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Javier Canon
Senior Policy Officer
Department of Planning, Industry & Environment
4 Parramatta Square, 12 Darcy Street
PARRAMATTA NSW 2150

19 June 2020

Reference: 0470861

Dear Javier Canon

Subject: Bonshaw Solar Farm (SSD 9438) – Response to RFI Dated 1 May 2020

1. INTRODUCTION

GAIA Australia Pty Ltd (GAIA) are seeking approval to develop a large scale photovoltaic (PV) generation facility with a capacity of 200 megawatts (MW) and associated infrastructure, including a Lithium-ion Energy Storage System (ESS/Li-ion). The proposed development of the Bonshaw Solar Farm (the 'Project') is located at Bonshaw, within the Inverell Local Government Area in New South Wales (NSW) (refer to **Figure 1-1**). The Project is located approximately 66 km north of Inverell, with site access fronting Bruxner Highway.

1.1 Project Progress

The Project's Environmental Impact Statement (EIS) was exhibited over a 29 day period, from 6 November 2019 to 4 December 2019. There were 13 submissions received from government agencies and two public submissions during this period. A Response To Submissions (RTS) was submitted to the Department of Planning, Industry and Environment (DPIE) to address these comments.

Since exhibition and subsequent submission of the RTS, the Project was amended through the submission of an Amendment Report (AR) to provide details of the overhead connection.

In addition, on 8 April 2020 the DPIE had requested further information on five (5) matters relating to the Project updates. These matters were addressed through the submission of a letter dated 16 April 2020.

1.2 Purpose of Letter

On 1 May 2020, DPIE provided a 'Request for Additional Information', seeking further details to effectively address eight (8) items raised, relating to traffic, biodiversity assessment, flooding and water supply. Upon submitting an initial response on 22 May 2020, DPIE requested additional information on three (3) other items on 27 May 2020. These matters are collectively outlined in **Table 2-1** below, with consideration for the three additional matters referred to in the 'Item' column as a sub-reference identified by the inclusion of the letter 'a' attached to the relevant matter.

The purpose of this letter is to provide details on items raised, to assist with the Department's assessment and determination of the Project. Details to address the items raised by the Department is provided in **Section 2** below.

In addition, this letter also addresses comments raised by the Biodiversity and Conservation Division (BCD) in relation to the location of AHIMS #11-3-0083 (refer to **Section 2.1**).

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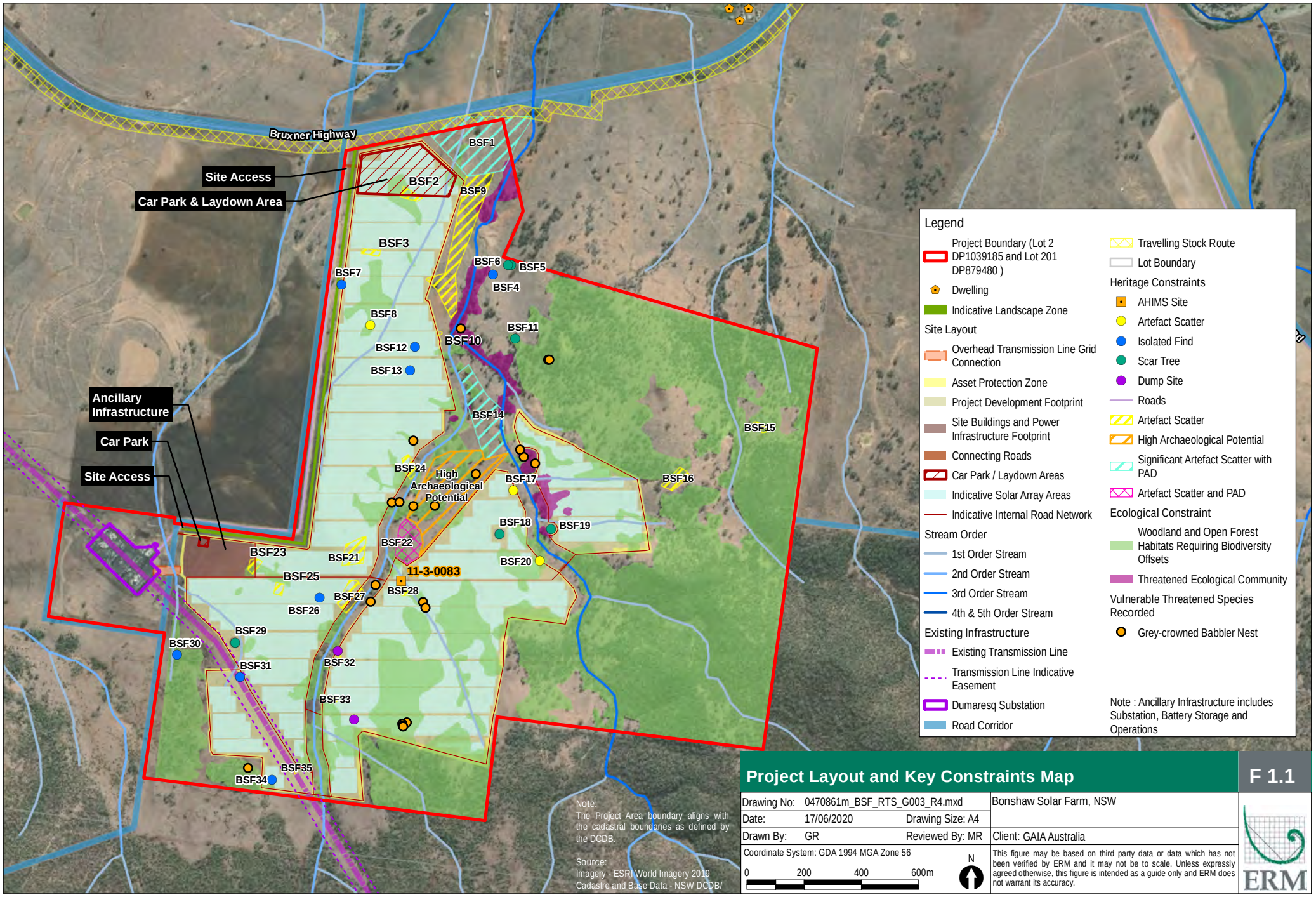

Project Layout and Key Constraints Map

F 1.1

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Date:	17/06/2020	Drawing Size: A4	
Drawn By:	GR	Reviewed By: MR	Client: GAIA Australia

Coordinate System: GDA 1994 MGA Zone 56

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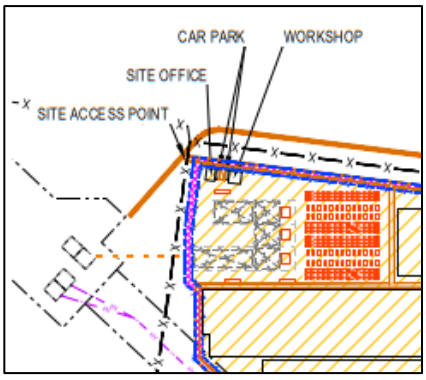
2. PROVISION OF ADDITIONAL INFORMATION

Each of the eleven collective items raised by DPIE have been outlined in **Table 2-1** below, with supporting details provided in the right column as a response to the request for information.

Table 2-1 Request for Information Details

Item	DPIE Comments	Details
Traffic and Access Route		
1	provide an assessment of the traffic impacts of the all phases of the development on all proposed access routes and key intersections identifying any improvements required to maintain road safety and associated assessment of the impact of any additional road improvements (including biodiversity and heritage);	The Traffic Impact Assessment (TIA) prepared by Seca Solution has identified the impacts during construction, when there will be the biggest impact, and has determined that no road upgrades on the external road network is required other than proposed upgrades to the site access point. All the roads used for heavy vehicle access to the Site currently carry B-doubles and regional / state and local traffic demands. The overall traffic flows along these roads are well within acceptable capacity limits and through the major urban centres the road capacity is increased and monitored by the road authority to ensure adequate capacity is provided. During the operational phase of the project, the traffic volumes are significantly lower than during construction with a maximum of 10 staff working on site and allowance for all staff to drive will generate 10 inbound vehicles in the morning and 10 outbound in the afternoon. For the decommissioning stage of the project, which could occur in 20-30 years time, the expected traffic demands would be less than those associated with the construction. The possible decommissioning stage of the development has been discussed with TfNSW who agreed that this would be more appropriate to review if the Project Site is decommissioned, due to a wide range of factors that could impact the Project at that stage. An updated Traffic Impact Assessment has been provided in **Attachment A** below.
1a	Provide an assessment of the proposed site access, considering heavy traffic safe turning requirements, sight distances, swept paths and safe deceleration requirements, and confirming any road upgrades required as a result of the assessment. The assessment of impacts of any road improvements must include a desktop biodiversity and heritage addendum.	Access to the site will be via the existing access provided to the electric substation adjacent to the subject site. This access was constructed to allow for the construction activities associated with the electric substation and is now used for maintenance purposes only for the substation. This access will be upgraded to provide a left turn deceleration lane and shoulder widening to provide an auxiliary right turn treatment, both in accordance with Austroads Guidelines (refer to **Figure 2-1**).

Item	DPIE Comments	Details
		An assessment of the road upgrade impacts on biodiversity and heritage matters is included in **Attachment B.**
2	provide swept paths at key intersections for the largest vehicle that will traverse the proposed access routes, including the Bruxner Highway access;	Any swept path analysis can only be completed via aerial photography, which is not as clear or accurate in this regional area. Therefore, this would not provide an accurate demonstration of the layout of the intersections. All of the external traffic routes for the Project construction are approved B-double routes and as such currently safely accommodate the movement of these vehicles. The construction will use semi-trailers only for access which require less road pavement than a B-double for turning movements. The site access, which will utilise the access road for the Dumaresq substation adjacent to the Project site, was designed and built to accommodate the swept path movement of the heavy vehicles associated with the construction of the electrical substation and these included over size / over mass vehicles associated with the delivery of the substation unit. This would have used a vehicle that was larger than a B double and as such the site access will accommodate the swept path of a semi-trailer entering and exiting the site.
3	update the project layout to include onsite parking and laydown areas;	The “Ancillary infrastructure” area is described broadly in the EIS as including a substation, battery storage and operations. Section 2.2.5 of the EIS also details the inclusion of the maintenance shed and car park area. The car park and laydown areas form part of the Ancillary Infrastructure area, previously indicated on relevant Project Figures. The car park area within this prescribed area, is shown in the snip below and in **Figure 2-2**. 

Item	DPIE Comments	Details
		Similarly, the ancillary infrastructure area will be used as a laydown area, although during construction, a temporary car park and laydown area will be utilised in the northern portion of the Site (refer to **Figure 2-2**).
3a	Please include the site access, car park and laydown areas and Bruxner Highway label as per the Updated Project Layout (Figure 2.1 in letter dated 22 May 2020) into the current project layout (Figure 5.1 in the Submissions report, Figure 2.2. in Amendment Report) and provide a consolidated project layout.	Site layout figures have been updated to include the site access, car park and proposed laydown areas (refer to **Figure 1-1**).
4	confirm if the access road from the site access point to the proposed site buildings and ancillary infrastructure area is wholly located within the project boundary (including additional landowners consent if required);	Site access will be provided from the existing access road leading to the Dumaresq substation. A connecting road will then join at the north-western corner of the Project Site to connect to the internal access road network. The internal road network will run around the parameter of the solar array, including running from the access point in the north-western corner, parallel to the existing Dumaresq access road, down to the ancillary infrastructure area. Landowner consent from Crown Lands, as owner of the site access road being utilised to gain access to the Project Site is provided in Attachment A of the AR. A second site access point is included as part of the Project at the Ancillary Infrastructure area in the western portion of the Site. This has been provided as an alternative emergency exist point.
5	provide the number of heavy vehicles required during operation;	Under standard operation, there will be no need for heavy vehicles. In the event that panels or an inverter requires replacing, a single B-Double truck would be required for delivery of materials. It is estimated that under a worst-case scenario, this may be required 2 to 3 times in a year.
Biodiversity Assessment		
6	provide an addendum to the BDAR to include a species polygon and appropriate justification for the four species that will be impacted by the proposal, or justification for the species credits (the Department notes that only one species polygon has been prepared as per Figure 5.3 in the BDAR, and the area of impact to calculate the species credits is not consistent for all species)	The Biodiversity Development Assessment Report (BDAR) has been updated to address this comment (refer to **Attachment C**) and revised species polygons and credit reports are provided in Appendix L of the BDAR.
6a	Provide an addendum to the BDAR, addressing:	The Biodiversity Development Assessment Report (BDAR) has been updated to address these comments (refer to **Attachment C**) and

Item	DPIE Comments	Details
	■ The species polygons for the Masked Owl and Barking Owl must be expanded to include each of the recorded hollow bearing trees (green dots) within the development site as identified in Figure 5.3 of the BDAR, because hollow bearing trees are an important part of the breeding and foraging habitat for these owls. The expanded species polygons do not need to include extensive areas of disturbed grassland. ■ The Bristle-faced Free-tailed bat species polygon currently covers the entire development site, including the mapped disturbed grassland areas. We note the precautionary approach of including large areas of disturbed grassland for potential foraging habitat. However, due to the large area of disturbed grassland, we would also accept a reduced species polygon, that aims to capture the more viable bat habitat components, such as hollow bearing trees, similar to that described above for the owls. ■ The amended species polygons above will need to also be reflected in the Biodiversity Assessment Method (BAM) calculator. We note the above changes will reduce the overall species credit requirement for the development.	revised species polygons are provided in Appendix L of the BDAR. ■ The updated species polygon for the Bristle-faced Free-tailed Bat conservatively includes all woodland PCT plus a 50m buffer to all hollow-bearing trees recorded within the Subject Land. Disturbed grasslands have been excluded from the updated species polygon as provided in Figure L-1. ■ The updated species polygon for the Barking Owl includes a 100m buffer to all mapped hollow-bearing trees that contained hollows of a suitable size (i.e. >20cm wide) and height above the ground (i.e. >4m) in accordance with breeding habitat constraints provided in BAM-C. The updated species polygon for the Barking Owl is provided in Figure L-2. ■ The updated species polygon for the Masked Owl includes a 100m buffer to all mapped hollow-bearing trees that contained hollows of a suitable size (i.e. >40cm wide). The updated species polygon for the Masked Owl is provided in Figure L-3. As both the Masked Owl and Barking Owl are dual credit species, potential foraging habitat is addressed within the ecosystem credit requirement for PCTs associated with this species. Therefore, the updated species polygons have been revised to include potential breeding sites only as required in the BAM. This is still considered to represent a conservative overestimate of actual/potential breeding habitat in that all hollow-bearing trees of a suitable size have been included rather than a single confirmed nest tree. Based on the updated mapping of the threatened species polygons, impacts to habitat of Threatened Species requiring offsets now include: ■ Habitat for the Bristle-faced Free-tailed Bat requiring 827 species credits; ■ Foraging habitat for Eastern Cave Bat requiring 1,030 species credits; ■ Potential (assumed) breeding habitat for Masked requiring 104 species credits; and ■ Potential (assumed) breeding habitat for Barking Owl requiring 283 species credits. A total of 598 ecosystem credits are also required to offset the impacts of the project.

Item	DPIE Comments	Details
Flooding		
7	provide further evidence that the project will not impact overland flows (including further consideration of drop-down fencing);	The Flood Impact Assessment prepared for the Project concluded that a minor increase to peak flood levels within the Site immediately upstream of the proposed vehicle crossings were observed, however, these impacts are contained within the channel and the Site boundary. This minor impact was modelled under the 1 in 100 Annual Exceedance Probability (1% AEP) flood event scenario. There is no proposed filling of the floodplain, except for works associated with the vehicle crossings and the installation of fencing along the Project boundary. The fencing of the Project boundary will either utilise the existing fencing if appropriate, upgrade existing fencing or install new chain-mesh fencing. Where fencing intersects with waterways, drop-down fencing will be adopted to mitigate any potential impact to overland flows. To ensure there is no debris build-up at these points, regular checks of the drop-down fencing will be incorporated into the Site's Environmental Management Plans. **Figure 2-3** below provides an indication of the location of drop-down fencing for the Site.
Water Supply		
8	provide further evidence of the ability of identified potential water suppliers for the project to meet the necessary water demands.	Water supply for the Project will be provided through a licensed water supplier. GAIA have been in discussions with three potential suppliers – Trident Water or Wade's Water in Warwick and Vital Water Service in Casino. Discussions are ongoing with water providers, however at this stage Trident Water have provided confirmation of their ability to supply the necessary water demands for the Project (refer to **Attachment D**)

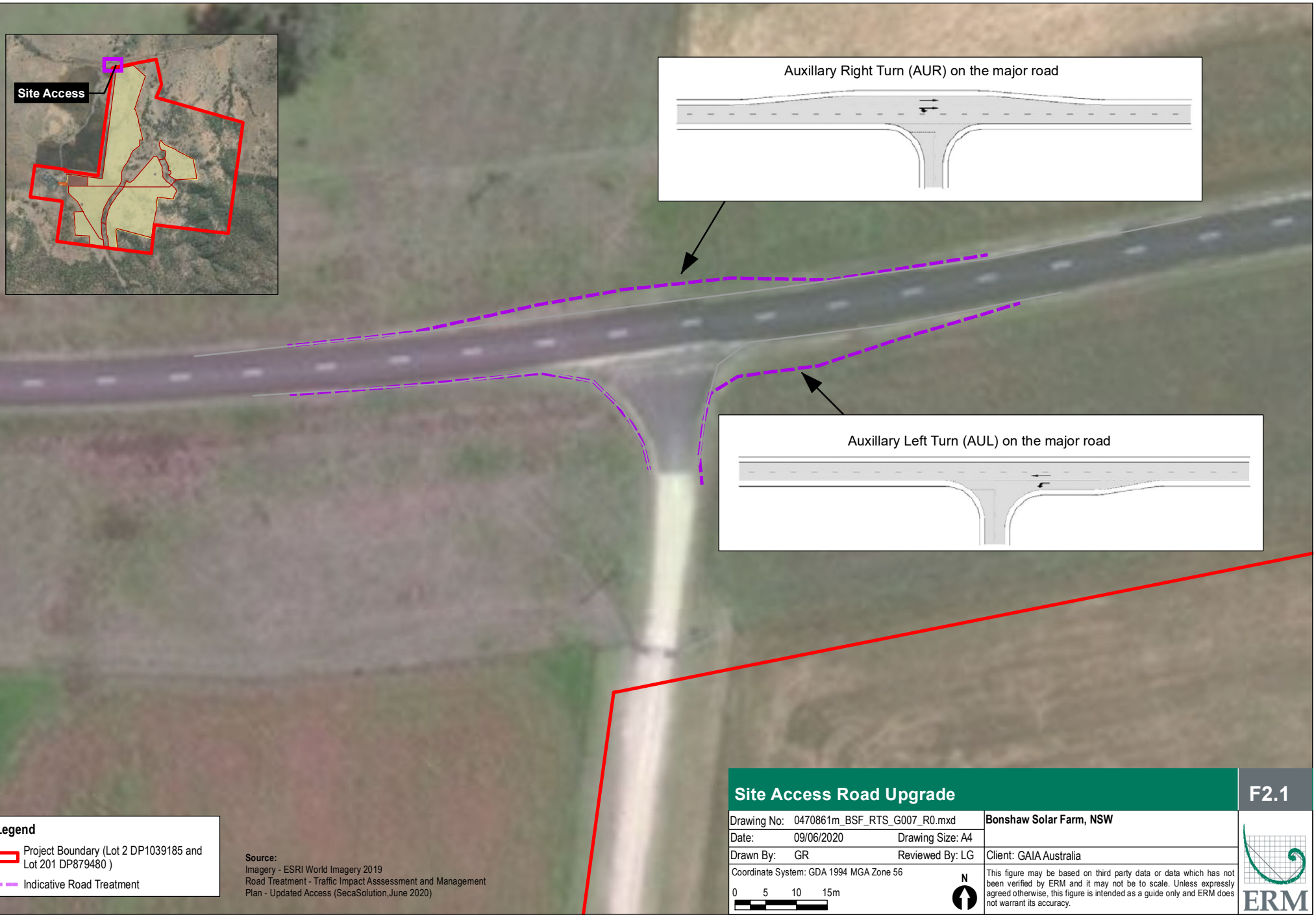
2.1 AHIMS #11-3-0083 Location Amendment

Comments were raised in the assessment process by BCD in relation to the 2018 survey effort being unsuccessful in locating AHIMS #11-3-0083. Although a concerted effort was originally made to locate AHIMS #11-3-0083, the survey was thought to be unsuccessful in relocating AHIMS #11-3-0083, with a number of newly recorded sites located in nearby areas.

Through the assessment process of the project, BCD undertook a technical assessment of all the information recorded regarding AHIMS #11-3-0083. The result of this assessment

suggests that a technical error in the recording of coordinates has resulted in a misunderstanding and error about the location of AHIMS #11-3-0038. Having projected the original coordinates, BCD has determined that the area was actually identified during the 2018 survey and given a new site identifier.

Accordingly, all figures showing the location of AHIMS #11-3-0083 have been updated to reflect the true location of AHIMS #11-3-0083. The Aboriginal Cultural Heritage Assessment has been updated is provided in **Attachment E**.



