into an O&M Building aims to continue the use of the homestead as a working structure. If the building is not adaptively changed to be used as an operations building for the Wellington Solar Farm it will no longer be used as an active structure.

**Does the existing use contribute to the significance of the heritage item?**

The existing use of the building has been as a residential farm house from its construction in 1908. The significance of the house lies within its historic and aesthetic values associated with the types of accommodation in the country pre WWI.

**Why does the use need to be changed?**

It has been identified that if the homestead is not adaptively reused to become an O&M Building, it will no longer be occupied and as a result will not be maintained. The Wellington Solar Farm lease will be active for 30 years, with potential for the lease to extend beyond this or to return the farm to a working agricultural site with a residential homestead. The use of the homestead as an O&M Building for the solar farm will ensure the building is maintained as a safe and watertight structure that has the potential to be reused as a residential structure if the solar farm is decommissioned into the future.

**What changes to the fabric are required as a result of the change of use?**

Changes to the fabric of the farm will include the need for a new, watertight roof that will be completed in sympathetic colours and form to the existing. "Colour schemes for Old Australian Houses" by Evans, Lucas and Stapleton (1984) should be used as a guideline for the works.

The works will also require the removal and replacement of a number of elements within the homestead including elements of the modern kitchen, carpet, bathroom fixtures and shelving. Some sheeting will also be removed from the walls and ceiling due to the risk of asbestos contamination. The proposed works will not have a significant impact on the original form or materials of the homestead and will instead be changing fabrics that have been subsequently introduced to the house during renovations to the property in the 1990s.

**What changes to the site are required as a result of the change of use?**

The site will require updated plumbing and sewerage, as well as the installation of four air-conditioning units to help heat and cool the homestead.

Proposed works will also include the repurposing of the current bedrooms into offices and the removal of shelving throughout the house to be replaced with office storage.

**Repainting****Have previous (including original) colour schemes been investigated? Are previous schemes being reinstated?**

The painting of the homestead both internally and externally should be completed in similar colours to the existing scheme. The homestead was sympathetically restored in the early 1990s and new paintwork colours should mirror the existing. "Colour schemes for Old Australian Houses" by Evans, Lucas and Stapleton (1984) should be used as a guideline for the works.

**Will the repainting effect the conservation of the fabric of the heritage item?**

The painting will not affect the conservation of the fabric of the heritage item and will be undertaken to help seal and protect the building from damage and decay.

**Re-roofing/ re-cladding****Have previous (including original) roofing/cladding materials been investigated (through archival and physical research)?**

The homestead roofing has been extended with the additions to the structure since its original construction in 1908. The homesteads roofing is currently constructed of light grey corrugated sheeting

with a pitched roof. The proposed replacement of the roof will be sympathetic in colour, form and materials to the existing roof and will be aimed at ensuring the roof is water and windproof into the future.

**Is a previous material being reinstated?**

Yes, the current corrugated iron roofing material will be replaced with new roofing of the same form, colour and comparable material, being colorbond.

**Will the re-cladding effect the conservation of the fabric of the heritage item?**

The proposed works will be completed in line with the current form, material, style and colour of the existing corrugated iron roof and will not result in a major change to the overall aesthetic of the homestead. The proposed recladding aims to help conserve the homestead into the future and ensure that it is suitable for occupation.

**Are all details in keeping with the heritage significance of the item (e.g. guttering, cladding profiles)?**

The proposed works aim to reinstate areas of the homestead that are in a deteriorated condition. Updates to the guttering, cladding and profiles will be completed in line with the current form and style of the roof and will be finished in sympathetic colours and styles to the existing roof and roofline.

**Has the advice of a heritage consultant or skilled tradesperson (e.g. slate roofer) been sought?**

Yes, the advice of a heritage consultant has been sought (this document). It is assessed that the replacement of the roof in similar colour, form and material to the original will not lead to an unacceptable heritage impact. The aim of the works is to ensure that the building is water and windproof into the future to ensure the building is suitably maintained for occupation.

**New services**

The installation of the air conditioning units should be undertaken by a service professional with the aim of reducing heritage impact to the walls of the building. Penetration to the wall should be minimised as much as possible and should be hidden behind the new air conditioning unit. If possible, the external units associated with the air conditioning should be located on the rear (north) side of the house (or on the western or eastern sides) in order to reduce the visual impact of the works to the front façade of the building.