Legend

- Project Boundary (Lot 2 DP1039185 and Lot 201 DP879480)
- Indicative Road Treatment

Source:
Imagery - ESRI World Imagery 2019
Road Treatment - Traffic Impact Asssessment and Management Plan - Updated Access (SecaSolution,June 2020)

Site Access Road Upgrade

F2.1

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Drawn By:	GR	Reviewed By: LG	Client: GAIA Australia

Coordinate System: GDA 1994 MGA Zone 56

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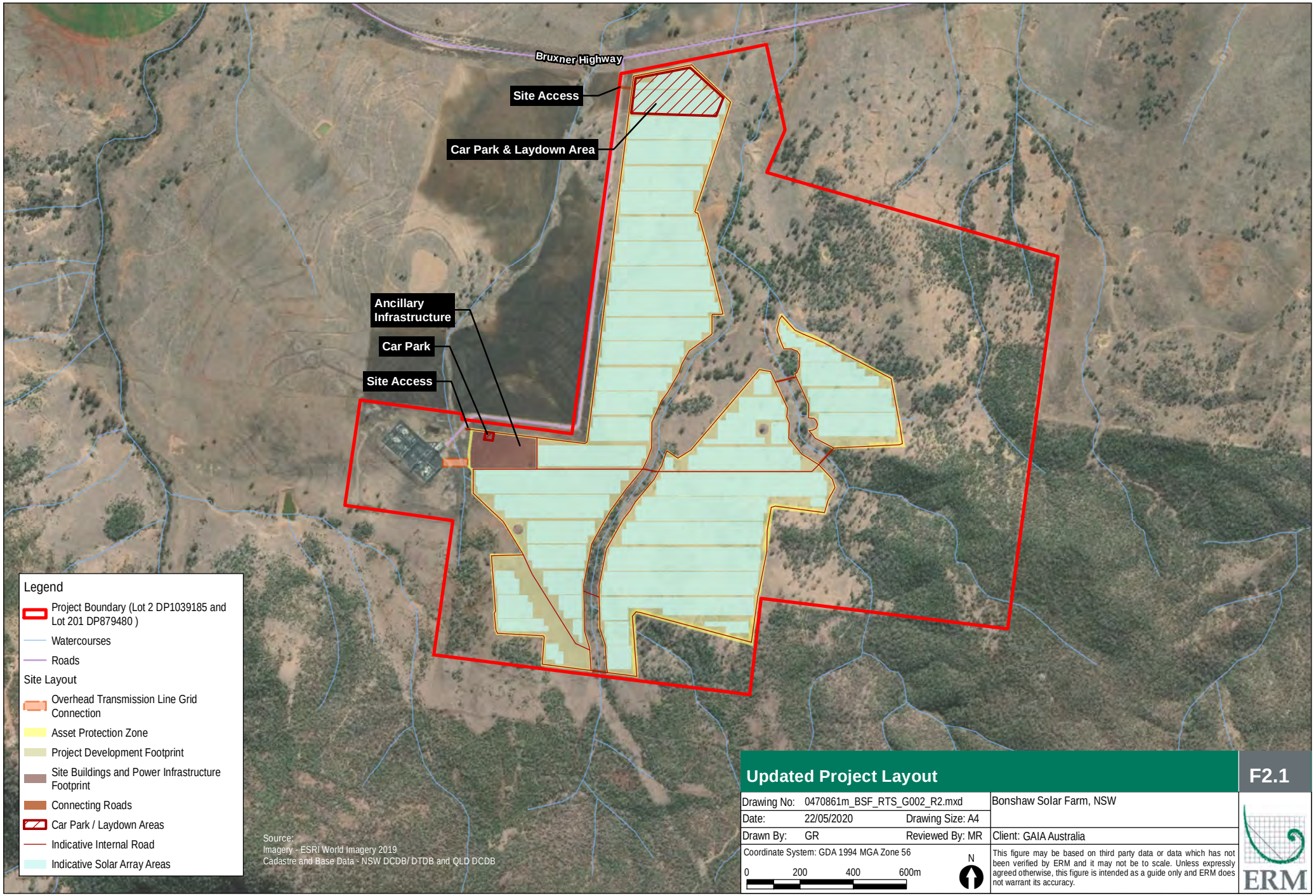
Bruxner Highway
Site Access
Car Park & Laydown Area
Ancillary Infrastructure
Car Park
Site Access
Legend
Project Boundary (Lot 2 DP1039185 and Lot 201 DP879480)
Watercourses
Roads
Site Layout
Overhead Transmission Line Grid Connection
Asset Protection Zone
Project Development Footprint
Site Buildings and Power Infrastructure Footprint
Connecting Roads
Car Park / Laydown Areas
Indicative Internal Road
Indicative Solar Array Areas
Source:
Imagery - ESRI World Imagery 2019
Cadastre and Base Data - NSW DCDB/ DTDB and QLD DCDB
Updated Project Layout
F2.1
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Bonshaw Solar Farm, NSW
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Drawn By: GR
Reviewed By: MR
Client: GAIA Australia
Coordinate System: GDA 1994 MGA Zone 56
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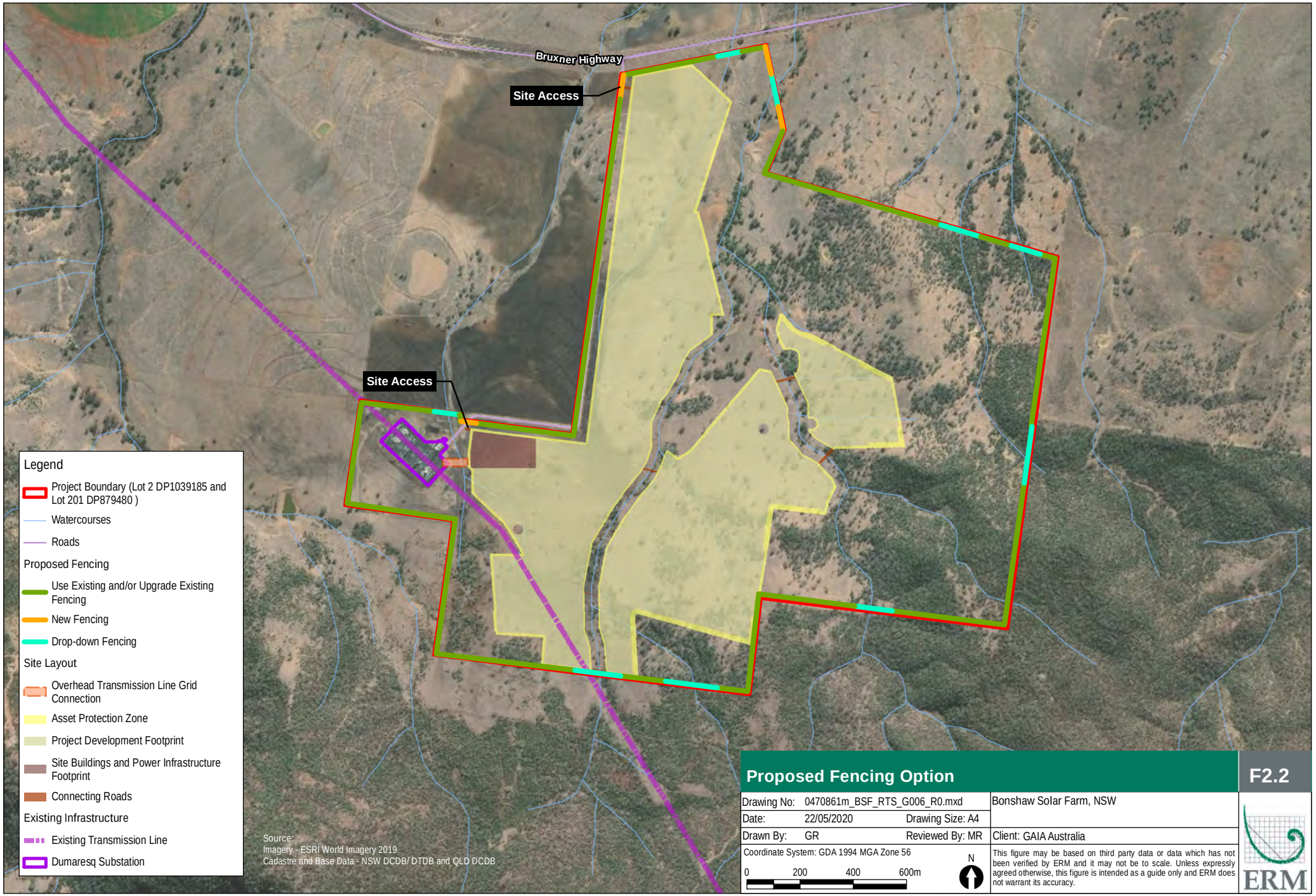
Bruxner Highway
Site Access
Site Access
Legend
Project Boundary (Lot 2 DP1039185 and Lot 201 DP879480)
Watercourses
Roads
Proposed Fencing
Use Existing and/or Upgrade Existing Fencing
New Fencing
Drop-down Fencing
Site Layout
Overhead Transmission Line Grid Connection
Asset Protection Zone
Project Development Footprint
Site Buildings and Power Infrastructure Footprint
Connecting Roads
Existing Infrastructure
Existing Transmission Line
Dumaresq Substation
Source:
Imagery - ESRI World Imagery 2019
Cadastre and Base Data - NSW DCDB/ DTDB and QLD DCDB
Proposed Fencing Option
F2.2
Drawing No: 0470861m_BSF_RTS_G006_R0.mxd
Date: 22/05/2020
Drawing Size: A4
Drawn By: GR
Reviewed By: MR
Coordinate System: GDA 1994 MGA Zone 56
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Bonshaw Solar Farm, NSW
Client: GAIA Australia
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3. SUMMATION

This response has been prepared to address items raised in the Department's request for information, dated 1 May 2020 and 27 May 2020. This response provides various updated details associated with the Bonshaw Project.

We trust the information provided is sufficient to address details requested by DPIE. Should you require any further details, please do not hesitate to contact the undersigned on (02) 4903 5535 or via email Lachlan.Giles@erm.com.

Yours sincerely,

Lachlan Giles
Environmental Planner

Michael Rookwood
Senior Planner

ATTACHMENT A UPDATED TRAFFIC IMPACT ASSESSMENT

Proposed Solar Farm,

Bruxner Highway, Bonshaw

ERM

Traffic Impact Assessment and Management Plan

Updated Access

Final Report

3rd June 2020

SECAsolution

Solar Farm Project, Bonshaw NSW

Traffic Assessment Report- access update

Author: Sean Morgan

Client: ERM

Issue: Final/3.06.2020

Reference: P1302

3 June 2020

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Quality Traffic Advice

1 Introduction

Seca Solution has been commissioned by Environmental Resources Management (ERM) Pty Ltd to review the traffic impacts associated with the construction and operational phase of a new Solar Farm development and to determine traffic management measures associated with the construction activities for the project. The project involves construction, operation and eventual decommissioning of a 200 megawatt (MW AC) solar farm located in Bonshaw, to the west of Tenterfield in NSW.

The traffic impact has been previously assessed by Seca Solution and has been reviewed by the Road Authority (Inverell Shire Council), the RMS (now Transport for NSW) and the Department of Planning, Industry and Environment. From this review, the access route has been altered in accordance with the Council and RMS comments and additional information provided to satisfy the requirements of these various stakeholders.

The following works and infrastructure would be required to support the construction and operation of the solar farm:

- Construction of a main access road for all access and egress for the Site
- Installation of Electrical infrastructure including:
- A 132kV Substation including two transformers and associated 132kV switchgear.
- Inverters to collect and convert DC to AC.
- BESS/battery storage with up to 300 MW (AC);
- Cabling and other electrical infrastructure (e.g. security systems).
- A maintenance compound and buildings.
- Fencing, landscaping and environmental works.
- Construct site access from the existing access road leading to the Dumaresq substation. A connecting road will join to the access road, connecting to the internal access road network at the north-western corner of the Project Site.
- installation of an overhead grid connection to Dumaresq Substation

The operational life of the solar farm is expected to be 30 years at which point the panels are either replaced and operations continue, or the infrastructure is removed, and the site is decommissioned and rehabilitated.

Construction of the site will take approximately 12 months.

Power generated by the facility will be transmitted via existing 330kV transmission lines, in an easement owned by TransGrid that traverses the Site.

As part of the development consent, and prior to work on site, a Construction Traffic Management Plan will need to be approved by the road authorities (Inverell Shire Council and Transport for NSW). The busiest period associated with the development with regards to traffic is during construction, with the operational phase of the project only requiring between 6-10 staff on site for the majority of the time. Seca Solution has prepared this Construction Traffic Management Plan (CTMP) for the project to ensure traffic issues can be safely and efficiently managed during the construction activities on site.

This CTMP has been developed for the construction activity for the project and the potential decommissioning element for the project, which may occur in 30 years' time. The potential decommissioning of the project site will require a similar level of activity, although will probably require less staff and would be completed over a shorter timeframe. The requirements and protocols for the decommission stage of the project will be as per the construction

phase, although it is acknowledged these may need to be reviewed and altered in 30 years to suit the road conditions at that time as well as the work requirements.

The site is located within the locality of Bonshaw, west of Tenterfield and is shown in Figure 1-1 and 1-2 to follow.

The site is currently arable land and has road frontage to the Bruxner Highway along its northern boundary.

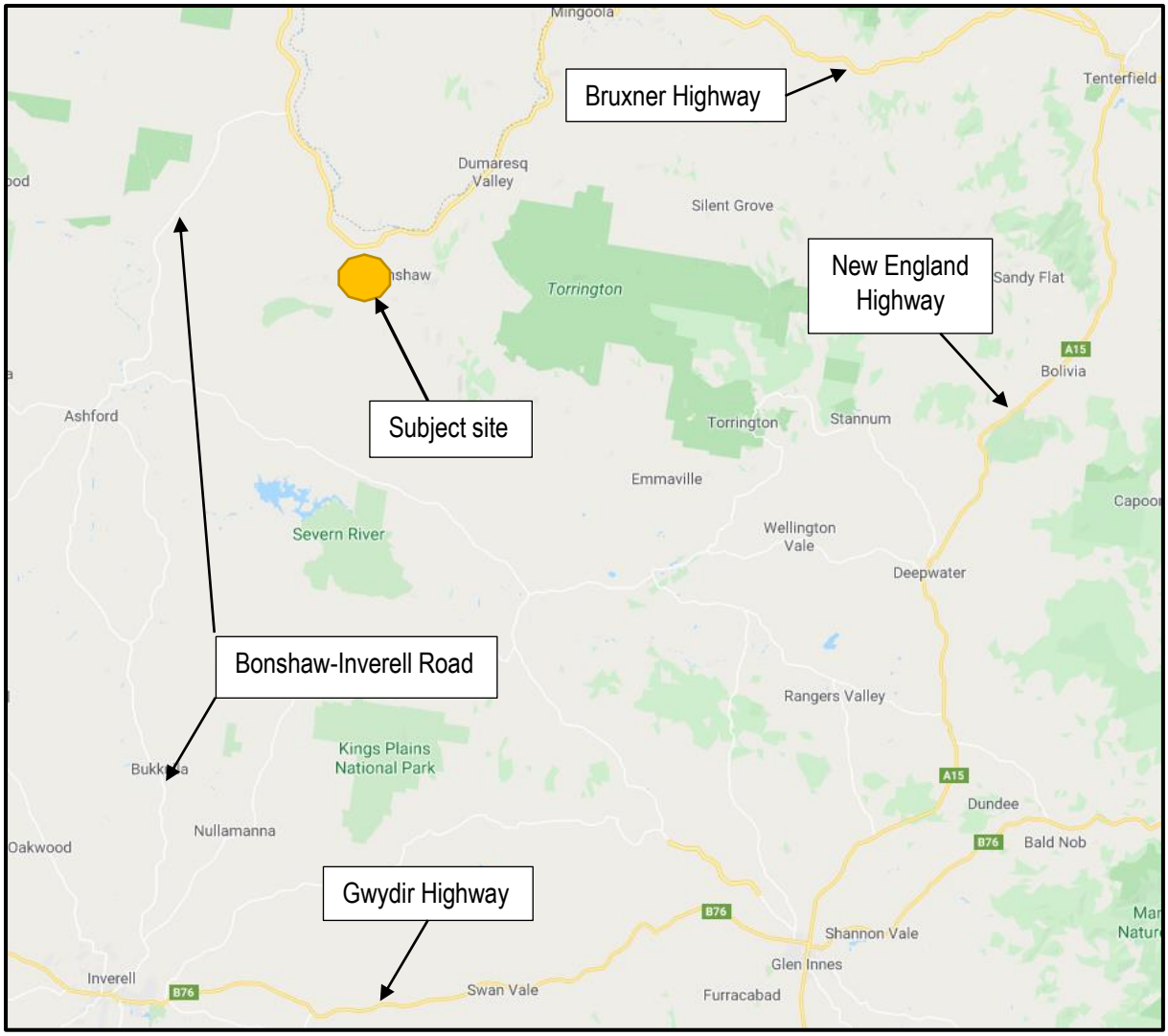

Figure 1-1: Site Location within the greater road network

Quality Traffic Advice

Figure 1-2 – Location of Sunnyside Platform Road

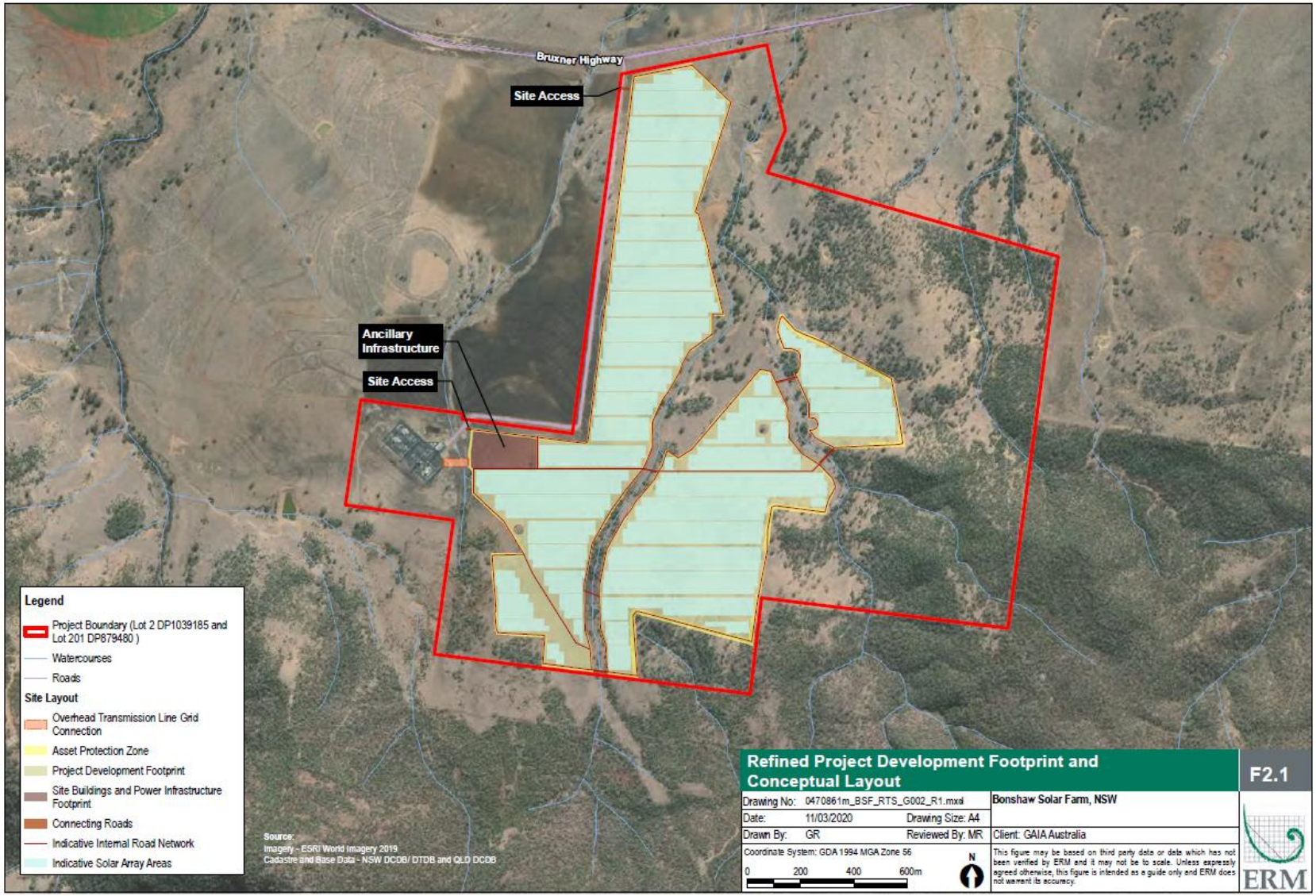

Figure 1-3 – Detailed site access and layout

1.1 Consultation and Authority Requirements

As part of the project, there has been consultation with the Department of Planning and Environment by the project manager and SEARs have been issued. A summary of the SEARs as they relate to traffic and access issues is presented below and the response is provided within this table.