**Are any of the existing services of heritage significance? In what way? Are they affected by the new work?**

No existing services within the homestead hold heritage significance.

**Has the advice of a heritage consultant been sought? Has the consultant's advice been implemented?**

Yes, the advice of a heritage consultant has been sought (this document) and will be implemented. The proposed works will require some ground disturbance, as well as the installation of four new air conditioning systems within the homestead. Whilst the installation of the air conditioning units will require an impact to the walls and cabling of the household, it is not assessed as a major impact to the homestead as the works aim to modernise the homestead and provide adequate heating and cooling in the winter and summer months.

**Are any known or potential archaeological deposits (underground and under floor) affected by the proposed new services?**

It has been identified that the archaeological potential of the homestead primarily lies within the surrounding area and would be associated with the residential and/or agricultural life of the homestead.



No significant buildings have been identified as no longer extant within proximity of the homestead, and as a result archaeological potential will be limited to smaller household or farming items.

The proposed works to install new electrical cabling as well as sewerage and stormwater piping will result in some ground disturbance to connect the new services. No significant items or areas of archaeological potential have been identified as being likely to be present on site, however during excavation works an unexpected finds procedure will be utilised that will ensure that any archaeological items of potential heritage significance that are uncovered during the works are assessed.

## 5.4. SCOPE OF WORKS ASSESSMENT

The individual components of the maintenance works are listed below and assessed for the potential impact on the identified heritage values and significance of the Narrawa Homestead.

**Table 8 Assessment of the proposed works to the Narrawa Homestead in relation to the heritage significance of the subject site**

Proposed works to Narrawa Homestead	Effects of the proposal on the heritage significance of the subject site	Impact positive, negative or nil/neutral on the significance of the subject item.
External demolition	<p>External demolition works at Narrawa Homestead will involve the removal of the hot water unit, the corrugated iron roof sheeting and associated roofing materials, removal of vegetation on the pergola and on the house, removal of coverings on the laundry walls to expose and remove asbestos lining, removal of floorboards on the southern verandah and removal of raked asbestos cement ceiling.</p> <p>These proposed works will not have a significant overall heritage impact on the homestead as they are aimed at making good the current structure and removing unsafe materials that have deteriorated and are no longer in good condition. The roofing and elements of the verandah to be replaced will be completed in similar materials and styles to the existing to mitigate any visual heritage impact the works may have.</p>	Neutral heritage impact.
Internal demolition	<p>The demolition of internal aspects of the homestead will include removal of elements in the kitchen, ensuite and walk-in wardrobe, laundry, bedroom 1, bathroom, old kitchen, hallway and enclosed verandah rooms.</p> <p>The removal the specified items from inside the homestead does not include the removal of any original material. Items to be removed include later additions to the homestead that do not contribute to the heritage significance of the site.</p>	Neutral heritage impact.

	<p>Whilst not material from the original construction of the house, the removal of the decorative architraves in from one of the enclosed western verandah rooms will not have a negative heritage impact on the site as the architraves will be correctly stored and reinstated once the potential for asbestos in the wall and ceiling linings has been investigated.</p>		
Concrete works	<p>Concrete works at Narrawa Homestead will include the installation of concrete pads for isolated brick piers, provide new piers as necessary on the southern verandah, and pad footings as necessary to support new floor framing in the area of the removed concrete hearth.</p> <p>These proposed works aim to make good the existing areas of the homestead that are currently at risk of collapse.</p>	Neutral impact.	heritage
Brickworks	<p>The proposed brickwork at Narrawa Homestead includes the pointing of verandah sub-floor, common brick isolated piers to repair the southern verandah, and ant capping.</p> <p>These proposed works aim to make good the existing areas of the homestead that are currently at risk of collapse.</p>	Neutral impact.	heritage
Carpentry and joinery	<p>The extent of the carpentry and joinery across the site has yet to be fully determined, but will aim to repair all wooden items (roof battens, floor framing, skirting, door frames etc) across the site that are in deteriorated condition.</p>	Neutral impact.	heritage
Roofing and roof plumbing	<p>The proposal includes the replacement of the roof of the homestead to ensure the structure is wind and waterproof. The proposal includes the replacement of the corrugated iron hipped main roof, verandah roof, rolled top ridge and hip flashings, gutters and downpipes and rainwater head.</p> <p>The replacement of the roof will be completed in sympathetic colours and style to the original and will maintain the overall form of the original roof. The proposed works have the aim of making the homestead wind and waterproof into the future, maintaining the overall condition of the building.</p>	Neutral impact.	heritage
Wall and ceiling finishes	<p>The changes to the wall and ceiling finishes in the Narrawa Homestead include the installation of plasterboard ceiling linings in a number of rooms across the site, the installation of fibrous cement wall linings, coved</p>		