SEARs issue	Response / Section of report
An assessment of the peak and average traffic generation including over-dimensional vehicle and construction worker transportation	The volume of traffic has been assessed for both the construction and operational phase. *Construction*: Peak staffing levels will require 65 light vehicles and 15 heavy vehicle inbound movements per day and similar outbound. For the sub-station installation there will be 3 over sized vehicles. *Operational*: 10 light vehicles per day inbound and outbound. Infrequent heavy vehicle for specific maintenance work only *Distribution:* Heavy vehicles via the designated heavy vehicle route to connect with the Bruxner Highway and New England Highway to east or west to Goondiwindi. **Refer Section 2.3, 2.4 3.1.1**
An assessment of the likely transport impacts to the site access route (including Bruxner Highway, Glenrock Road and Rocky Creek Road), site access point, rail safety issues, any Crown Land, particularly in relation to capacity and condition of the road	Heavy vehicles approaching the site will travel via the Bruxner Highway and New England Highway. For heavy vehicles exiting the site, they shall travel via the Bruxner Highway, then south through Ashford via Inverell – Bonshaw Road to Inverell then along the Gwydir Highway to the New England Highway at Glen Innes. No heavy vehicle access via Glenrock Road or Rocky Creek Road. **Refer Section 3, Figure 3.1** Existing traffic flows on New England Highway, Bruxner Highway and Gwydir Highway are low and well within acceptable limits. Minimal impact created by traffic during construction and operations. **Refer Section 4.1**
A cumulative impact assessment of traffic from nearby developments (including cumulative impacts from Sundown Solar Farm, Sapphire Solar Farm and White Rock Solar Farm)	Sundown Solar Farm located off Gwydir Highway and currently EIS being prepared. Limited interaction with the Bonshaw site on Bruxner Highway. Sapphire Solar Farm constructed and operational. Limited interaction with Bonshaw site on Bruxner Highway. White Rock Solar farm under construction. Limited interaction with Bonshaw site on Bruxner Highway. **Refer Section 4.2**
A description of any proposed road upgrades developed in consultation with the relevant road authority and rail authorities (if required)	Access provided on Bruxner Highway via the existing access to the electrical substation in this location. This access will be upgraded to provide a left turn deceleration lane (AUL (s)) and a widened shoulder for eastbound traffic (BAR treatment) in accordance with Austroads Guidelines. No other road upgrades proposed.

A description of the measures that would be implemented to mitigate any transportation impacts during construction	Map of route for heavy vehicles provided Refer Section 3 Figure 3.1. All drivers will sign code of conduct which specifies all road rules must be obeyed including driving through school zones - Refer Appendix B All staff and delivery drivers will be inducted to site and sign a driver code of conduct – Refer Appendix B The contractor on site shall establish a complaint handling process and resolution process. During construction activities nearby properties along the local haulage route on Bruxner Highway will be notified via a letter drop of construction work and timeframe – Refer Appendix A.

Transport for NSW consultation

Post exhibition of the project, discussion has been held with Greg Schiffe (GS) on 20th December 2019 from the RMS (now Transport for NSW) and the following points are noted:

- Agreed that the right turn out of Bruxner Highway onto the New England Highway is not suitable for the project. However, the left turn into this road is considered safe and appropriate. The right turn into the Bruxner Highway is also not considered appropriate for the project construction work;
- GS stated that the use of Sunnyside Platform Road is considered appropriate for the project, with this intersection providing a safe layout for vehicles including trucks turning right into Sunnyside Platform Road for access from the north.
- Accident data review is required for access between the site and the regional road network (being the New England Highway);
- If exit truck movements are to head south via Ashford to Inverell then this route needs to be reviewed and assessed for the impact of these trucks on this route
- Require clarification on the access location and GS indicated access via the existing access to the electric substation is the preferred option
- Require clarification on access routes for light and heavy vehicles. GS indicated that directing light vehicles to use the route via Ashford is not feasible due to the additional travel distance / time and directing light vehicles via Sunnyside Platform Road is appropriate.

RMS Consultation

Consultation has been held via a phone conversation with Andrew McIntyre, manager Land Use Assessment, Western Region (September 2017) with regard to a number of solar farms proposed to be constructed across rural NSW. The relevant outcome of the discussion with Andrew McIntyre is provided below:

- The critical phase for the assessment is the construction activities as this involves heavy vehicle access to the site along regional and local roads as well as a high number of workers;
- Consideration to the movement of staff to and from the site must be given. In remote areas where the solar farms are constructed, there are a large number of staff who can be drive in/drive out re-locating for temporary work from the established east coast centres such as Sydney and Newcastle. This requires staff to drive a long-distance home after working on the site for long hours for a week or more – consideration to controls for staff driving home after working on site should be considered;
- Provide details on the access routes to the site for heavy vehicles and the size / number of heavy vehicle movements associated with the construction and operation of the site;

- Provide details on the operational characteristics of the project – it is recognised that the staff levels and traffic volumes for the operational stage of the project are low;
- Provide comment with regard to the decommissioning stage of the project and the potential traffic impacts;
- Prepare a driver code of conduct for the project to control vehicle access and maintain safety;
- Assess impacts on road safety, including pedestrians and cyclists and any bus routes impacted
- Review alternative transport options for the site including pedestrians, cyclists and bus use
- Provide details on any road upgrades identified as part of the project and include a Road Safety Audit as required

2 Existing Road Network and Local Characteristics

The **Bruxner Highway** is a state classified road, which runs to the north of the subject site with an east-west orientation providing connection between the New England Highway to the east and Boggabilla to the west where it connects with the Newell Highway. The south, east and west boundaries of the subject lands are defined by neighbouring agricultural lots with some sections of unnamed, unsealed rural roads. The Bruxner Highway is sealed (refer Photo 1 below) and provides a width of approximately 6 metres passing the site allowing for 2-way traffic movements as required. It operates under the posted speed limit of 100 km/h.

The Bruxner Highway connects with the New England Highway to the east of the site at a four way give way controlled intersection with the New England being the priority road and Old Ballandean Road being the opposite minor road.

Photo 1 – View along Bruxner Highway in the vicinity of the project site

The **New England Highway** is a state classified road that is a key freight route in NSW and forms part of the road network designated by the Roads and Maritime to carry oversize, over mass vehicles. It typically provides a single lane of travel in both directions and operates under the posted speed limit of 110 km/h outside of the urban areas where the alignment permits. As part of the state road network, the New England Highway carries a mixture of local, regional and inter-state traffic with a significant number of trucks including B-double combinations. The **Cunningham Highway** operate in a similar manner providing key transport routes between Ipswich and the New England Highway at Warwick.

To the south of the site is the **Gwydir Highway**, which is a state classified road that is a key freight route in NSW and forms part of the road network designated by Transport for NSW to carry oversize, over mass vehicles. It typically provides a single lane of travel in both directions and operates under the posted speed limit of 100 km/h outside of the urban areas where the alignment permits. As part of the state road network, the Gwydir Highway carries a mixture of local, regional and inter-state traffic with a significant number of trucks including B-double combinations.

Bonshaw Road is a local road managed by Inverell Shire Council, located to the west of the site. It is a sealed two-way road with an overall width in the order of 7 metres. It intersects with the Bruxner Highway via a simple give way controlled intersection with the Bruxner Highway being the priority road. This road continues south and connects with **Ashford Road** in Ashford to provide a road link through to Inverell. This route provides a consistent road standard and forms part of the approved B-double road network in NSW. Both of these road provide a single lane of travel in both directions and operate under the posted speed limit of 100 km/h.

Sunnyside Platform Road is a local road providing an approved B-double connection between the New England Highway and Bruxner Highway. It provides a pavement width in the order of 7 metres wide permitting 2-way traffic movements.

As part of the project, it is proposed that all heavy vehicles will travel via the roads identified above. Local supplies could be sourced from Goondiwindi or Tenterfield as well as accommodation for workers associated with the project.

2.1 Traffic Volumes and Road Operation

Traffic volumes in the immediate vicinity of the subject site are very low, reflective of the rural environment. The Bruxner Highway carries relatively low traffic flows, reflective of its rural setting with a mixture of local traffic as well as regional traffic demands. Observations on site during a typical morning period (Tuesday 11th September 2018) shows that the current road network in the vicinity of the subject site operates very well with no delays. The route proposed to be used for the project carries low traffic flows and operates with no delays except for those associated with drivers slowing down to observe traffic flows on the approaches to the various intersections and negotiating the intersections.

Transport for NSW webpage provides traffic data on the Bruxner Highway at Mingoola (station Id 91170), approximately 15 kms east of the subject site. The traffic data from 2011 shows that the daily traffic flow was 213 vehicles per day with around 23% heavy vehicles, reflective of rural demands in this location. It is considered that there has been limited growth in traffic since this time and as such the current daily traffic flows are considered to be similar.

The same web page shows that in 2011 the daily traffic flow on the New England Highway to the immediate north of Tenterfield (station Id 91577) was 2421. It is considered that there has been limited growth in this area since 2011 and as such the daily traffic flows would be similar. In 2012 the traffic flows on Bonshaw Road were 232 vehicles per day northbound. Assuming southbound flows to be the same would give daily flows in the order of 500 vehicles per day. It is considered that these flows would not have altered much since 2012.

For the Gwydir Highway, the same web page shows that the daily flows to the east of Inverell were 1,317 in 2019 whilst to the west of Glen Innes the flows on the Gwydir Highway in 2019 were 1,442.

2.2 Road Safety

It is recognised that as part of the project work, there will be a significant number of heavy vehicle movements associated with construction which may impact the local road network. All inbound heavy vehicle access to the project site will be via the Bruxner Highway and the New England Highway. For traffic from Goondiwindi, the route will be via the Newell Highway to town and along the Bruxner Highway. Inbound items such as the solar panels will be via the New England Highway (northbound from the Port of Newcastle) or via the Cunningham Highway connecting with the Port of Brisbane. No alternative route for inbound heavy delivery vehicles has been considered as this route is appropriate.

For outbound empty truck movements, movements to Goondiwindi would be the same, as would truck movements to the Brisbane area which shall use Sunnyside Platform Road to then turn left on the New England Highway. However, for trucks heading back towards Newcastle, the right turn out of the Bruxner Highway onto the New England Highway is not considered appropriate due to its poor visibility and intersection layout it represents a road safety risk for the project. As such, trucks wishing to head south towards Newcastle shall use the route via Inverell - Bonshaw Road to connect to Inverell and the Gwydir Highway. This is via the approved B-double road network and shall have an acceptable impact upon road safety.

Photo 2 – Sheltered turn lane for right turning vehicles into Sunnyside Platform Road from the New England Highway. Note straight alignment that allow for good visibility

Figure 2-1– aerial photo showing layout of New England Highway and Sunnyside Platform Road showing straight alignment of New England Highway and sheltered turn lane (source: google maps).

The major road safety impact is associated with the delivery trucks accessing the site and their impact upon the operation of the intersections. The trucks carrying the solar panels and other specialist materials will be accessing the site from either the Port of Newcastle or the Port at Brisbane, to which the solar panels shall be shipped. The trucks will then access Bonshaw via the regional road network which will include the New England Highway and the Cunningham Highway if from Brisbane. These regional roads currently provide a high standard of road and allow for the movement of local, regional and national road freight and carry B-double trucks. It is considered that the additional truck movements associated with the construction activities for the project will have a minimal and acceptable impact upon road safety along these roads.

For the sub-station installation there is a requirement for 3 over sized vehicles to access the site. These will require a separate approval and permit through the National Heavy Vehicle Regulator with Transport for NSW approval. Safety requirements and impacts are assessed as part of the permit application and the necessary safety controls applied which can include escort vehicles and Police vehicle support.

The nominated vehicle route currently caters for a large number of heavy vehicles including B-double combinations. This route provides a wide road pavement and in major built up areas cater for kerb side parking and the safe 2-way movement of trucks along the road. The intersections along this route are well laid out and provide good visibility in all directions to allow for the safe turning movements of vehicles. It is considered that this route through the various towns can safely accommodate the additional traffic movements associated with the project.

For the local traffic impacts, consideration has been given to the existing alignment of the road, intersection layouts, current traffic flows and existing users along the Bruxner Highway. Observations on site with regard to road safety are summarised below:

- Existing traffic flows on the local road are very low
- The sealed width of the road allows for two-way traffic movements
- The alignment of the road is generally good
- There are a number of sub-standard curves where there are advisory signs provided in advance with 55 and 65 km/h speed limit guidance signs
- A number of heavy vehicles were observed travelling along the Bruxner Highway during the site work, associated with local farm requirements as well as general deliveries in the area. These included semi-trailers.

These routes are provided below (Figure 2-1) and will be included within the Driver's Code of Conduct which will form part of the project inception meeting for the project for all staff and drivers.

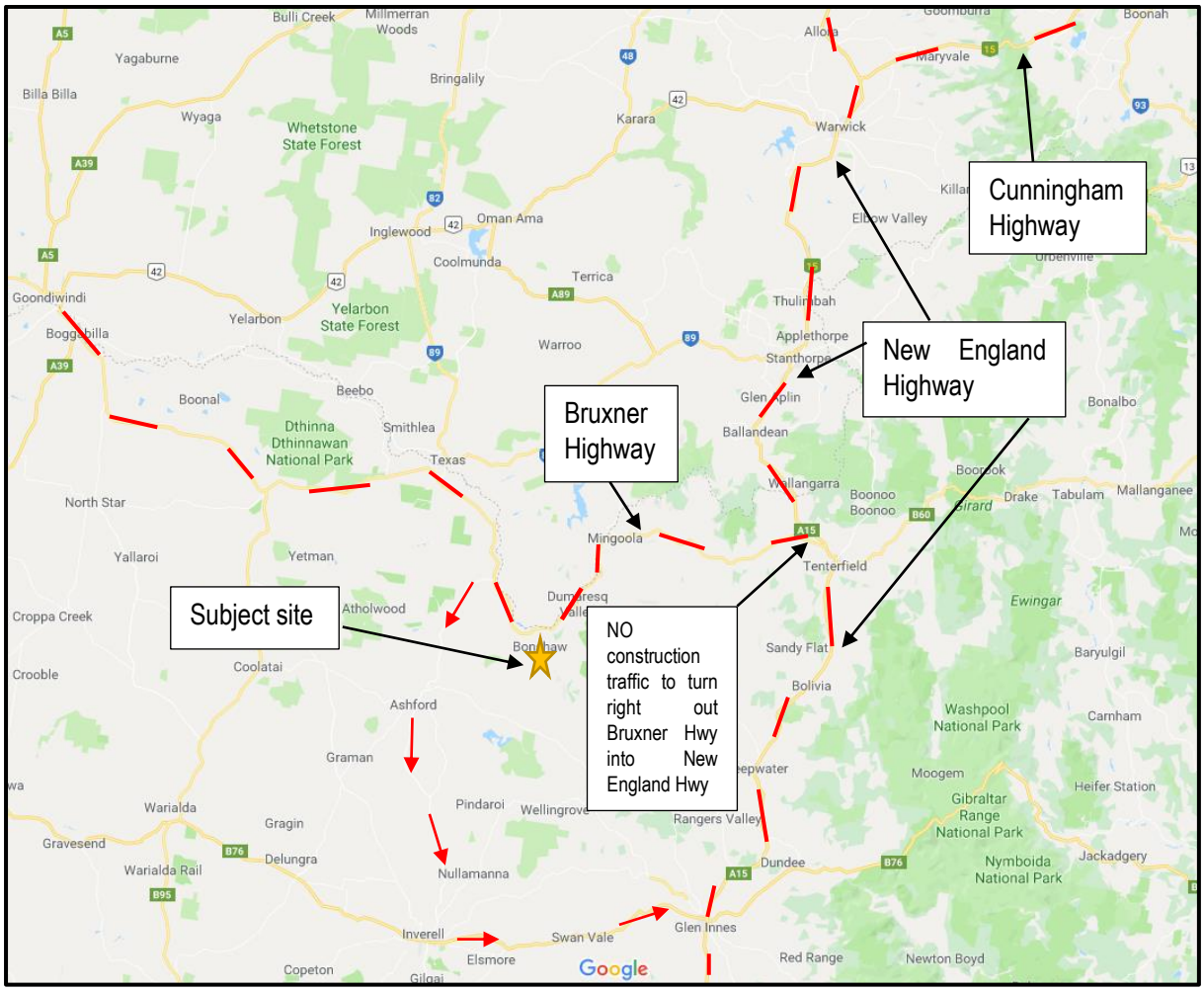

Figure 2-2 – Designated Heavy Vehicle route to project site

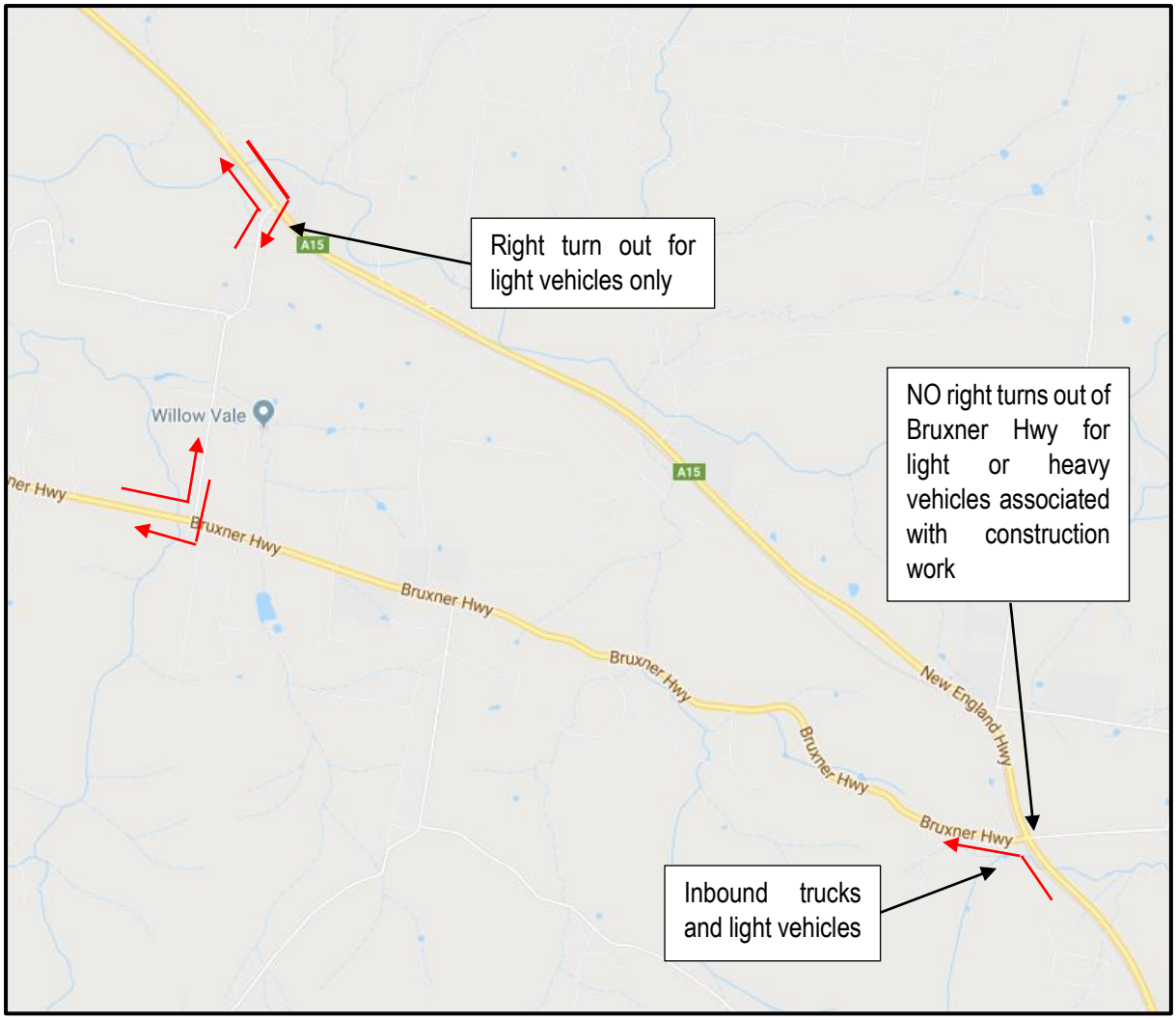

Figure 2-3 – Detail for truck connection from north between New England Highway and Bruxner Highway. Allows for inbound and outbound connection

2.2.1 Intersection of Bruxner Highway and New England Highway

The intersection of the Bruxner Highway and New England Highway is 4-way cross road with the New England Highway being the priority road. Give way signs delineate the controls for the side road. This intersection has been upgraded with new line marking that provides a sheltered right turn lane for traffic turning off the New England Highway into the Bruxner Highway from the north as well as a right turn lane for traffic from the south turning into Old Ballandean Road. It allows for all turning movements and as part of the main transport route in this area caters for the swept path of B-double combinations. This intersection is located within a posted speed zone of 100 km/h. The sight line requirements for drivers approaching the intersection have been assessed against the requirements of Austroads Guidelines. For the posted speed limit of 100 km/h the sight distance requirement is 248 metres. To the right, looking south this sight line is available for drivers. However, to the left (north) the sight line is restricted due to the vertical alignment of the road, which creates a safety concern. In addition, for a truck turning right out of this road onto the New England Highway, there is a single lane southbound which creates further safety concerns for the project. A truck turning right out of the Bruxner Highway could then be a hazard for a southbound vehicle leading to rear end accidents. In a 100 km/h speed zone this is not considered to be acceptable.

For the right turn into the Bruxner Highway off the New England Highway this visibility restriction also creates concerns with potential for rear end type accidents.

Photo 3 – View to left for a driver exiting the Bruxner Highway onto the New England Highway.

Photo 4 – View northbound on the New England Highway on approach to intersection with the Bruxner Highway. Note good forward visibility and dual lanes to allow a through vehicle movement to pass a left turning vehicle into the Bruxner Highway.

For all other movements at the intersection of the Bruxner Highway and the New England Highway the existing intersection controls are considered to be appropriate for the traffic movements associated with the project site. For traffic from the south on the New England Highway, the forward visibility is good allowing a driver to adjust their vehicle speed to cater for a vehicle in front turning left onto the Bruxner Highway. The traffic flows on the New England Highway in this location are relatively low and as such this will create minimal delays for other drivers.

With the proposed restrictions in turn movements for the construction traffic at this intersection, no upgrade works are required at this intersection to accommodate the traffic movements associated with the proposed solar farm (both construction and operation phase).