	<p>cornice, insulation within the homestead and ceramic wall tiles.</p> <p>These works are aimed at the removal of any dangerous asbestos material throughout the homestead, as well as the works to areas of deterioration within the house.</p> <p>The proposed works will not include the removal and/or replacement of any of the original areas of the homestead and will not have an overall negative heritage impact on the structure.</p>	
Floor finishes	<p>Floor finishes across the site will include changes to the ceramic floor tiles, threshold tiles, carpet and sheet vinyl flooring.</p> <p>The proposed changes to the internal flooring will not have an impact upon the original hardwood floors of the homestead that remain in situ.</p>	Neutral heritage impact.
Electrical	<p>Electrical works within the homestead will include the installation of a new underground single phase mains power supply, a new mounted switchboard, the testing and replacement of faulty power points, and the installation of four reverse cycle air-conditioning units.</p> <p>Whilst these works will involve changes to the overall aesthetic of the homestead, the installation of air conditioning is not assessed to be a major negative heritage impact as the works are aimed at modernising the homestead in order for the building to be used as a comfortable work space. In order to reduce the heritage impact of the works on the structure, if possible the external elements of the air conditioning units should be located on the rear (north) side of the building (or on either the western or eastern sides of the structure) in order to avoid impact on the front façade of the homestead.</p>	Negative-neutral impact.
Plumbing and drainage	<p>Plumbing and drainage across the site will include excavation and backfilling for stormwater and sewerage drainage and the general replacement of sanitary plumbing fixtures, fittings and tapware.</p> <p>The excavation of the yard to install the appropriate drainage will result in targeted ground disturbance in the yard that has the potential to impact on any archaeological potential in the area. It has been identified in Section 4 of this report that the archaeological potential within the area of the homestead lies with any deposits associated with the residential or agricultural life within the</p>	Neutral heritage impact.



	<p>homestead and is unlikely to reveal significant deposits. Excavation works will utilise an unexpected finds procedure to determine the significance of (any) archaeological items if uncovered during works.</p> <p>The existing fittings are not original and do not add to the heritage significance of the homestead. The existing fittings are not original and do not add to the heritage significance of the homestead.</p>	
Painting	<p>Painting at the homestead will include all external surfaces, tongue oil to be applied on the new verandah flooring, the painting of all walls and surfaces internally, as well as the polishing of existing tongue and groove internal floors. Painting of the homestead is considered general maintenance to keep the structure in good condition and should be completed in complementary colours to the existing. "Colour schemes for Old Australian Houses" by Evans, Lucas and Stapleton (1984) should be used as a guideline for the works</p>	Positive heritage impact.

## 5.5. SUMMARY OF IMPACTS

In summary, the assessment of heritage impacts for the proposal to adaptively re-use Narrawa Homestead as an O&M Building for the Wellington Solar Farm has found that the overall impact is minor and that any significant heritage impact is unlikely. This is due to:

- The works aim to keep the homestead in use as a working building and will result in the homestead being maintained to a safe and occupiable level;
- The proposed works do not aim to significantly alter the original layout of the homestead;
- The proposed works aim to primarily update areas of the homestead that have previously undergone renovations;
- The proposed works will require some ground disturbance however it has been identified that the archaeological potential at the site is limited to potential residential and agricultural deposits. An unexpected finds procedure will be utilised during the works in the event of encountering any deposits that may hold heritage significance.
- The replacement of the existing roof is aimed at ensuring the homestead is waterproof and serviceable into the future. The new roof will be completed in the same colour, form, detail and style as the existing roof; and
- The repainting of the homestead internally and externally will be completed in sympathetic colours to the existing homestead and will be aimed at sealing and protecting the homestead from damage and decay.

In summary, the cumulative impact of the proposed adaptive reuse of Narrawa Homestead is assessed to be low. The intention to make the Narrawa Homestead building structurally sound and safe while maintaining the character of the building may result in a positive heritage outcome in the future, in particular where parts of the house previously in poor condition such as the former kitchen are better maintained.

## 6. CONCLUSION & RECOMMENDATIONS

### 6.1. CONCLUSIONS

It has been identified by Lightsource BP that the proposed Wellington Solar Farm, located in Wellington NSW, is to be constructed and maintained for an initial 30 year period and will require an O&M Building to help manage the farm for the period of its life. The solar farm is to be constructed surrounding the local heritage listed Narrawa Homestead (wellington LEP 2012 Listing ID:I49) and as a result Lightsource BP have acquired the property from the existing owners.

It has been identified that Narrawa Homestead would be appropriate to be adaptively re-used as the necessary O&M Building, as otherwise the heritage building will be left unoccupied and unmaintained for the life of the solar farm (minimum 30 year period).

The proposed changes to the building do not represent a significant impact to the original material of the house, and instead focus primarily on the more recent additions. The proposed works aim to maintain the homestead as a working building, resulting in the structure continuing to be used and maintained to a safe and occupiable level.

### 6.2. RECOMMENDATIONS

The proposal to undertake essential restoration works on Narrawa Homestead as outlined in this assessment is not considered to lead to a significant impact in accordance with the NSW *Heritage Act 1977*, *Environmental Planning and Conservation Act 1979*, and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*, in terms of heritage.

The following recommendations are made for the proposal:

1. In the event any unexpected archaeological heritage finds are identified, works must cease temporarily and the 'Unexpected Finds Procedure' described in Appendix A should be adhered to;
2. The proposed painting of the homestead should be completed in complementary palette to the existing surfaces. "Colour schemes for Old Australian Houses" by Evans, Lucas and Stapleton (1984) should be used as a guideline for the works;
3. The replacement of the roof should be completed in sympathetic colours and style to the original and will maintain the overall form of the original roof. "Colour schemes for Old Australian Houses" by Evans, Lucas and Stapleton (1984) should be used as a guideline for the works;
4. Original elements of the house that are in good condition should be carefully removed during works and reused where possible;
5. The proposed works should aim to maintain the overall character of the homestead and be completed in complimentary colours and styles to the existing;
6. The external elements of the air conditioning units should be placed at the rear of the house to avoid a visual impact on the façade of the homestead;
7. Changes to the internal flooring should not include the removal of any of the original hardwood flooring unless it is identified that the boards are in a significantly deteriorated condition. If any of the boards cannot be repaired then a specialist heritage architect and/or builder should be engaged to determine the type of hardwood in order to replace like for like;
8. The existing gardens should be maintained through regular gardening to ensure the views to and from the property are maintained;

9. The proposed works should not impact on the existing fireplaces within the building and not include the removal of the existing mantles or hearth tiling; and
10. The original kitchen stove located in the old kitchen should be retained in situ.



## **7. REFERENCES**

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## **APPENDIX A UNEXPECTED FINDS PROCEDURE**

An unexpected heritage item means any unanticipated discovery of an actual or potential heritage item, for which the Proponent does not have prior approval to disturb or does not have a safeguard in place to manage the disturbance.

These discoveries are categorised as either:

- a) Aboriginal objects
- b) Historic/non-Aboriginal heritage items
- c) Human skeletal remains

If any of the above items are suspected or identified during construction activities then a series of steps must be followed. These are outlined below:

1. all work should cease in that area and notify a Project Manager or Supervisor immediately of the find;
2. A 'no-go' zone should be established around the find, using visibility fencing (where applicable);
3. Inform all on-site personnel and staff of the find and the demarcated 'no-go' zone;
4. Contact a qualified archaeologist/heritage consultant to inspect the find and provide recommendations.
5. In the event that human remains are identified, complete steps 1-3. Replace Step 4 by immediately contacting the local police to investigate if the find relates to a criminal investigation. The police may take command of part or all of the site.
6. Once clearance of the site has been given by either the qualified archaeologist/heritage consultant then works may proceed within the 'no-go' zone UNLESS specifically instructed by the professional that no further works can be completed.

## **APPENDIX B NARRAWA HOMESTEAD INVENTORY SHEET**



## APPENDIX D CONSISTENCY REVIEW

Key extracts of the Consistency Review undertaken by NGH in April 2019 are provided below.