To mitigate the issue associated with the right turn out of the Bruxner Highway into the New England Highway, all trucks leaving the site wishing to head south shall instead turn left out of the site onto the Bruxner Highway, then turn left onto Bonshaw Road to head south to Ashford continuing south on Ashford Road to Inverell via the approved B-double route. These vehicles shall then travel along the Gwydir Highway to Glen Innes to connect to the New England Highway. This will eliminate right turn movements allowing for left turn movements only.

For all other intersections along the routes, the intersections are well laid out and provide good visibility for road users. As such these other routes, which are all approved for use by B-doubles, will provide a safe and appropriate route for heavy and light vehicles associated with the project site,

2.2.2 Site access on Bruxner Highway

The access to the site will be via the existing access provided to the electric substation adjacent to the subject site. This access was constructed to allow for the construction activities associated with the electric substation and is now used for maintenance purposes only for the substation. This access will be upgraded to provide a left turn deceleration lane (AUL(s)) and shoulder widening to provide an AUR treatment, both in accordance with Austroads Guidelines.

The design of this upgrade will be reviewed with the road authority through the approval process.

Photo 5 View on Bruxner Highway showing layout of access connection to existing electric substation.

During the construction work, there will be some heavy vehicles arriving to the site from Goondiwindi, west of the site. These movements would be associated with the supply of equipment for the construction work. For traffic approaching from the west, the forward sight distance to the site access is approximately 700 metres. Austroads Guidelines require a sight distance of 248 metres for the posted speed limit of 100 km/h and 300 metres for a speed limit of 110 km/h. With the forward sight distance available, a driver can adjust their vehicle speed if required on the approach to the site access if there is a vehicle propped waiting to turn right into the site. However, given the very low traffic flows on the Bruxner Highway, it is not considered that vehicles turning right into the site will need to prop on the highway with the only delays created by vehicles slowing down to negotiate the site access driveway. Safety will be maintained with a Traffic Control Plan to reduce vehicles speeds on the Bruxner Highway during this construction work with reduced vehicle speeds and truck turning advisory signs.

Trucks exiting the site will all turn left onto the Bruxner Highway. With the low traffic flows on the Bruxner Highway, this can safely occur as there are large gaps in the through traffic movements in this location. For trucks turning left out of the site, the sight distance available to the right (east) exceeds 700 metres allowing a driver to safely exit the site and travel along the highway. No left turn acceleration lane is required for this movement.

Photo 6 – View to right along Bruxner Highway for drivers exiting the project site

Photo 7 – view to left for vehicles exiting the access to the electric substation

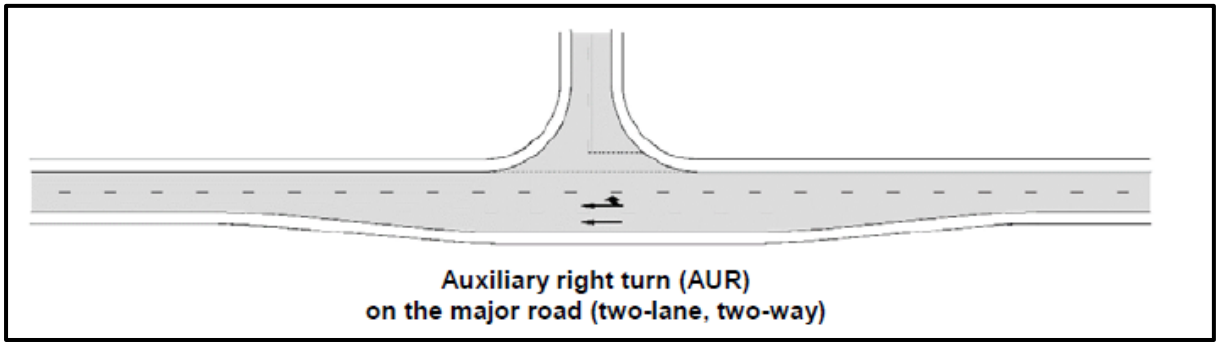

Figure 4 – AUR type right turn treatment proposed at site access (same as old BAR type control)

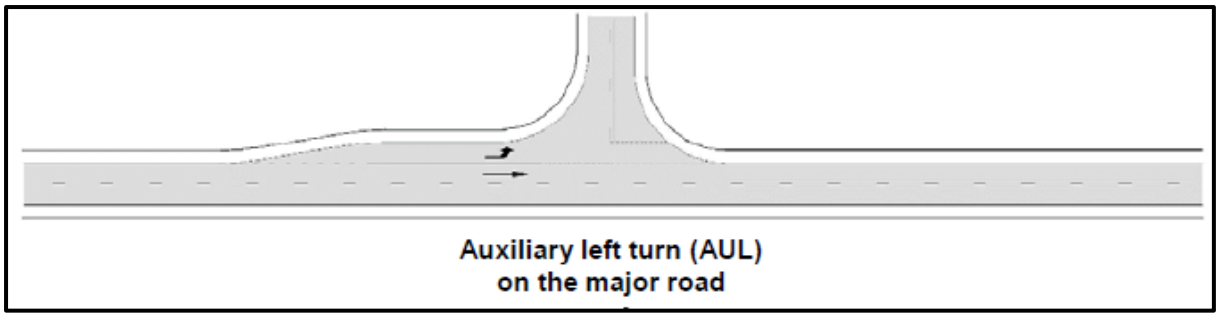

Figure 5 – AUL type left turn treatment proposed at site access

2.3 Accident History

A review of accident data provided by TfNSW (Appendix C) for the period July 2014 to June 2019 has determined the vast majority of accidents along the proposed heavy vehicle route involved single vehicles (74%). Speeding was also determined as a contributing factor for over half of the accidents recorded, with the most common crash type being vehicles going off-road. In reviewing the data, it can be seen that speeding is a major factor in the number of accidents recorded. As discussed above the route and major intersections have been assessed on road, with no inherent road safety issue identified.

2.4 Mitigation Measures

From the details above the following mitigation measures are proposed.

- Provide a temporary TCP on the site frontage on the Bruxner Highway, adjacent to the site access, for construction work associated with upgrading the access and for traffic entering and exiting the site. This TCP shall only be in place during construction and signs shall be removed or covered outside of construction activities on the site. Once the construction work is complete this TCP shall be fully removed. This TCP will be prepared in accordance with "Traffic Control at work sites" published by the RMS dated July 2018. This TCP is provided in Appendix D to this report;
- Provide regular community updates for residents along the Bruxner Highway in the vicinity of the site to advise of construction activities and increased heavy vehicle movements along this road;

2.4.1 Light Vehicle Route

For light vehicles associated with workers, the proposed access route will be via the designated heavy vehicle route shown in Figure 2-1 above. This route provides a safe and acceptable route for light vehicles which can safely and conveniently access the site. For light vehicles leaving the site and heading towards Tenterfield or Glen Innes (via the New England Highway), these drivers will be required to turn left onto Sunnyside Platform Road and then turn right from this road onto the New England Highway, to avoid the existing safety concerns identified at the intersection of the Bruxner Highway and New England Highway. This shall be documented through the Driver Code of Conduct for the construction staff.

Light vehicle access could also be from Goondiwindi associated with construction workers via the Bruxner Highway.

The project will be utilising workers local to the site from the main centres e.g. Tenterfield, Goondiwindi, Inverell who will use this route as well as other local roads to connect between Inverell and the site. Additional specialist staff may be required, and these staff members would be located in accommodation in Tenterfield, Inverell and Goondiwindi.

3 Construction Activities

The construction and commissioning phase is expected to last approximately 12 months with expected commencement in late 2020. The main construction activities would include:

- **Site preparation:** geotechnical investigations to confirm ground conditions; site survey to confirm allotment boundary, riparian zone, and infrastructure positioning and placement; installation of fencing, internal access tracks, establishment of foundations and hardstands; office and car parking area;
- **Construction activities:** including installation of mounting structures and tracker tubes; securing PV modules to tracker tubes; installation of cabling and switching station, establishment of BESS / battery storage and maintenance compounds and associated site infrastructure; and testing and commissioning;
- **Plant and Equipment:** will include earthmoving plant and equipment for site preparation and clearing; cable trenching and laying equipment; pile drive equipment; forklifts and cranes; water truck for dust suppression and machinery equipment for construction of BESS / battery storage and associated facilities.

The project does not require any concrete footings to be provided for the solar panels construction.

A site office and compound will be established on site for the duration of the works with temporary access tracks provided to allow for access as required across the site.

Staffing levels at peak construction activities is expected to be 190 personnel on site maximum. The demand for staff numbers will be lower at the commencement of the project and shall increase overtime to the maximum of 190 staff. This demand is also expected to decrease towards the end of the project.

All staff vehicles will be able to park within the site adjacent to the site office with no external parking demands. The car park area will allow for up to 80 vehicles to park within this compound area. The size of the overall site footprint however will allow for all construction staff vehicles to park on site. As part of the project construction it is proposed to maximise the local workers content and car-pooling will be encouraged and supported as part of these trips. With 2 or 3 people arriving in a single vehicle it can be seen that the parking demands can be contained within the site.

The access to the site will be via the existing access constructed for the adjacent electric sub-station. This access road was previously used for the construction works associated with this substation and is now only used for access for maintenance work on the sub-station. With the vast majority of the heavy vehicles accessing the site from the east (via the New England Highway) it is proposed to provide a left turn deceleration lane for the site access to allow for a safe entry for the construction traffic. With limited demand for access from the west of the site, there is no requirements for a sheltered right turn lane to be provided at the access point.

3.1 Timing

The construction of the solar farm is expected to commence in 2020 and be completed within a 12 month timeframe.

3.2 Working Hours

Construction hours are in accordance with the *Interim Construction Noise Guidelines* (DECC 2009) (ICNG) with standard construction hours being

- 7:00am and 6:00pm Monday to Friday
- 8.00 AM to 1.00 PM on a Saturday

- No construction work is to be carried out on a Sunday or public holiday.

No construction work, upgrading or decommissioning activities will be undertaken outside of these hours with the exception of:

- The delivery of material as requested by the NSW Police Force to other authorities for safety reasons; or
- Emergency work to avoid the loss of life, property and / or material harm to the environment.

3.3 Construction staff numbers

Peak demand levels for the construction work will vary with a peak of 190 people for a 6 month duration and a lower level outside of this peak period. The staff will be sourced locally where appropriate with some specialist and project management staff being temporarily located in Tenterfield, Inverell and potentially Goondiwindi. Staff will be encouraged and supported to carpool as appropriate with other staff transferred to and from the site via mini coaches to reduce vehicle demands. Due to the size of the site footprint, these same vehicles will also be used on site to move staff across the site.

With a peak of 190 staff, a vehicle occupancy rate of 3 people per vehicle has been assumed based upon carpooling and the use of a mini bus e.g. Toyota Hiace. This would give around 65 vehicle movements inbound and outbound for staff movements during this peak construction activity. Either side f this peak the staff levels will be lower and hence light vehicle numbers will correspondingly decrease.

All light construction vehicles will be able to park on site within the office compound or across the site as required. The parking on site will be informal and located across the site to suit the construction work. Due to the overall footprint of the site the vehicles on site will be required to carry staff and equipment across the site to the construction activity area (which varies across the project) and as such the vehicles are not all parked in one location for the duration of the project.

Given the overall size of the project site all parking demands can be managed on site with no impact upon the external road network.

3.4 Heavy vehicle requirements

The number of heavy vehicles accessing the site will vary across the project timeframe. At the beginning of the project there will be a requirement for some earth moving equipment to construct the access road and some minor earthworks across the site as required. This may require a scraper or bulldozer which will be transported to site on a low loader. This machinery will remain on site for the duration of the earthworks portion of the project construction work.

While extensive earthworks are not proposed, some land forming (including localised cut and fill areas) may be undertaken to achieve more consistent gradients beneath the PV modules. Additionally, earthworks are required for trenching works.

In total:

- Approximately 15,000 m^3 of gravel would be required to cap the access road
- Approximately 15,000 m^3 of sand (subject to detailed design) would be required for the bedding of cables that are to be buried throughout the site

Should any excavated material not be suitable for reuse or additional fill material required, the maximum amount of fill is estimated to be 12,000 m^3.

Once the earthworks have been completed, the balance of the construction work will commence requiring machinery including:

- Pile driver (20)

- Piling rig
- All terrain fork-lift (20)
- All terrain utility vehicles (10)
- Backhoe (10)
- Flatbed trucks (10)
- Mobile crane (1)

Other equipment if required may include an elevated work platform, scraper, roller and winches. All of the plant will be located on site and will therefore be only required to access the site once for the construction works.

The solar panels are expected to be delivered from either the Port of Newcastle or Port of Brisbane. Other specialist equipment is generally sourced from Newcastle or Brisbane as required whilst consumables such as concrete and general material supplies will be sourced locally from the Tenterfield area.

A summary of the expected vehicle movements associated with the construction work is provided below and shows the full movements for the duration of the project. These movements are spread out across the project, with the site set up and earthworks commencing at the beginning of the project. Once this work is complete, the balance of the construction work will commence with deliveries of the specialist equipment etc along with the import of backfill material being over a number of weeks to suit the construction timeframe.

These traffic numbers are based on the concept design work for the project and could alter through the detailed design phase of the project.

3.5 Vehicle movements

A summary of the vehicle movements is provided below.

Phase	Purpose	Vehicle Type / Trailer Type	No. of one-way vehicle movements
Site Set-Up and Demobilisation	Portacabin delivery and removal	Low loader	20
	Skip delivery and removal	Low loader	40
	Generator delivery and removal	Semi-trailer	4
	General deliveries	Semi-trailer	40
	Crane mobilization and demobilization	Crane	4
	Water tank delivery and removal		4
Roads and hardstands	Delivery of imported capping for road laydowns and crane hardstands	Truck and dog	500
	Plant delivery and removal: excavators, compactors drill rig	Low loader	40
	Concrete deliveries for maintenance container hardstands	Concrete agitator	120
Generating Equipment	Tool container delivery and removal	Low loader	4
	Module deliveries	Semi-trailer	2000
	Mounting structure and pile deliveries	Semi-trailer	1600
	Inverter Station deliveries	Low loader	3
	DC cabling trays and combiner boxes	Semi-trailer	400
AC Cable Installation	AC Cable delivery	Semi-trailer	400
	Backfill material delivery	Dump Truck	1800
Plant delivery and removal	Telescopic handler and excavator	Low loader	50
Overhead Line	Conductor delivery	Semi-trailer	25
	Pole deliveries	RAV	6
	Pole dressing delivery	Semi-trailer	2
Other	Miscellaneous deliveries	Light vehicle	40
	Monitoring equipment fibre SCADA servers etc	Truck	2
	Waste Collection	Truck	400
	Consumables (Oil and Fuel)	Truck	40
		TOTAL	**7,544**

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In summary, typical vehicle movements during the peak construction period (over 6 months) are in the order of 65 light and 20 heavy vehicles two-way (65/20 inbound, 65/20 outbound) per day. For the light vehicles, the vast majority of these will be inbound movements in the morning bringing workers to the site with these vehicles then remaining on site for the full working day before leaving at the end of the working day. It is expected that there will be limited light vehicle movement outside of these periods, other than support staff e.g. office staff or the occasional visitor to the site.

For the heavy vehicles, these will typically be spread across the working day. For the solar panel deliveries, these trucks are arriving from either the Port of Brisbane or the Port of Newcastle and the journey length will be over 5 or 7 hours respectively, seeing a spread of these vehicles not all arriving at the same time. Allowing for each truck to be emptied on site one at a time, the outbound movements will also be spread out and not all leave at the same time. All other heavy vehicles will also be spread out across the normal working day with no concentration of heavy movements expected.

Outside of the peak period of construction, the staff levels will be lower and the daily light vehicle numbers will be less than 65 inbound and outbound per day. The heavy vehicle numbers will also be lower outside of the peak construction activity and less than 20 vehicles inbound and outbound per day.

4 Traffic Management Assessment

The proposed traffic management measures allow for all access off the Bruxner Highway only. The access to be used will be for the construction traffic movements as well as the future on-site operational demands. This access is to be provided in accordance with the requirements for the site operations (including swept path requirements for delivery vehicles) and take into account the design requirements of Inverell Shire Council.

The designated access route to the site will be used by both light and heavy vehicles.

All vehicle movements in and out of the site are as shown below in Figure 4-1.

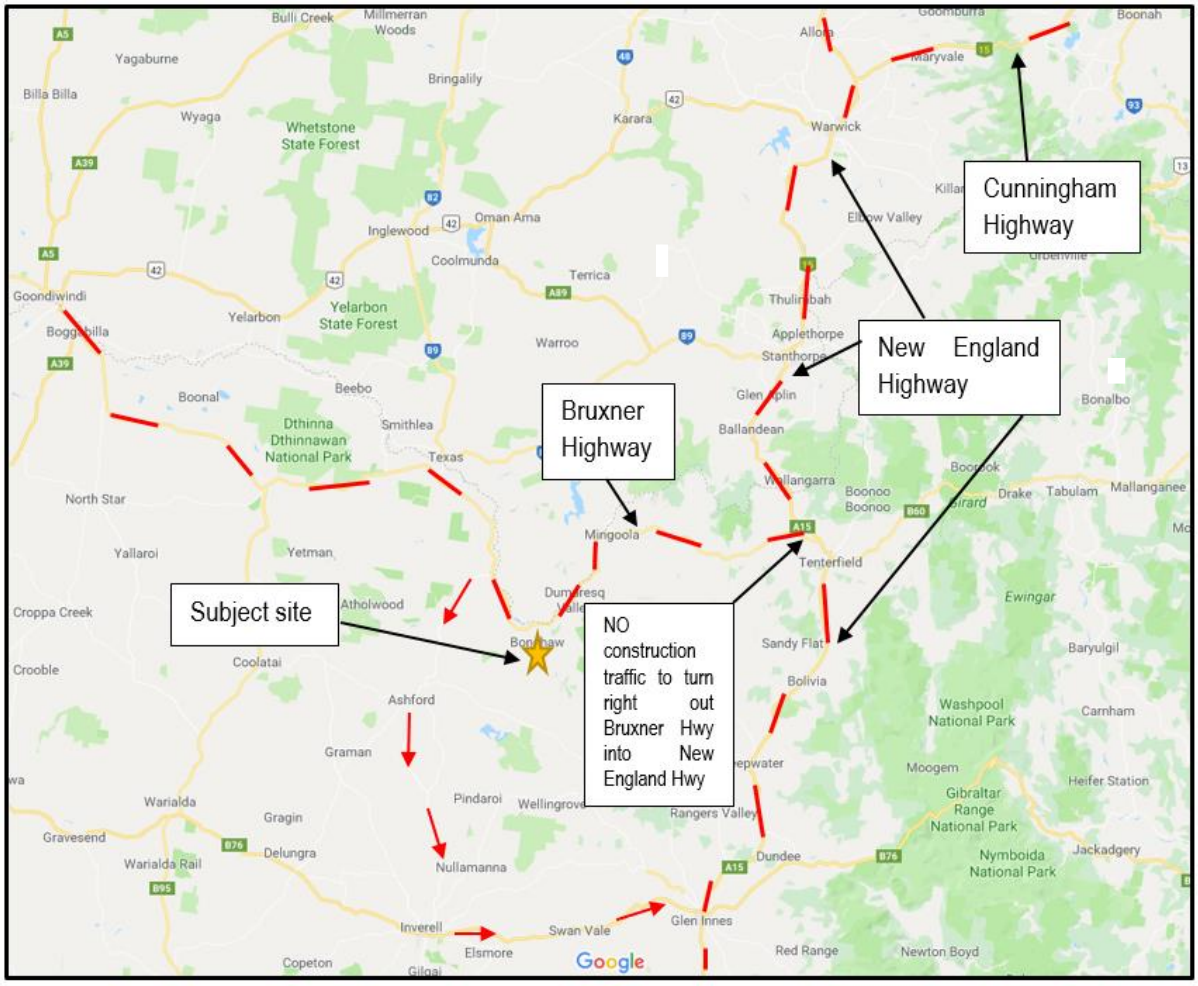

Figure 4-1 – Heavy and Light Vehicle access route to subject site

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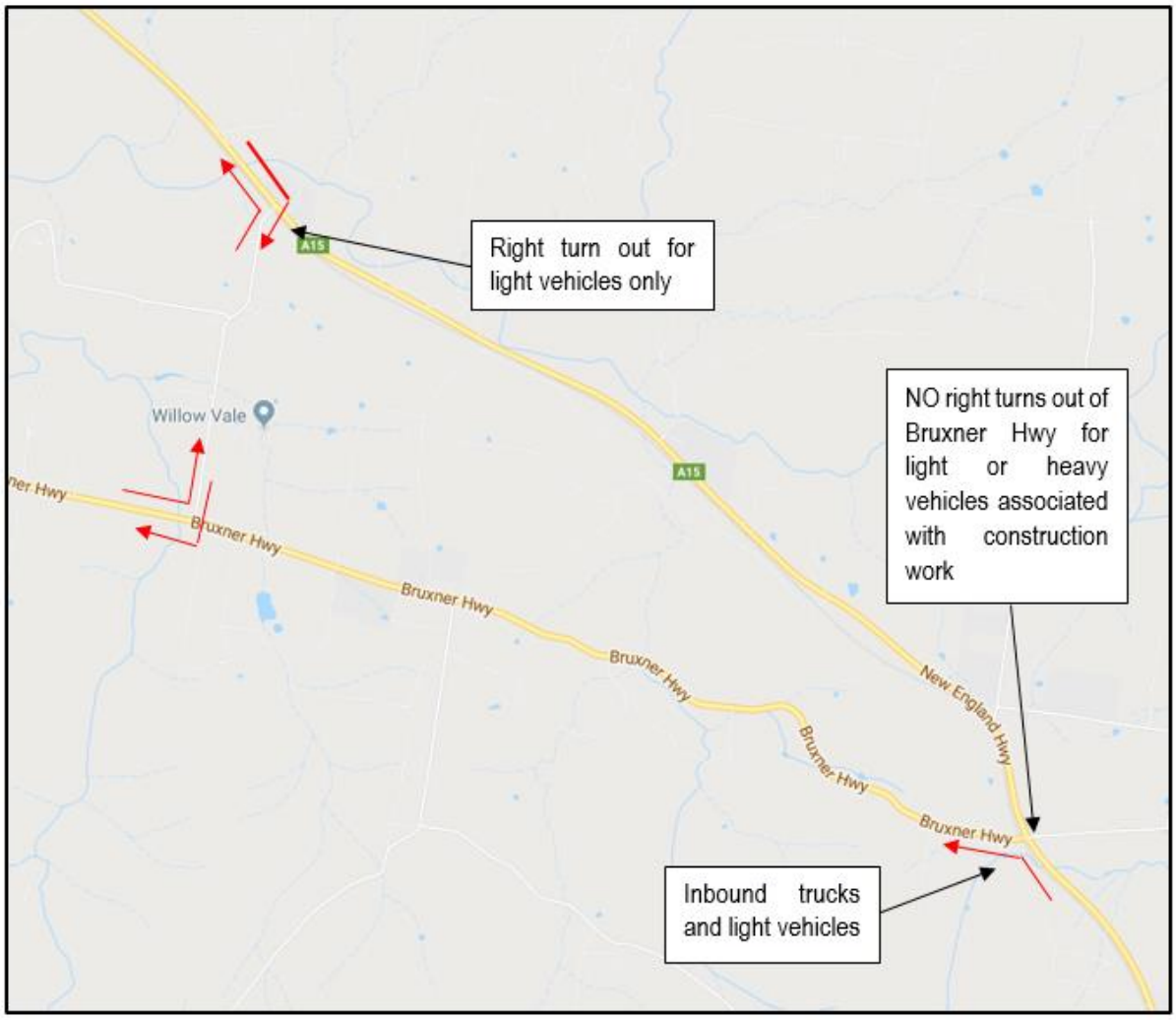

Figure 4-2 – detail for connection between New England Highway and Bruxner Highway

4.1 Impact Assessment

The project will require the delivery of the solar panels and other specialist equipment from Newcastle or Brisbane with the access route via:

- Newcastle metropolitan regional road network
- Hunter Expressway / New England Highway
- New England Highway to Bruxner Highway turn off
- Bruxner Highway to site access
- Bonshaw-Inverell Road
- Gwydir Highway
- Brisbane metropolitan regional road network
- Cunningham Highway
- New England Highway to Bruxner Highway.

These roads all form part of the road freight routes within the State road network and all are approved for heavy vehicle movements including B-double access for the full length of the routes. These routes will be documented as the Haulage Route for all delivery vehicles associated with haulage of the solar panels and other specialist materials for the project site.

These roads carry a high number of heavy vehicles, including B-doubles associated with local and regional agricultural demands. These agricultural demands are seasonal in nature and occur 24 hours a day often involving night travel and operations. There are a number of farms in the general locality of the project site as well as in the wider area that use these local and regional roads during these seasonally high demand periods. Due to the seasonal nature of this work and the requirement for quick turnaround of crop deliveries it is considered that it is not appropriate to limit truck movements for these farms. Similarly, it is considered that it is not appropriate to limit truck movements to and from the project site at these times as the traffic movements on the local roads will continue to remain low.

The roads proposed to be used for trucks accessing the site all currently accommodate the swept path requirements for B doubles to access the site. The site access on the Bruxner Highway was previously used for constructing the electric sub station on the site and accommodates the swept path movements of B doubles as well as Over Size Over Mass (OSOM) vehicles that were required as part of the construction for this electric substation.

For the regional road network e.g. New England Highway / Hunter Expressway, Bruxner Highway, Cunningham Highway the total traffic flows will remain well within acceptable limits and as such will continue to operate to a good level of service and accommodate all road users.

The traffic flows along the local roads giving access for the heavy and light vehicle movements associated with the project are currently very low based on-site observations. Therefore, during the peak construction period and peak staff / material demands, the additional 65 light vehicle movements associated with the staff movements and 20 daily truck movements (per direction) will have a minimal and acceptable impact upon the operation of these local roads during construction. Once operational, the traffic movements are much lower with a maximum of 10 staff on site per day and as such the impact will be negligible.

There is minimal background traffic growth in this location. Transport for NSW count data from the station located between Tenterfield and Glen Innes (Station I.D. DNDSTC) shows traffic flows of 2,201 in 2012 and 2,091 in 2019, with minor fluctuations up and down for the intervening years. Other counts along the regional road network show similar or lower increases in values. For the assessment of the future impacts in 10 years-time, it can be seen that the site at that time will be operational with 10 staff located on the site. The impact of these ten staff will be negligible on the local and regional road network.

The site is expected to be operational for more than 10 years so that the impact of the decommissioning of the site cannot be assessed in detail at this stage. The site could remain operational beyond 10 years and the impact will remain low beyond the10 year design horizon.

There will be no public vehicle access within the work site during the construction works, with a fence provided at the commencement of the project along the entire site boundary. This fence will remain once the project is constructed for security purposes with a locked gate to be provided at the site access off the Bruxner Highway.

There will be no pedestrian access to the site for the general public. There are no pedestrian paths in the locality of the site nor expected demands in this remote rural area so there will be no impacts for pedestrians created by the project works.

There is a school bus that runs along the Bruxner Highway to Bonshaw in the morning with the return trip in the afternoon. There may be some deliveries occurring in the morning and afternoon during the school bus operation, depending on the stage of the construction work and travel requirements for the deliveries. All staff will be on site prior to the morning bus run and will depart site after the afternoon bus run. As such it is considered that there is very limited interaction with the school bus. On the regional and state road network all school zones will be delineated in accordance with RMS Guidelines with reduced speed limits in accordance with normal NSW road rules. All drivers associated with the project construction work will adhere to the road rules as applicable and will be advised of the school bus operation on the Bruxner Highway.

There will be no impact upon public transport services with no diversions required. There are no bus stops impacted upon by the proposal.

There will be minimal impact for emergency vehicles and heavy vehicles with no diversions required.

There will be minimal impact upon any other development within the locality of the site.

There will be minimal impact upon adjoining Council areas. Traffic routes in and out of the locality will be along the arterial road network which will experience minimal impacts due to the works.

There are no residential dwellings in the immediate locality of the site access that will be impacted upon by the project and construction work. There are a number of residences along the heavy and light vehicle access route. The residents along the Bruxner Highway will be notified in writing of the construction works and the activities as required.

Construction vehicle movement on internal roads could lead to dust generation. A water truck will be used for dust suppression to minimise the production of dust, with the amount of water spreading adjusted accordingly to respond to the conditions. Additionally, any significant deposits of dirt and other construction materials will be promptly removed from public roadways.

Post construction, the traffic numbers generated by the project are very low, with staffing levels varying daily with a maximum on-site workforce of 10 people on any one day. There will not be any need for regular heavy vehicle access to the site once the solar farm is operational except for the occasional heavy vehicle for emergency repairs or irregular maintenance.

4.2 Cumulative impacts

A search of the Major Projects Register on the DPE website was undertaken together with the requirements of the SEARs for the project. The following projects are in the council area that may add to cumulative impacts.

- Sundown Solar Farm
- Sapphire Solar Farm
- White Rock Solar Farm

Project	Cumulative construction Impacts	Cumulative operational Impacts
Sundown Solar Farm (EIS currently being prepared)	Site located off Gwydir Highway between Inverell and Glen Innes. No overlap with construction along Gwydir Highway. If constructed at same time cumulative impact along New England Highway. As a state highway there is adequate capacity to accommodate these vehicles movements.	Operational traffic would be expected to be less than 10 light vehicles per day in the morning and afternoon and no impact with traffic for Bonshaw Solar Farm site.
Sapphire Solar Farm	Site located off Gwydir Highway and currently under constructed. This site will be fully constructed before the Bonshaw Solar Farm commences construction.	Operational traffic would be expected to be less than 10 light vehicles per day in the morning and afternoon and no impact with traffic for Bonshaw Solar Farm site.
White Rocks Solar Farm	Construction complete.	Operational traffic would be expected to be less than 10 light vehicles per day in the morning and afternoon and no impact with traffic for Bonshaw Solar Farm site.

4.2.1 Delivery vehicles

The majority of the deliveries for the project will be via 19 metres semi-trailers and B-doubles. The access routes along the regional / state road network to the site are all along approved B double routes.

Delivery vehicles would be required throughout the project period. The travel time between the ports (Newcastle or Brisbane) and the site for the solar panels is approximately 5 to 7 hours and these deliveries will be spaced out over the construction period, to minimise the impact upon the road network and to reduce the need to store the panels on site. Other deliveries will include the metal structures for the solar panels, sand and gravel for the foundations and internal tracks and cabling. There will also be some deliveries of specialist equipment such as photovoltaic boxes or skids and delivery stations.

The trucks associated with the delivery of the supplies will all travel along the State and regional road network. There are a number of schools located along these routes, however all have marked school zones and speed limit restrictions as per State guidelines. As these routes are all on the State and regional road network it can be seen that heavy vehicles currently operate on these roads safely. It is considered that the additional truck movements associated with the construction work will result in no noticeable impact upon road safety adjacent to these schools.

There is no requirement to divert traffic as part of this construction work.

The substation will require 3 over sized vehicle deliveries to the site. These will require a separate approval and permit through the National Heavy Vehicle Regulator with RMS approval. Safety requirements and impacts are assessed as part of the permit application and the necessary safety controls applied which can include escort vehicles and Police vehicle support.

4.2.2 Construction staff movements

For the construction work, the staffing levels will peak at 190 on site and as part of the project, staff will be encouraged and supported to carpool as part of the Code of Conduct for the project and use mini buses provided to allow for shared trips to the site from shared accommodation in Tenterfield, Glen Innes and Goondiwindi. There could be 65 vehicles inbound in the morning associated with on-site staff and a similar number departing at the end of the working day. Either side of the peak demand for construction staff the light vehicle demands associated with staff movements will be less than 65 inbound and outbound per day.

The site is in a rural location well away from the local towns and as such it is considered that there will be no pedestrian or cyclists accessing the site in conjunction with staff movements.

The vehicle numbers associated with the construction work are relatively low and it is considered that the movement of vehicles in and out of the site for construction works can occur in a safe manner. No limitation on truck access times is considered appropriate for the project. Given the journey length between the port and the subject site, the vehicles as they are approaching the site will be spread out reducing the impact of the arrivals. With unloading of vehicles taking 30 minutes or more, trucks exiting the site will also be spread out.

4.3 Impacts on road pavement

A protocol will be provided for both undertaking dilapidation surveys and making any necessary repairs following construction to Bruxner Highway to within 200 metres to both sides of the site access. It is considered that there could be some impact here due to the turning movements and braking / accelerating of trucks. Beyond these limits it is considered that the impact on the state road will be minor and shall not impact upon the overall pavement construction.

With regards to any emergency repairs required within the above zone, the contractor on site would contact the relevant authorities and will ensure the road is safe. Repairs will be made in accordance with the relevant authority standard.

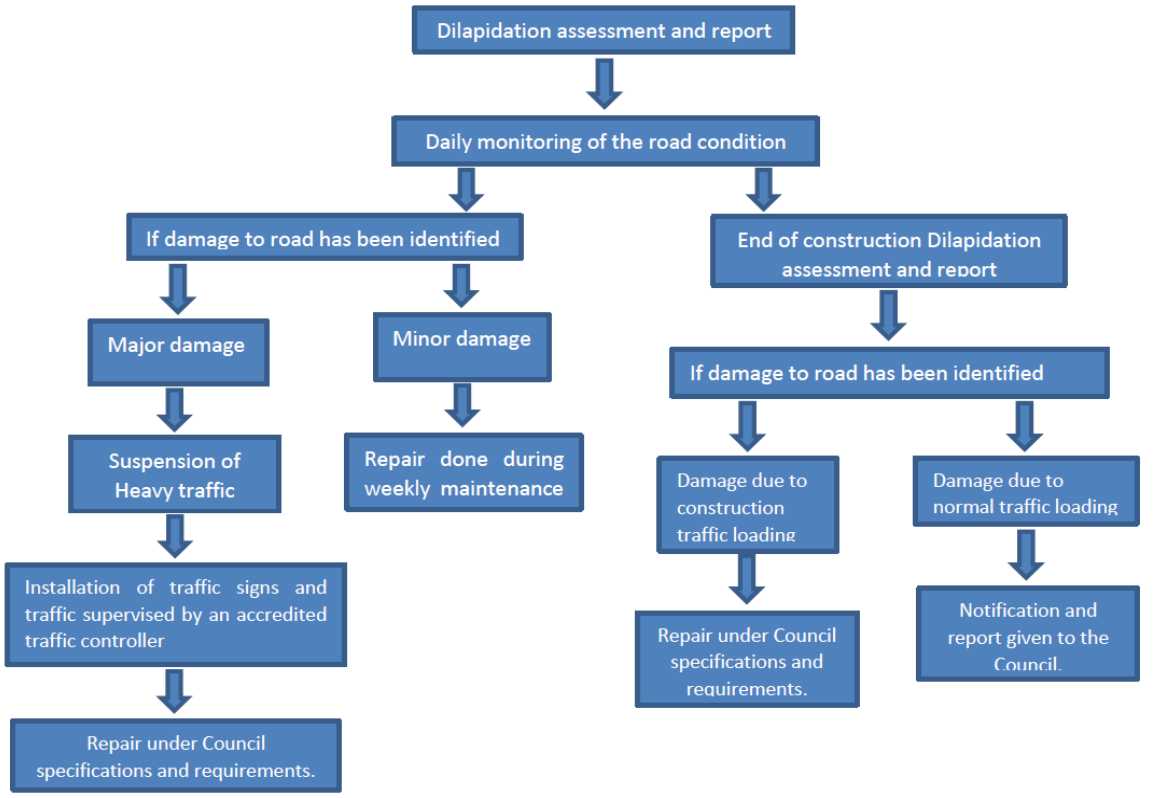

Figure 4-3 Dilapidation Assessment Protocol

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5 Summary and Conclusion

The project allows for the construction of a solar farm in the locality of Bonshaw in northern NSW located off the Bruxner Highway. The construction work is planned to commence in late 2020 and will take approximately 12 months to construct. During construction there will be a requirement for a significant number of trucks to access the site for material delivery as well as light vehicles associated with construction staff. All vehicle access will be directly off the Bruxner Highway with the majority of deliveries expected to be via the New England Highway, with the solar equipment arriving via the Port of Newcastle or Port of Brisbane.

The trucks accessing the site will all travel along the regional and state road network, which currently carries heavy vehicle movements including B-doubles. The site is located in a rural setting and as such the hourly and daily traffic flows along the Bruxner Highway and the New England Highway in this location are relatively low. As such there is considerable spare capacity to cater for the additional traffic movements associate with the project construction stage. During peak construction activities, the project will generate 65 inbound light vehicle movements in the morning associated with the construction staff with a similar number of vehicles leaving the site in the late afternoon. At these peak activity times, the site will also generate approximately 20 trucks inbound and outbound per day, associated with the delivery of material and specialist equipment to the site. Outside of the peak construction activity the light and heavy vehicle movements will be lower per day.

Post construction, the operational traffic demands are very low with around 10 people working on the site. There will also be the requirement for occasional heavy vehicle movements, associated with on-going maintenance for the facility.

The access to the site will be via the existing access constructed for the adjacent electric sub-station. This access road was previously used for the construction works associated with this substation and is now only used for access for maintenance work on the sub-station. With the vast majority of the heavy vehicles accessing the site from the east (via the New England Highway) it is proposed to provide a left turn deceleration lane (AUL(s)) for the site access to allow for a safe entry for the construction traffic. Shoulder widening will also be provide to cater for the limited demand for right turning traffic into the site with a AUR type upgrade.

A review of the access route shows that the layout of the intersection of the Bruxner Highway and the New England Highway does not safely cater for the right turn out movement. The sight distance for this right run is restricted and the width of the New England Highway in this location does not allow for a run off area for vehicles. It is proposed that as part of the construction traffic management plan, southbound empty trucks leaving the site shall turn left onto the Bruxner Highway then proceed south via Bonshaw-Inverell Road to Inverell then along the Gwydir Highway to connect to the New England Highway via Glen Innes.

All access routes for the heavy vehicles associated with the delivery of materials to the site are approved for B-double use and carry B-doubles associated with local rural demands.

A Traffic Control Plan will be in place during construction work at the site access to ensure safety for road users and construction workers is managed in an appropriate manner. A Construction Traffic Management Plan has been prepared for the project (see below) to ensure that road safety is managed for all workers associated with the project as well as existing road users.

The overall conclusion for the project shows that the construction traffic can safely and efficiently access the site with minimal impact for existing road users. The management plan for the construction traffic access ensures that the trucks accessing the site shall have an acceptable impact on the road network and safety concerns at the intersection of the Bruxner Highway and the New England Highway are address through the drivers code of conduct. Once operational, the traffic demands are minimal and shall have little impact upon the local road network.

Appendix A. Safe Construction Actvities

The contractor on site is responsible for the management of all traffic in connection with its activities and the construction works conducted on the site. The Contractor will provide all traffic management, safety warnings and signage including such persons as necessary to direct traffic, as required by AS 1742:2009 – Manual of uniform traffic control devices.

External traffic movements

The Contractor will:

Ensure traffic management controls are established, maintained and monitored to underpin the safety of workers, other personnel and the general public

Establish traffic management controls in consultation with relevant stakeholders

Ensure traffic management controls comply with regulatory and legislative requirements

Ensure traffic management controls comply with the contract

Ensure traffic management controls maintain the flow of traffic within the site and on surrounding public roads

Reinstate any areas affected by the temporary construction access requirements to their original condition

The primary drivers for determining the traffic management controls during the construction period are:

- Safety of personnel, the general public and construction workers
- Minimising impact (if any) on operations
- Contractual requirements (including site access)
- Road traffic authority and local government requirements
- OHS requirements in relation to the movement of all vehicular traffic and pedestrians either within or adjacent to sites
- Environmental management requirements
- The impact construction traffic has on the local community in the surrounding area, and
- The need to meet construction requirements (including any schedule and cost constraints)

The traffic management controls will be communicated to appropriate stakeholders which will include the local community in the site vicinity via a letter box drop.

The Contractor will ensure:

Any significant deposit of dirt and other materials caused by construction traffic and other operations (in relation to the works) will be promptly removed from existing public roadways

Suitable precautions are taken to ensure no rock is dislodged onto any roadway from construction vehicles

Construction plant and equipment do not park on or within the pavement or shoulders of any existing trafficked roadway

Construction vehicles (when loaded) comply with the mass, loading and access requirements of the road traffic authority

Construction traffic will cause the least possible obstruction to public and other traffic

Directional signage will be installed to direct construction traffic and warn other motorists of construction traffic.

This signage is positioned in accordance with the approved Traffic Control Plans.

All drivers will be provided with a copy of the access routes to and from the site as part of their induction for the project;

A Vehicle Movement Strategy has been developed to eliminate the impact on local roads arising from additional construction traffic (e.g. solar panel delivery vehicles). The Vehicle Movement Strategy directs all drivers to access the site from the Bruxner Highway to eliminate the impact on the local roads. There is no requirement to restrict the direction of flow and/or time of day for movements.

The Contractor will comply with any client or Road Traffic Authority signage requirements for traffic control. Where construction work is to be undertaken either on or adjacent to a public roadway that is open to traffic, the work must be undertaken in accordance with all regulatory and legislative requirements that govern the movement of vehicles and pedestrians on any public roadway.

Within the Worksite

All employees, subcontractors, suppliers and any other persons connected with the project must adhere to all such Statutory Requirements and comply with all lawful directions. Any breach of such requirements may result in disciplinary action of the persons concerned.

The maximum speed limits within the Worksite are:

40 kph on formed roads
20 kph during foggy/dusty conditions with headlights on
10 kph when passing pedestrians

The Contractor will manage access to and from the site by all employees, subcontractors, suppliers and any other persons connected with its activities and the works; and all occupants within the worksite and through each area of the site.

The Contractor shall provide for safe and continuous operation of normal pedestrian and vehicular traffic along all roads, pedestrian paths and vehicular access to the worksite and must provide and maintain all necessary watchmen, lights, barriers, notices and signs.

The Contractor will not unnecessarily obstruct any side road, branch track, drain or watercourse and will not break down or remove any fences or gates without prior notification to the client. If unavoidable, the Contractor will remove such obstruction or repair such breakage as soon as possible, or as directed by the Client.

A Vehicle and Traffic Management Procedures briefing will be included in the Project Site Induction.

Pedestrian Traffic

The Contractor may encounter pedestrian traffic at and near to the site. The Contractor will ensure that sites are appropriately isolated and secured from unauthorised entry; and that the Site is appropriately sign-posted and controlled. Given the location of the site it is considered that any pedestrian activity will be negligible.

Site Construction Traffic

Traffic within the Site will be managed in accordance with the Site Management Plan. The Sites Layout Plans will indicate site access and egress points and detail any required separation of construction plant and personnel. These plans will be communicated during Tool Box Meetings and/or Daily Pre-start Meetings.

The Site Layout Plan will incorporate details of parking arrangements for the site construction workers, speed limits within the construction works or through access roads established for vehicular and plant construction traffic.

The Sites Layout Plan will detail traffic management controls that are appropriate within each site.

Traffic controls shall be regularly reviewed for effectiveness and will be amended to maintain or improve a safe work environment. Traffic management controls established for sites will be inspected at ***weekly intervals*** to verify that a safe work environment is being maintained. Records of inspections shall be maintained.