### D.1 PROJECT DESCRIPTION

#### D.1.1 Nature of the development

The revised project layout is in keeping with the project description and objectives, as described in the EIS and is therefore considered ‘substantially the same development’:

*...the construction, operation, and decommissioning of the proposed Wellington photovoltaic (PV) solar farm.*

*The objectives of the Wellington SF proposal are to:*

- *Select a site which is suitable for commercial scale solar electricity generation, in terms of solar yield, connection to the national electricity grid and environmental (including social) constraints.*
- *Develop a profitable commercial scale solar electricity generation project and potentially an Energy Storage Facility.*
- *In producing renewably sourced energy:*
  - *Assist the NSW and Commonwealth Governments to meet Australia’s renewable energy targets and other energy and carbon mitigation goals.*
  - *Provide a clean and renewable energy source to assist in reducing greenhouse gas (GHG) emissions.*
- *Obtain a social license to operate from the local community.*
- *Provide local and regional employment opportunities and other social benefits during construction and operation.*
- *Identify opportunities to avoid and minimise environmental impacts in the construction and operation of the project.*

#### D.1.2 Distribution of impacts

Key definitions in the Conditions of Consent include:

<i>Development</i>	<i>The development as described in the EIS</i>
<i>Development footprint</i>	<i>The area within the project site on which the components of the project will be constructed</i>

No ‘development footprint’ is mapped in the approval. The approval shows ‘exclusion areas’ and the ‘proposed infrastructure’ (refer Attachment B) however, the EIS is clear on the matter of the infrastructure layout being indicative. Considering the proposed infrastructure layout, it remains within the development footprint (in that it is within the project boundary and avoids areas of constraint).

The project site area remains 493 ha in total (incorrectly noted as 508.1 ha in the EIS). The development footprint under the indicative layout presented in the EIS was 282 ha. The changes proposed add approximately 6 ha to this and would now be 288 ha. The increased impact area does not necessarily

equate to increased environmental impact. The increased inter-panel spacing will be beneficial for health and diversity of ground cover and air quality for example. The greater spacing between panels means that soil disturbance impacts will be less than predicted on a per hectare basis. This matter is considered in more depth in Section 3.3 and Section 4.

## D.2 CONSIDERATION OF ENVIRONMENTAL IMPACTS

The following risks were investigated within the EIS. Five of these are discussed further in this report.

**Table 1. EIS impacts**

Relevant EIS section	Environmental risk	Unmitigated EIS risk rating	Implication of revised project layout
7.1	Biodiversity	Very high	The revised project layout results in additional areas of impact and excised areas of impact. The overall impacts to native vegetation have been reduced by 6.71 ha. Two separate calculations were run in the Biodiversity Assessment Method (BAM) calculator detailing the ecosystem credits generated for additional and excised areas for each vegetation zone. Refer Attachment B.2.
7.2	Aboriginal heritage	Very high	Some of the additional panel areas were assessed as being impacted in the EIS but some were not.  Specialist input sought, in Section 4.1.
7.3	Visual amenity	Very high	The revised project layout is larger than was modelled in view shed mapping.  Specialist input sought, in Section 4.2.
7.4	Noise and vibration	Very high	Impacts on the revised project layout have been assessed for construction and operational noise.  Specialist input sought, in Section 4.3.
7.5	Historic heritage	High	The revised project layout would not affect existing heritage sites or affect the ability to meet conditions of consent. No impacts.

Relevant EIS section	Environmental risk	Unmitigated EIS risk rating	Implication of revised project layout
8.1	Traffic, transport and road safety	High	No more infrastructure would be transported to site, hence no increased traffic impacts would result.
8.2	Soils	Medium	Minor increase in soil disturbance to accommodate more cable trenching. Discussed further in Section 4.4.
8.3	Water use and water quality (surface and ground water)	Medium	Impacts are closer to riparian areas but still maintain prescribed buffers.
8.4	Flooding	Medium	The revised project layout places some infrastructure closer to waterways. Specialist input sought, in Section 4.5.
8.5	Land use (including mineral resources)	Medium	No impacts.
8.6	Resource use and waste generation	Medium	No impacts.
8.7	Socio-economic and community	Medium	See visual amenity.
8.8	Climate and air quality	Medium	No impacts.
8.9	Hazards (including bushfire and EMF)	Medium	No change in impact.
8.10	Cumulative impacts	Medium	The combined impacts are not substantive and can be mitigated separately.

### D.3 CONSIDERATION OF APPROVAL

With reference to the conditions of consent for the project, 25 May 2018, two areas are identified for further consideration.