Access Roads and Site Movement

Unless sign-posted otherwise, load limits on public roads adjoining the sites apply within them.

If required the Contractor shall request approval from the client prior to any over-dimensional load, or load in excess of load limits entering the site, or using the roads within the site.

All workers must travel to and from the site via the nominated access roads.

Parking

All workers must park in the Designated Parking Areas as specified in the Site Management Plan. The Contractor shall ensure no persons (in connection with its activities) parks in any other area of the site or in any other area without prior written consent.

Monitoring, Measurement and Review

The purpose of Monitoring and Measurement is to ensure that all construction works, including subcontracted activities, are being performed in accordance with the contract requirements, statutory requirement and in a controlled and safe environment. Ongoing monitoring and audit of Traffic Management procedures and the worksite implementation of traffic control shall be conducted.

Audits of the Traffic Control measures under differing operating conditions are to be carried out including during overcast and rainy weather, at night or at any other restrictive times where conditions may change in accordance with the requirements of AS1742.3.

Results of audits, inspections and improvements are to be reported in the reporting cycle of the contract to enable assessment of the adequacy of the implementation of the Traffic Control within contract performance and system review meetings.

Inspection and Auditing of Traffic Control Plan (TCP)

Regular Site Inspections by designated supervisory and field staff of worksite protection are to be arranged on a ***daily frequency*** depending on the complexity of traffic control on the site.

Site Inspections will be carried out and the following Traffic Management Forms completed:

Traffic Control Daily Checklist
Traffic Control Weekly Checklist

A daily record of the inspections should be kept. This should include:

- When traffic controls were erected
- When changes to controls occurred and why the changes were undertaken
- Any significant incidents or observations associated with the traffic controls and their impacts on road users or adjacent properties
- Where significant changes to the work or traffic environment or adverse impacts are observed, the controls should be reviewed as a matter of urgency.

The monitoring program should generally incorporate inspections:

- Before the start of work activities on site
- During the hours of work
- Closing down at the end of the shift period

The inspection program shall be adjusted to suit changing circumstances and/or risk environment such as during times of increased traffic flows or speeds, contra-flow arrangements or when changed controls are introduced.

The Audits of the implemented Traffic Management features will be undertaken following setup in accordance with the TCP and prior to the TCP being put into service.

Appendix B. Drivers Code of Conduct

1.1 General Requirements

All vehicles / drivers accessing the site must:

i) Be registered and hold a valid driver's licence for the class of vehicle being operated;
ii) Operate the vehicle in a safe and appropriate manner whilst travelling to / from the site or when operating within the site. This includes obeying all New South Wales state road rules.
iii) ALL heavy vehicles must adhere to the designated heavy vehicle routes as far as practical;
iv) NO trucks shall turn right from the Bruxner Highway onto the New England Highway.
v) ALL trucks heading south shall turn left out of the site then proceed via Bonshaw-Inverell Road to Inverell then travel along the Gwydir Highway to Glen Inness to connect with the New England Highway.
vi) Comply with the directions of authorised personnel when operating within the site and obey any relevant signage installed along the internal roads.
vii) Not use a mobile phone while operating any vehicle.
viii) Must always wear a seatbelt when operating any vehicle.

1.2 Vehicle Speeds

Drivers shall observe the posted speed limit along the designated transport route and adjust their vehicle speed as required to suit the road environment and prevailing weather conditions. Vehicle speeds must be appropriate to ensure the safe movements of the vehicle with consideration to the vehicle configuration.

Maximum speeds limits within the project site shall be as follows:

i) 40 km/hr along formed roads.
ii) 20 km/hr during foggy / dusty conditions. Headlights must be on.
iii) 10 km/hr when passing pedestrians or any plant equipment.

1.3 Driver Fatigue

Drivers shall not be permitted to operate a vehicle or plant equipment when impaired by fatigue. If you suspect that you or someone else is experiencing fatigue, please inform your supervisor.

Operators of heavy vehicles shall be aware of the requirements relating to fatigue as outlined in the Heavy Vehicle National Law. Drivers shall also be aware of their adopted fatigue management scheme (shown below) and ensure that they are operating within its requirements.

i) Standard Hours of Operation
ii) Basic Fatigue Management (BFM)
iii) Advanced Fatigue Management (AFM)

Basic Fatigue Management (single driver)

Time	Work	Rest
In any period of…	A driver must not work for more than a maximum of…	And must have the rest of that period off work with at least a minimum rest break of…
6 ¼ hours	6 hours work time	15 continuous minutes rest time
9 hours	8 1/2 hours work time	30 minutes rest time in blocks of 15 continuous minutes
12 hours	11 hours work time	60 minutes rest time in blocks of 15 continuous minutes
24 hours	14 hours work time	7 continuous hours stationary rest time*
7 days	36 hours long/night work time**	No limit has been set
14 days	144 hours work time	24 continuous hours stationary rest time taken after no more than 84 hours work time and 24 continuous hours stationary rest time and 2 x night rest breaks# and 2 x night rest breaks taken on consecutive days.

Advanced Fatigue management:

The seven principles are grouped into three categories:

Work-related rest breaks (such as short rest breaks):

1. Reduce the time spent continuously working in the work opportunity

2. The more frequent breaks from driving, the better

Recovery breaks (such as major rest breaks):

1. Ensure an adequate sleep opportunity in order to obtain sufficient sleep

2. Maximise adequate night sleep

3. Minimise shifts ending between 00:00-06:00

4. Minimise extended shifts

Reset breaks (such as long periods of rest or extended leave):

1. Prevent accumulation of fatigue with reset breaks of at least 30hrs (and include two night periods, 00:00 – 06:00) between work sequences

ALL details relating to fatigue management for delivery vehicles are covered by the National Heavy Vehicle Regulator

1.4 Operating Hours

Construction

Construction is to be in completed in accordance with the *Interim Construction Noise Guideline* (DECC 2009) which defined standard construction work hours as:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sunday and Public holidays: No work

The following construction, upgrading and decommissioning activities may be undertaken outside these hours without the approval of the secretary:

- The delivery of materials as requested by the NSW Police Force or other authorities for safety reasons; or
- Emergency work to avoid loss of life, property and / or material harm to the environment.

Vehicle movements shall be undertaken during standard construction hours (or just before to allow workers to get to site). Oversize vehicles up to 26 metres long may require access to the site after hours however this would be subject to the requirements of Roads and Maritime, Dubbo Regional Council or NSW Police.

Normal Operations

Daily operations and maintenance by site staff would be undertaken during standard working hours:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sunday and Public holidays: No work

During normal operations, all vehicle movements shall be undertaken during the standard operating hours (or just before to allow workers to get to site). There may be a requirement for vehicles to access the site after hours during an emergency however these would be infrequent.

Vehicles which arrive at the site prior to commencement of working hours shall have the engine turned off to minimise noise impacts on surrounding residences.

1.5 Transport Routes

All vehicles must travel to and from the project site via the route as shown below (Figure 1).

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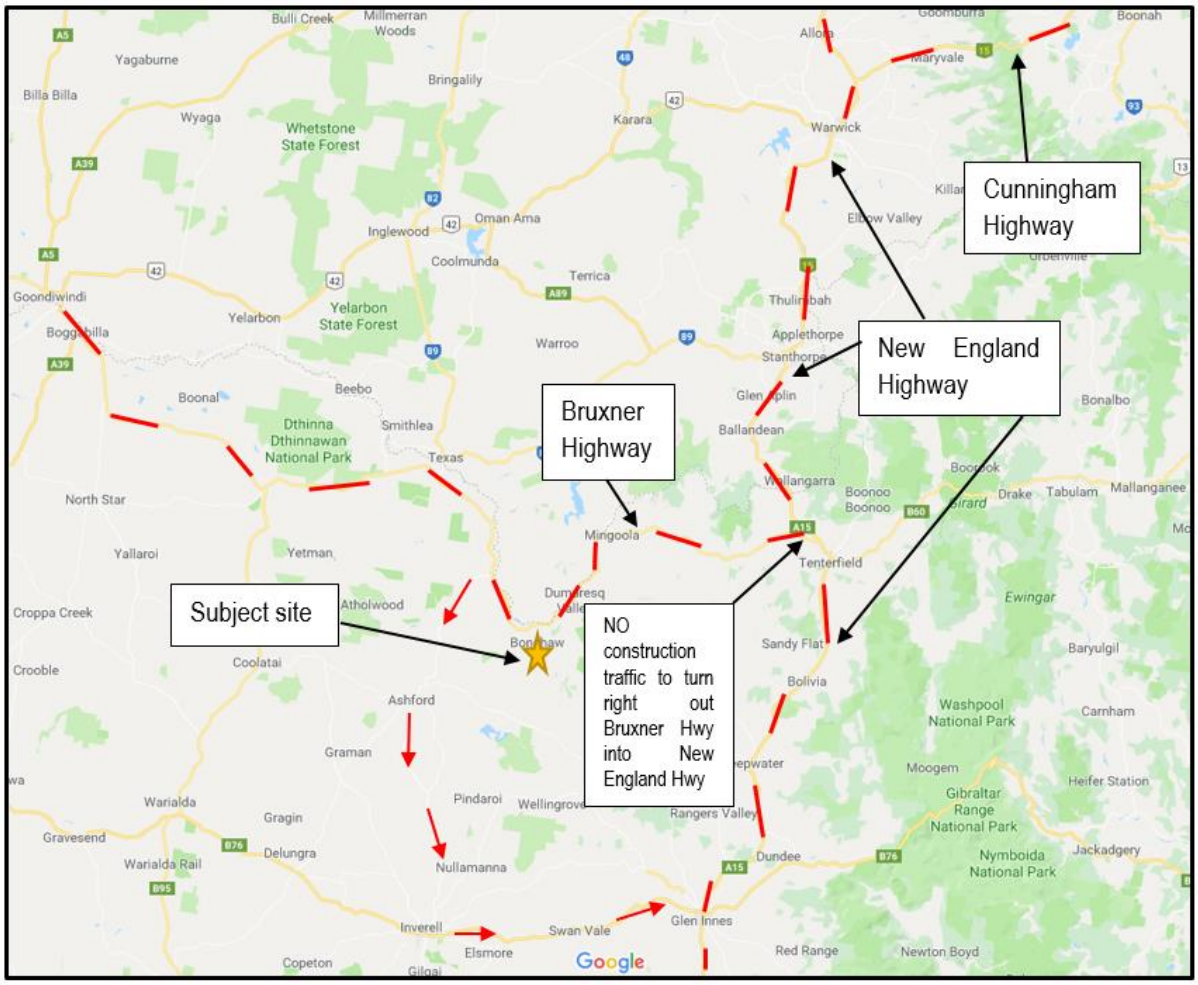

Figure 1 - Transport route to/from the site for ALL 19 m semi-trailers or greater

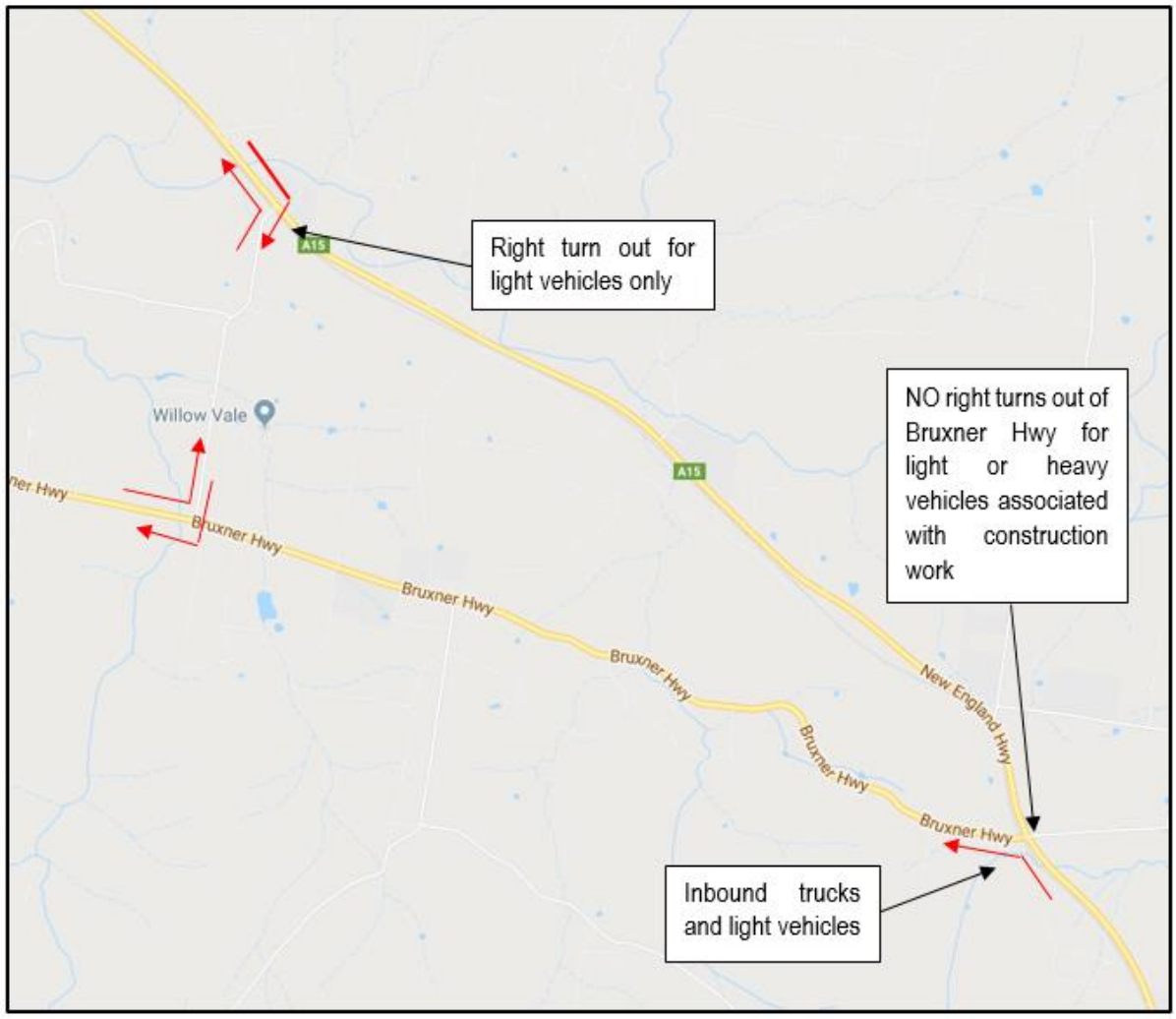

Figure 2 - Transport route to/from the site for ALL 19 m semi-trailers or greater (detail for northbound via New England Highway to use Sunnyside Platform Road)

1.6 Vehicle Departure and Arrival

Heavy vehicles departing the site shall have a minimum 5 minute separation to reduce the impacts upon the local road network.

Always maintain a minimum separation of at least 50 metres between vehicles when travelling within the site.

Drivers must contact the site supervisor upon arrival and await further instructions or direction before proceeding.

Drivers must also report to the site supervisor prior to departure.

All vehicles must enter and exit the site in a forward direction. Vehicles are to have clean tyres upon exiting the site to prevent dirt being tracked onto the public road network.

ALL 19 metres semi-trailer or greater must turn left out of the site and proceed via Bonshaw-Inverell Road to Inverell then via the Gwydir Highway to Glen Innes and the New England Highway when heading south.

1.7 Overtaking

Overtaking shall not be permitted within the site unless the intention to overtake has been communicated to the driver of the leading vehicle and consent to overtake granted.

1.8 Breakdowns and Incidents

Heavy Vehicles

In the case of a breakdown, the vehicle must be towed to the nearest breakdown point as soon as possible. All breakdowns must be reported to Transport for NSW Transport Management Centre on 131 700 and the vehicle protected in accordance with the Heavy Vehicle Drivers Handbook. The relevant shift manager on site shall also be notified.

If a breakdown occurs on-site please remain inside your vehicle, notify the shift manager of your location and await further instruction.

If you are involved in an accident, please notify the shift manager immediately and contact emergency services if required.

Light Vehicles

In the case of a breakdown, ensure that the vehicle is secure, notify the shift manager of your location and await further instruction.

If you are involved in an accident, please notify the shift manager immediately and contact emergency services if required.

1.9 Penalties and Disciplinary Action

Any driver who fails to comply with the above requirements will have their details recorded and may be subject to disciplinary action.

1.10 Emergency Contact Numbers

i)	RMS Transport Management Centre	131 700
ii)	Queensland Traffic	131 940
iii)	Inverell Shire Council	(02) 6728 8288
iv)	NSW Police Service	(02) 6722 0599
v)	Site Office	_____
vi)	Shift Manager on Duty	_____

1.11 Driver Declaration

I, the undersigned, hereby agree to abide by this Driver Code of Conduct for the transport of equipment or personnel to / from the Bonshaw Solar Farm, located off Bruxner Highway in the general locality of Bonshaw, NSW. I have read and understand the requirements outlined in the attached document and will, to the best of my ability, comply and assist with their implementation, requirements or ongoing administration.

The subject document to which this declaration relates is included as part of this overall document and signing of this declaration confirms that the signee has read and understood their requirements as outlined throughout.

Driver Details

Full Name	
Organisation	
Signature	
Date	

Representative of:

Full Name	
Signature	
Date	

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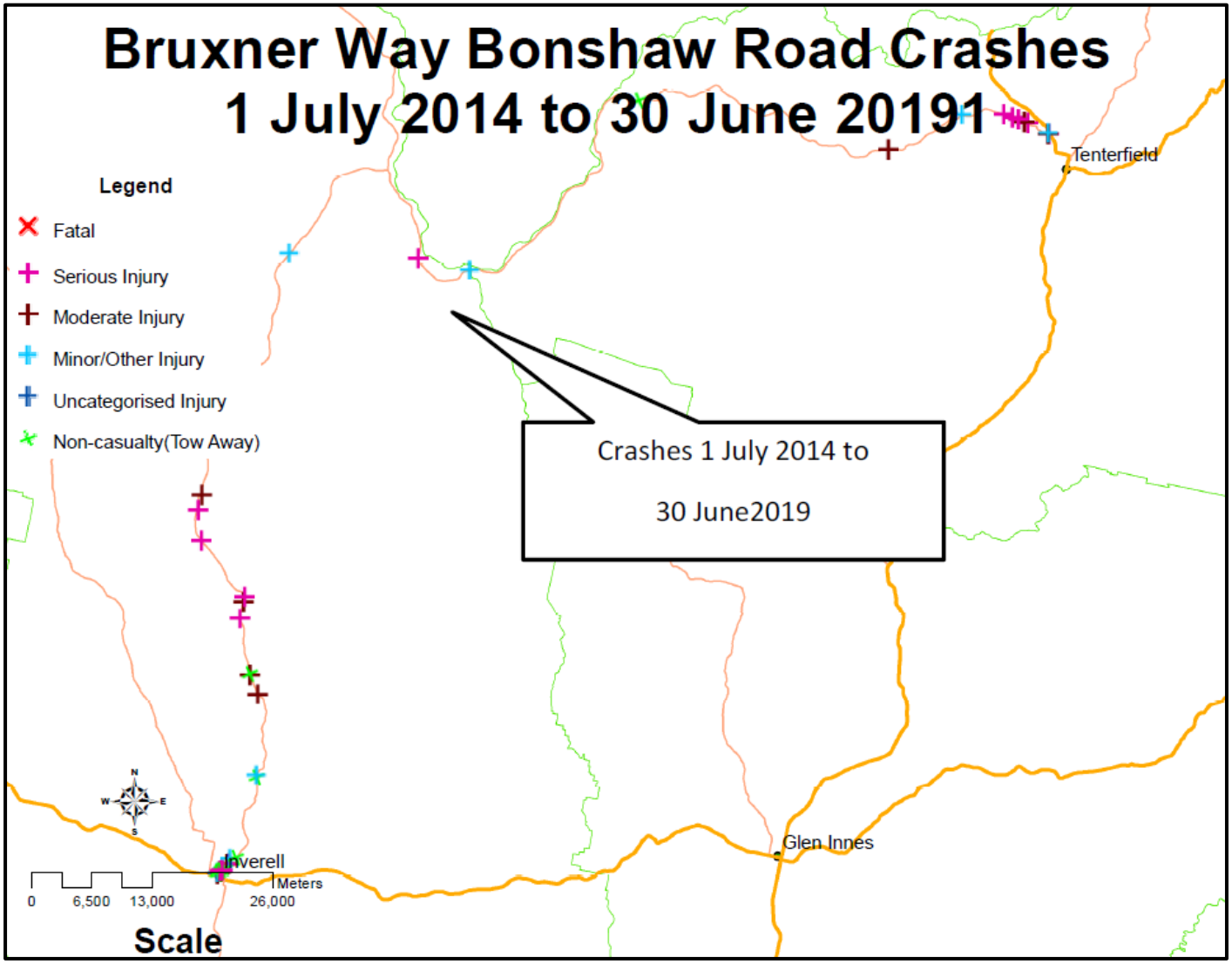
Appendix C. Accident Data



Summary Crash Report

Transport for NSW — Centre for Road Safety

# Crash Type		
Car Crash	24	57.1%
Light Truck Crash	9	21.4%
Rigid Truck Crash	2	4.8%
Articulated Truck Crash	4	9.5%
'Heavy Truck Crash	(6)	(14.3%)
Bus Crash	0	0.0%
"Heavy Vehicle Crash	(6)	(14.3%)
Emergency Vehicle Crash	0	0.0%
Motorcycle Crash	7	16.7%
Pedal Cycle Crash	1	2.4%
Pedestrian Crash	1	2.4%

' Rigid or Artic. Truck " Heavy Truck or Heavy Bus
These categories are NOT mutually exclusive

Location Type		
*Intersection	13	31.0%
Non intersection	29	69.0%

* Up to 10 metres from an intersection

Collision Type		
Single Vehicle	31	73.8%
Multi Vehicle	11	26.2%

Road Classification		
Freeway/Motorway	0	0.0%
State Highway	3	7.1%
Other Classified Road	37	88.1%
Unclassified Road	2	4.8%

Contributing Factors		
Speeding	22	52.4%
Fatigue	6	14.3%

Weather		
Fine	36	85.7%
Rain	4	9.5%
Overcast	2	4.8%
Fog or mist	0	0.0%
Other	0	0.0%

Road Surface Condition		
Wet	8	19.0%
Dry	34	81.0%
Snow or ice	0	0.0%

Natural Lighting		
Dawn	2	4.8%
Daylight	32	76.2%
Dusk	4	9.5%
Darkness	4	9.5%

Crash Movement		
Intersection, adjacent approaches	1	2.4%
Head-on (not overtaking)	2	4.8%
Opposing vehicles; turning	0	0.0%
U-turn	1	2.4%
Rear-end	3	7.1%
Lane change	0	0.0%
Parallel lanes; turning	0	0.0%
Vehicle leaving driveway	1	2.4%
Overtaking; same direction	1	2.4%
Hit parked vehicle	0	0.0%
Hit railway train	0	0.0%
Hit pedestrian	1	2.4%
Permanent obstruction on road	0	0.0%
Hit animal	1	2.4%
Off road, on straight	2	4.8%
Off road on straight, hit object	6	14.3%
Out of control on straight	0	0.0%
Off road, on curve	6	14.3%
Off road on curve, hit object	11	26.2%
Out of control on curve	2	4.8%
Other crash type	4	9.5%

Speed Limit					
40 km/h or less	4	9.5%	80 km/h zone	4	9.5%
50 km/h zone	1	2.4%	90 km/h zone	0	0.0%
60 km/h zone	11	26.2%	100 km/h zone	22	52.4%
70 km/h zone	0	0.0%	110 km/h zone	0	0.0%

~ 07:30-09:30 or 14:30-17:00 on school days	~ 40km/h or less		~ School Travel Time Involvement		
	1	11.1%		9	21.4%

Day of the Week												
Monday	6	14.3%	Wednesday	4	9.5%	Friday	9	21.4%	Sunday	9	21.4%	WEEKEND	13	31.0%
Tuesday	6	14.3%	Thursday	4	9.5%	Saturday	4	9.5%	WEEKDAY	29	69.0%			

CRASHES	42	
Fatal	0	0.0%
Serious inj.	14	33.3%
Moderate inj.	10	23.8%
Minor/Other inj.	7	16.7%
Uncategorised inj.	0	0.0%
Non-casualty	11	26.2%

Self Reported Crash	8	19.05%

Time Group		% of Day	
00:01 - 02:59	1	2.4%	12.5%
03:00 - 04:59	1	2.4%	8.3%
05:00 - 05:59	1	2.4%	4.2%
06:00 - 06:59	0	0.0%	4.2%
07:00 - 07:59	1	2.4%	4.2%
08:00 - 08:59	1	2.4%	4.2%
09:00 - 09:59	4	9.5%	4.2%
10:00 - 10:59	3	7.1%	4.2%
11:00 - 11:59	3	7.1%	4.2%
12:00 - 12:59	3	7.1%	4.2%
13:00 - 13:59	2	4.8%	4.2%
14:00 - 14:59	2	4.8%	4.2%
15:00 - 15:59	4	9.5%	4.2%
16:00 - 16:59	6	14.3%	4.2%
17:00 - 17:59	2	4.8%	4.2%
18:00 - 18:59	1	2.4%	4.2%
19:00 - 19:59	4	9.5%	4.2%
20:00 - 21:59	3	7.1%	8.3%
22:00 - 24:00	0	0.0%	8.3%

Street Lighting Off/Nil		% of Dark	
3	of	4	in Dark 75.0%

CASUALTIES	36	
Killed	0	0.0%
Seriously inj.	14	38.9%
Moderately inj.	12	33.3%
Minor/Other inj.	10	27.8%
Uncategorised inj.	0	0.0%
^ Unrestrained	1	2.8%

^ Belt fitted but not worn, No restraint fitted to position OR No helmet worn

Crashes		Casualties
8	2018	9
9	2017	6
10	2016	6
8	2015	10
7	2014	5

McLean Periods		% Week	
A	2	4.8%	17.9%
B	2	4.8%	7.1%
C	11	26.2%	17.9%
D	1	2.4%	3.5%
E	5	11.9%	3.6%
F	7	16.7%	10.7%
G	7	16.7%	7.1%
H	5	11.9%	7.1%
I	1	2.4%	12.5%
J	1	2.4%	10.7%

#Holiday Periods																
New Year	0	0.0%	Easter	0	0.0%	Queen's BD	0	0.0%	Christmas	1	2.4%	Easter SH	0	0.0%	Sept./Oct. SH	2	4.8%
Aust. Day	0	0.0%	Anzac Day	0	0.0%	Labour Day	2	4.8%	January SH	1	2.4%	June/July SH	3	7.1%	December SH	1	2.4%

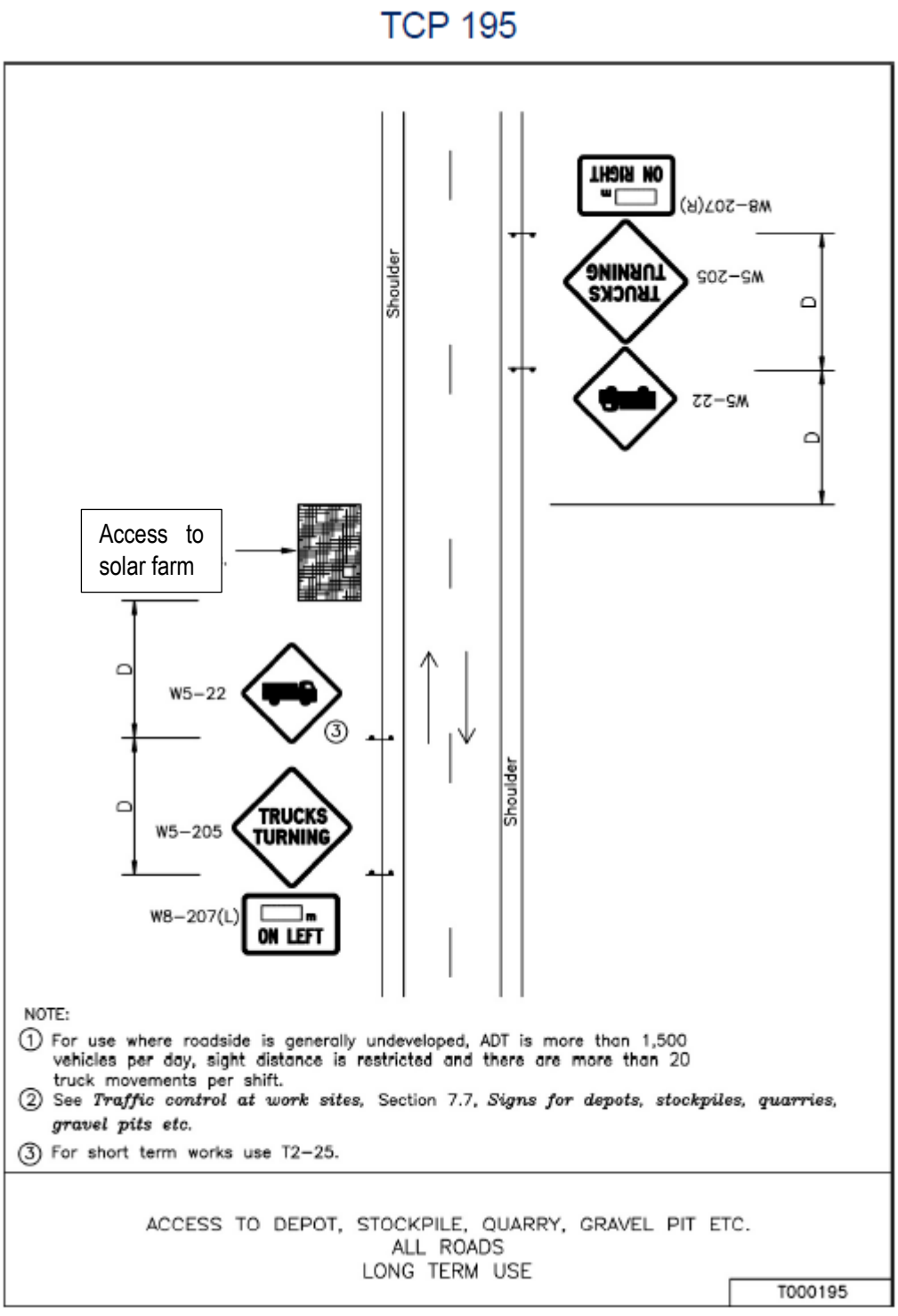
Crashid dataset SECA Crashes Bruxner Way New Enland to Gwydir Highway 1.7.14 to 30.6.19

Note: Crash self reporting, including self reported injuries began Oct 2014. Trends from 2014 are expected to vary from previous yrs. More unknowns are expected in self reported data. Reporting yrs 1996-2004 & 2019 Q3 onwards contain uncategorised inj crashes.

Percentages are percentages of all crashes. Unknown values for each category are not shown on this report.

Appendix D. Traffic Control Plan for Works at Site Access on Bruxner Highway

Access controls for on-site construction (upon completion of construction of site access). Distance D = 100 metres



Appendix E. Construction Traffic Management Plan (CTMP)

Quality Traffic Advice

Proposed Solar Farm,

Bruxner Highway, Bonshaw

ERM

Construction Traffic Management Plan

Final Report

February 2020

SECAsolution

Bonshaw Solar Farm, Bonshaw NSW

Construction Traffic Management Plan

Author: Sean Morgan

Client: ERM Australia

Issue: Ver02

Reference: P1302

14 February 2020

Quality Review and Document History

Version	Date	Description	Prepared By	Checked By
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Quality Traffic Advice

1 Introduction

The impact of the proposed Bonshaw Solar Farm has been assessed and submitted for review by the authorities. From this review Transport for NSW have requested a Construction Traffic Management Plan (CTMP) be prepared for the project. This CTMP has been prepared based upon the information available at the time of this submission, however, may be altered by the construction company for the future construction. Any changes to this CTMP in the future will be submitted to the road authorities for review and approval.

Due to the nature of works involved, the CTMP includes details of the required Traffic Control Plans (TCPs) to ensure that the safety for road users is preserved throughout the construction works.

The following CTMP has been prepared allowing for the construction of the Bonshaw Solar Farm project. Details of traffic management associated with decommissioning of the site has not been considered and shall be addressed prior to the decommissioning of the site to reflect the road and traffic conditions at this future time.

Bonshaw Solar Farm is located off the Bruxner Highway in the general locality of Bonshaw and approximately 65 kms west of Tenterfield, as shown in Figure 1-1.

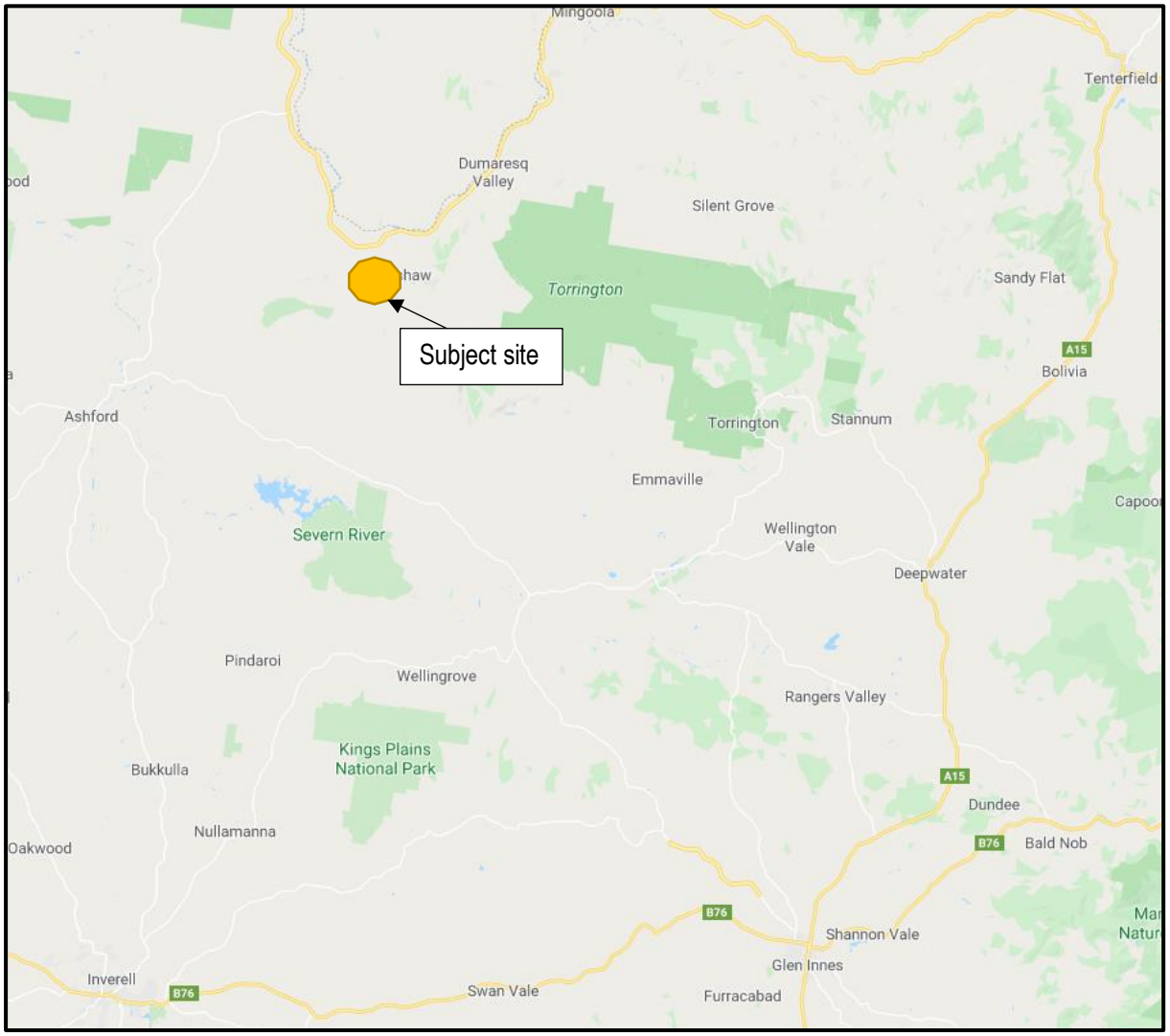

Figure 1-1 – Site Location and Road Network

Figure 1-2 - Location of Sunnyside Platform Road

1.1 Existing Road Network and Local Characteristics

The **Bruxner Highway** is a state classified road, which runs to the north of the subject site with an east-west orientation providing connection between the New England Highway to the east and Boggabilla to the west where it connects with the Newell Highway. The south, east and west boundaries of the subject lands are defined by neighbouring agricultural lots with some sections of unnamed, unsealed rural roads. The Bruxner Highway is sealed (refer Photo 1 below) and provides a width of approximately 6 metres passing the site allowing for 2-way traffic movements as required. It operates under the posted speed limit of 100 km/h.

The Bruxner Highway connects with the New England Highway to the east of the site at a four way give way controlled intersection with the New England being the priority road and Old Ballandean Road being the opposite minor road.

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Photo 1 – View along Bruxner Highway in the vicinity of the project site

The **New England Highway** is a state classified road that is a key freight route in NSW and forms part of the road network designated by the Roads and Maritime to carry oversize, over mass vehicles. It typically provides a single lane of travel in both directions and operates under the posted speed limit of 110 km/h outside of the urban areas where the alignment permits. As part of the state road network, the New England Highway carries a mixture of local, regional and inter-state traffic with a significant number of trucks including B-double combinations. The **Cunningham Highway** operates in a similar manner providing key transport routes between Ipswich and the New England Highway at Warwick.

To the south of the site is the **Gwydir Highway**, a state classified road that is a key freight route in NSW and forms part of the road network designated by Transport for NSW to carry oversize, over mass vehicles. It typically provides a single lane of travel in both directions and operates under the posted speed limit of 100 km/h outside of the urban areas where the alignment permits. As part of the state road network, the Gwydir Highway carries a mixture of local, regional and inter-state traffic with a significant number of trucks including B-double combinations.

Bonshaw Road is a local road managed by Inverell Shire Council, located to the west of the site. It is a sealed two-way road with an overall width in the order of 7 metres. It intersects with the Bruxner Highway via a simple give way controlled intersection with the Bruxner Highway being the priority road. This road continues south and connects with **Ashford Road** in Ashford to provide a road link through to Inverell. This route provides a consistent road standard and forms part of the approved B-double road network in NSW. Both of these roads provide a single lane of travel in both directions and operate under the posted speed limit of 100 km/h.

Sunnyside Platform Road is a local road providing an approved B-double connection between the New England Highway and Bruxner Highway. It provides a pavement width in the order of 7 metres wide permitting 2-way traffic movements.

As part of the project, it is proposed that all heavy vehicles will travel via the roads identified above. Local supplies could be sourced from Goondiwindi or Tenterfield as well as accommodation for workers associated with the project.

1.2 Traffic Volumes and Road Operation

Traffic volumes in the immediate vicinity of the subject site are very low, reflective of the rural environment. The Bruxner Highway carries relatively low traffic flows, reflective of its rural setting with a mixture of local traffic as well as regional traffic demands. Observations on site during a typical morning period (Tuesday 11th September 2018) shows that the current road network in the vicinity of the subject site operates very well with no delays. The route proposed to be used for the project carries low traffic flows and operates with no delays except for those associated with drivers slowing down to observe traffic flows on the approaches to the various intersections and negotiate the intersections.

Transport for NSW webpage provides traffic data on the Bruxner Highway at Mingoola (station Id 91170), approximately 15 kms east of the subject site. The traffic data from 2011 shows that the daily traffic flow was 213 vehicles per day with around 23% heavy vehicles, reflective of rural demands in this location. It is considered that there has been limited growth in traffic since this time and as such the current daily traffic flows are considered to be similar.

The same web page shows that in 2011 the daily traffic flow on the New England Highway to the immediate north of Tenterfield (station Id 91577) was 2421. It is considered that there has been limited growth in this area since 2011 and as such the daily traffic flows would be similar. In 2012 the traffic flows on Bonshaw Road were 232 vehicles per day northbound. Assuming southbound flows to be the same would give daily flows in the order of 500 vehicles per day. It is considered that these flows would not have altered much since 2012.

For the Gwydir Highway, the same web page shows that the daily flows to the east of Inverell were 1,317 in 2019 whilst to the west of Glen Innes the flows on the Gwydir Highway in 2019 were 1,442 vpd.

2 Construction Works

The construction and commissioning phase is expected to last approximately 12 months with expected commencement by late 2020. The main construction activities would include:

- Site establishment and preparation for construction:
  - Installation of security measures including fencing.
  - Establishment of site compound and material layout areas. This shall include the provision of suitable on site parking for vehicles and workers.
  - Ground preparation.
- Installation of environmental controls:
  - A detailed Construction Environmental Management Plan (CEMP) would outline the environmental controls required.
- Minor vegetation clearing (grasses, shrubs and isolated trees):
  - Targeted clearance of low laying vegetation around trenching areas to steel post installation to minimise disturbance to existing ground cover.
  - Establishment of tree and vegetation protection measures as required.
  - Clearance of larger vegetation such as bushes and isolated trees.
  - Establishment of additional sedimentation and erosion controls as required.
- Preliminary civil works including:
  - Drainage works
  - Setting up foundations for the substation
  - Earthing works (see below)
- Installation of steel post and rail foundation system for the solar panels.
- Installation of PV panels and DC wiring beneath the panels.
- Installation of underground cabling (trenching) and installation of inverter stations.
- Testing of electrical infrastructure
- Removal of temporary construction facilities and rehabilitation of disturbed areas.

The project does not require any concrete footings to be provided for the solar panels construction.

A site office and compound will be established on site for the duration of the works with temporary access tracks provided to allow for access across the site as required. Internal roads shall be constructed as all-weather roads.

All staff vehicles will be able to park within the site adjacent to the site office and across the site as required. The construction site is relatively large and the vehicles will be parked across the site located near the active work site, with no external parking demands created by the project. As part of the project construction it is proposed to maximise the local workers content (from Tenterfield and Glen Innes as well as potentially Goondiwindi) and car-pooling will be supported as part of these trips. With 3 or 4 people arriving in a single vehicle it can be seen that the parking demands can be contained within the site.

2.1 Timing

Construction of the solar farm will commence in 2020 (subject to approval) requiring approximately 12 months to complete.

2.2 Working Hours

Construction hours are in accordance with the *Interim Construction Noise Guidelines* (DECC 2009) (ICNG) with standard construction hours being

- 7:00am and 6:00pm Monday to Friday
- 8.00 AM to 1.00 PM on a Saturday
- No construction work is to be carried out on a Sunday or NSW public holiday.

No construction work, upgrading or decommissioning activities will be undertaken outside of these hours with the exception of:

- The delivery of material as requested by the NSW Police Force to other authorities for safety reasons; or
- Emergency work to avoid the loss of life, property and / or material harm to the environment.

2.3 Construction staff numbers

Peak demand levels for the construction work will vary with a peak of 190 people for a 6 month duration and a lower level outside of this peak period. The staff will be sourced locally where appropriate with any specialist and project management staff from outside of the local area to be housed in Tenterfield and Glen Innes as well as potentially Goondiwindi.