**Table 2. Approval conditions**

Consent reference		Implication of revised project layout
Definitions	Ancillary infrastructure	All project infrastructure with the exception of solar panels, including but not limited to collector substations, switching stations, permanent offices, site compounds, electricity transmission lines and internal roads
Definitions	Applicant Lightsource Development Services Australia Pty Ltd, or any person who seeks to carry out the development approved under this consent	The same project, new applicant.
Definitions	The development, as described in the EIS	Is substantially the same.



Consent reference		Implication of revised project layout
Definitions	'Development footprint', The area within the project site on which the components of the project will be constructed	Corresponds to mapped 'proposed infrastructure' but this is noted as indicative in the EIS.
Definitions	EIS	
Definitions	'Project site', The land defined in the figure in Appendix 1 and the table in Appendix 2	Is within the project site.
Definitions	Temporary facilities	Addition of "laydown areas and parking spaces" in description
Administrative conditions	<p>Obligation to minimise harm to the environment</p> <p>In meeting the specific environmental performance criteria established under this consent, the applicant must implement all reasonable and feasible measures to prevent and/or minimise any material harm to the environment that may result from the construction, operation, upgrading or decommissioning of the development.</p>	Minimal additional impacts, which can be minimised further with recommendations in Section 4.
Administrative conditions	<p>The Applicant must carry out the development:</p> <p>Generally in accordance with the EIS; and</p> <p>In accordance with the conditions of this consent.</p> <p><i>Note: The general layout of the development is shown in Appendix 1.</i></p>	The layout is approximately 8 ha greater in area than stated in the EIS. The areas affected are unlikely to result in material additional impacts.
Schedule 3	<p>Landscaping</p> <p>Vegetation buffer</p> <p>The applicant must establish and maintain a mature vegetation buffer (landscape screening) at the locations outlined in the figure in appendix 1 to the satisfaction of the secretary.</p>	No augmentation warranted.

Consent reference		Implication of revised project layout
Schedule 3	<p>Biodiversity</p> <p>Retirement of credits</p> <p>Within two years of commencing development under this consent, unless otherwise agreed by the secretary, the applicant must retire biodiversity credits of a number and class specified in table 1 below to the satisfaction of OEH.</p> <p>White box grassy woodland in the upper slopes sub-region of the NSW south western slopes bioregion – 3 credits</p>	<p>Ecosystem credits have been calculated under BAM for additional and excised area. The net credit requirement can now be used to update the credit requirement for the project. An application for reasonable equivalence has been submitted. The net ecosystem credit requirements have been reduced as a result of Mod 2. 1 Gang-Gang and 1 Superb Parrot species credit species have been generated as a result of Mod 2.</p>
Schedule 3	<p>Protection of Heritage Items</p> <p>Prior to the commencement of construction, the Applicant must salvage and relocate all Aboriginal heritage items located within the approved development footprint to suitable alternative locations on site, in accordance with the <i>Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW</i> (DECCW, 2010), or its latest version.</p> <p><i>Note: The location of the Aboriginal heritage items referred to in this condition are shown in the figure in Appendix 1.</i></p>	<p>The development footprint has expanded but this does not affect impacts materially or the mitigation strategy.</p>
Schedule 3	<p>Soil &amp; water</p> <p>Water pollution</p> <p>The applicant must ensure that the development does not cause any water pollution, as defined under section 120 of the <i>protection of the environment operations act 1997</i>.</p>	<p>The layout is approximately 8 ha greater in area than stated in the EIS. Soil and water impacts are considered in Section 4.</p>
Schedule 3	<p>Fire safety study</p> <p>At least one month prior to the commencement of construction of the development, or unless otherwise agreed by the secretary, the applicant must prepare a fire safety study for the development, in consultation with fire &amp; rescue nsw, and to the satisfaction of the secretary.</p>	<p>No implication.</p>
Schedule 3	<p>Fire Management and Emergency Response Plan</p> <p>Prior to the commencement of operations, the Applicant must prepare a Fire Management and Emergency Response Plan for the development in consultation with the RFS and Fire &amp; Rescue NSW.</p>	<p>No implication.</p>

Consent reference		Implication of revised project layout
Schedule 3	<p>Decommissioning and rehabilitation</p> <p>Within 18 months of the cessation of operations, unless the secretary agrees otherwise, the applicant shall rehabilitate the site to the satisfaction of the secretary. This rehabilitation must comply with the objectives in table 2.</p>	<p>Additional areas will require management during operation and decommissioning. No implication in terms of ability to meet this condition.</p>