Details of staff accommodation and employment shall be addressed within an Accommodation and Employment Strategy to be provided to Inverell Shire Council.

2.4 Construction Traffic

2.4.1 Light Vehicles

A shuttle bus service shall be provided to transport staff housed in Tenterfield and Glen Innes as well as potentially Goondiwindi to the site and to discourage private vehicle use. Shuttle buses will typically be 12 or 22 seater mini buses which will arrive at the start of the and leave at the end of the day. The route for these shuttle buses shall allow for collection at local hotels / motels to be determined once workers have been housed.

Specialist trades which require the use of their own vehicle for the transportation of tools and other equipment shall be encouraged to car pool where appropriate.

Local staff who reside outside of Tenterfield and Glen Innes as well as potentially Goondiwindi shall be permitted to drive to the site, however shall be encouraged and supported to car pool where appropriate to minimise demands for light vehicle travel to the site.

With a peak of 190 staff, a vehicle occupancy rate of 3 people per vehicle has been assumed based upon carpooling and the use of a mini bus e.g. Toyota Coaster. This would give 65 vehicle movements inbound and outbound for staff movements.

All construction light vehicles will be able to park on site as required.

2.4.2 Heavy Vehicles

The demands for heavy vehicles accessing the site will vary throughout the construction phase. At the beginning of the project there will be a requirement for some earthwork moving equipment to construct the access and some minor earthworks across the site as required. This may require a scraper or bull dozer which will be transported to site on a low loader. This machinery will remain on site for the duration of the earthworks portion of the project construction work.

While extensive earthworks are not proposed, some land forming (including localised cut and fill areas) may be undertaken to achieve more consistent gradients beneath the PV modules. Additionally, earthworks are required for trenching works.

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In total, approximately:

- Approximately 15,000 m^3 of gravel would be required to cap roads within the site
- Approximately 13,000 m^3 of sand (subject to detailed design) would be required for the bedding of cables that are to be buried throughout the site

Should any excavated material not be suitable for reuse or additional fill material is required, the maximum amount of fill is estimated to be 12,000 m^3.

Once the earthworks have been completed, the balance of the construction work will commence requiring machinery including:

- Pile driver
- Piling rig
- All terrain fork-lift
- All terrain utility vehicles
- Backhoe
- Flatbed trucks
- Mobile crane

Other equipment if required may include an elevated work platform, scraper, roller and winches. All of the plant will be located on site and will therefore be only required to access the site once for the construction works.

The solar panels are expected to be all delivered from the Port of Newcastle or Port of Brisbane. Other specialist equipment is generally sourced from Newcastle or Greater Brisbane as required whilst consumables be local from the Tenterfield and Glen Innes as well as potentially Goondiwindi.

Typical vehicle movements during the peak construction period (over 6 months) are in the order of 65 light and 20 heavy vehicles two-way (65/20 inbound, 65/20 outbound) per day. For the light vehicles, the vast majority of these will be inbound movements in the morning bringing workers to the site with these vehicles then remaining on site for the full working day before leaving at the end of the working day. It is expected that there will be limited light vehicle movement outside of these periods, other than support staff e.g. office staff or the occasional visitor to the site.

For the heavy vehicles, these will typically be spread across the working day. For the solar panel deliveries, these trucks are arriving from either the Port of Brisbane or the Port of Newcastle and the journey length will be over 5 or 7 hours respectively, seeing a spread of these vehicles not all arriving at the same time. Allowing for each truck to be emptied on site one at a time, the outbound movements will also be spread out and not all leave at the same time avoiding platooning of heavy vehicles on the road network. All other heavy vehicles will also be spread out across the normal working day with no concentration of heavy movements expected.

Outside of the peak period of construction, the staff levels will be lower and the daily light vehicle numbers will be less than 65 inbound and outbound per day. The heavy vehicle numbers will also be lower outside of the peak construction activity and less than 20 vehicles inbound and outbound per day

The construction company on site shall keep records of the number of heavy and over-dimensional entering and leaving each day.

3 Site Operations

Once constructed the site will operate for approximately 25 years at which point the site will either be decommissioned, or panels replaced to extend the length of operations. The site is expected to provide employment for no more than 10 staff with traffic demands associated with the ongoing operations to be significantly lower than those during construction.

4 Traffic Management

4.1 Traffic Management Objectives

The objectives of the traffic management plan are to:

- Minimise disruptions and ensure the safety of traffic on the external road network.
- Provide suitable access to the site for construction workers, heavy and over-dimensional vehicles.
- Ensure the safety and protection of workers working within the public domain.

4.2 Vehicle Movement Plan

The proposed traffic management measures allow for all access off the Bruxner Highway only, via the existing access to the adjacent electric substation. This access shall be used by the construction traffic movements as well as the future on-site operational demands.

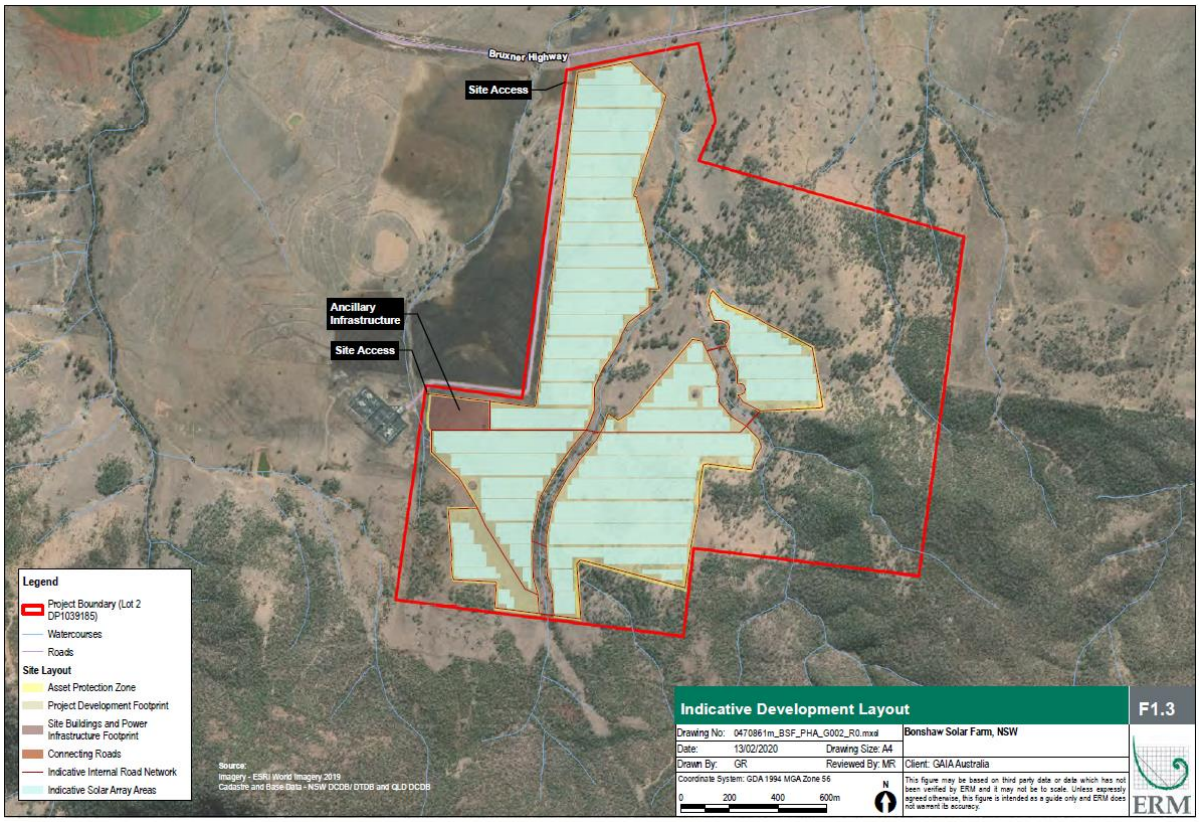


Figure 4-1 – Detailed site layout showing access point via existing access to electric sub-station

All heavy and over-dimensional vehicles associated with the development shall travel to and from the site via the Bruxner Highway. Due to safety concerns at the intersection of the Bruxner Highway and the New England Highway trucks heading south from the site shall travel via Ashford and Inverell. The proposed heavy vehicle routes are shown in Figure 4-2 below.

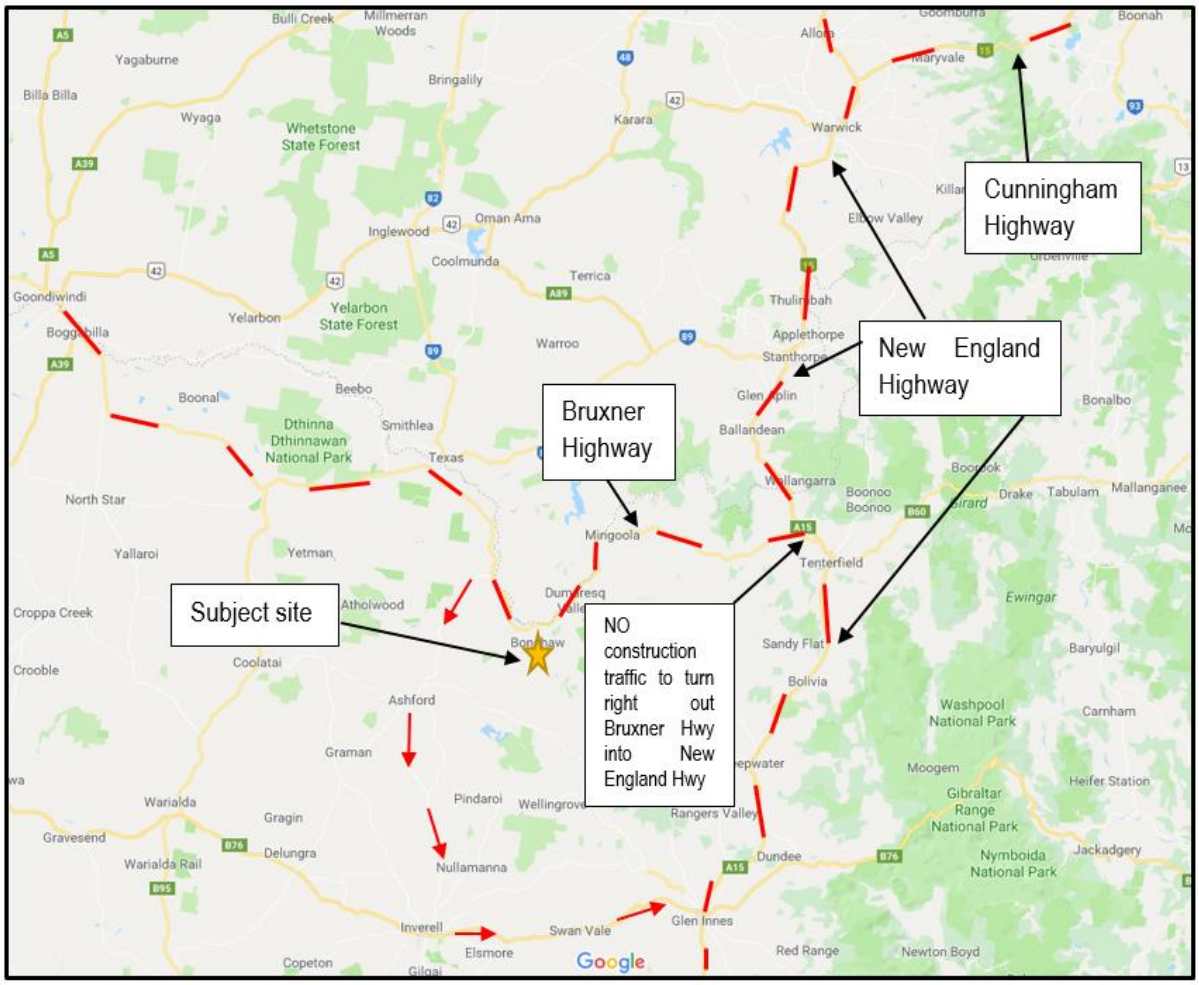


Figure 4-2 – Heavy and Over-Dimensional Vehicle Route

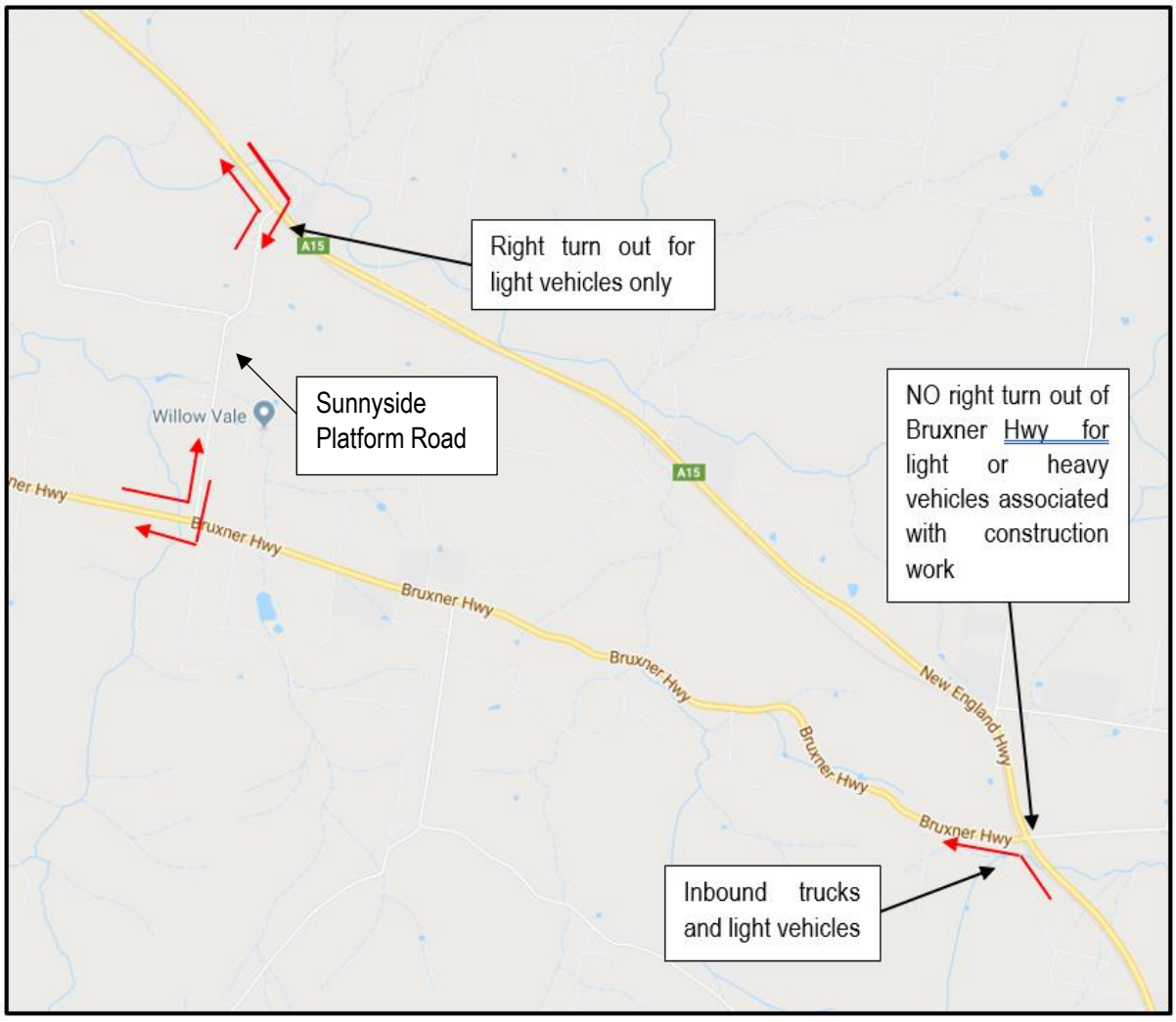


Figure 4-3 - Detail for connection between New England Highway and Bruxner Highway using Sunnyside Platform Road

The application is required to obtain relevant permits under Heavy Vehicle National Law (NSW) for the use of over-dimensional vehicles on the road network.

4.3 Traffic Diversions

There are no diversions or road closures associated with the construction or ongoing operation of the Bonshaw Solar Farm.

4.3.1 Proposed Speed Zone

No reduced speed zones shall be implemented during construction of the solar farm.

4.4 Traffic Impacts

The potential impacts of construction and operational traffic on the surrounding road network have been assessed and documented and included the cumulative impacts of other State Significant Projects within the general locality.

As there are no road closures or diversions required during the various stages of the project, there shall be only minor delays associated with the proposed on-site construction works on the Bruxner Highway.

There will be no public vehicle access within the work site during the construction works, with a fence provided at the commencement of the project along the entire site boundary. This fence will remain once the project is constructed for security purposes with a locked gate to be provided at the site access off the Bruxner Highway.

All vehicles are to be loaded and unloaded within the site only and will enter and exit in a forward direction.

Deliveries are to be scheduled to avoid platooning of heavy vehicles travelling together when accessing or departing the site. Two trucks travelling together should leave a suitable gap to enable other drivers to overtake as required.

4.4.1 Construction Parking Demands

Parking of vehicles will be accommodated as required within the site. Management policies shall be implemented to discourage construction workers living in Tenterfield and Glen Innes as well as potentially Goondiwindi driving to the site (unless required for the transportation of specialist tools and equipment).

No vehicles shall be permitted to park on the Bruxner Highway or other local roads.

4.4.2 Public Transport and School Buses

There is school bus that runs along the Bruxner Highway, with one bus in the morning and one bus in the afternoon. The majority of the nominated heavy vehicle routes does not form part of the school bus route with the only interactions being along the Bruxner Highway and the New England Highway to Tenterfield.

Whilst there may be some deliveries occurring in the morning during the school bus operation, very limited deliveries are expected in the afternoon period. All staff will be on site prior to the morning bus run and will depart site after the afternoon bus run. As such it is considered that there is very limited interaction with the school bus.

On the regional and state road network all school zones will be delineated in accordance with Transport for NSW Guidelines with reduced speed limits in accordance with normal NSW road rules. All drivers associated with the project construction work will adhere to the road rules as applicable and will be advised of the school bus operation on the Bruxner Highway.

There will be no impact upon public transport services with no diversions required. There are no bus stops impacted upon by the proposal.

4.4.3 Pedestrians and Cyclists

Given the rural location, demands for pedestrians and cyclists are very low. No pedestrian or cyclist diversions are required for the project work.

4.4.4 Emergency Services

There will be minimal impact for emergency vehicles with no diversions required.

4.4.5 Local Residents

There are no residential dwellings in the immediate locality of the site access that will be impacted upon by the project and construction work. There are a number of residences along the heavy and light vehicle access routes and these residents will be notified in writing of the construction works as necessary including any works which may impact on the local road network.

4.4.6 Other Developments

There will be minimal impact upon any other development within the locality of the site.

4.4.7 Adjoining Council Areas

There will be minimal impact upon adjoining Council areas. Traffic routes in and out of the locality will be along the arterial road network which will experience minimal impacts due to the works.

5 Environmental Conditions

Noise has been considered in the approved working times.

Construction vehicle movement on internal roads could lead to dust generation. A water truck will be used for dust suppression to minimise the production of dust, with the amount of water spreading adjusted accordingly to reflect the conditions. Additionally, any significant deposits of dirt and other construction materials will be promptly removed from public roadways.

Vehicles departing the site are to be in a clean condition to ensure dirt is not tracked into the public road network. A suitable wash bay shall be provided adjacent to the access point for the cleaning of vehicles wheels as required. The access to the sub-station provides a length of seal to prevent the tracking of dirt onto the Bruxner Highway.

The rural location of the site presents a number of environmental hazards such as fog or wildlife along the haulage route. Drivers accessing the site are to drive to suit the road conditions including slowing down in fog or adverse weather conditions. Incidents involving wildlife are to be reported to the site and relevant authorities as appropriate.

6 Incident Procedures

In the case of an incident on site, emergency services will be notified and given priority access to the site as required.

7 Complaints

Any complaints received from the community in relation to the construction and operational traffic for Bonshaw Solar Farm shall be directed to the nominated Health Safety Environment and Community Manager for the project. Details shall be confirmed.

8 Review Process

The Construction Traffic Management Plan and relevant Traffic Control Guidance Plans (TCGPs) will be monitored regularly to ensure their effectiveness and applicability and updated accordingly.

9 Compliance Documentation

Refer to Legislative and Jurisdiction compliance requirements, company policies and procedures as appropriate.

10 Traffic Control Guidance Plan

10.1 General

This TCGP has been prepared to meet the requirements of the RMS Traffic Control at Work Sites Manual 2018. The plans cover the access requirements to the site on the Bruxner Highway.

At all times the Roads and Maritime Service's Traffic Control at Work Sites guidelines must be adhered to. Please refer to the RMS guidelines for traffic control matters not listed in this report.

10.2 Existing Traffic Conditions

- 100 km/hr posted speed limit on the Bruxner Highway.
- Daily traffic volumes on the Bruxner Highway are less than 300 vehicles per day.

10.3 Cyclists and Pedestrians

Given the rural location, demands for pedestrians and cyclists are zero.

10.4 General Traffic Control Considerations

The factors that have been considered in preparing the TCGP are:

- Duration of the works and minimising potential disruptions to local traffic.
- Provision of safe access for heavy and over-dimensional vehicles off the Bruxner Highway.
- Existing traffic volumes and road conditions.

The location and nature of the work will NOT require safety barrier to be installed along the Bruxner Highway.

10.5 Traffic Control – Signage and Line Marking

The TCGP provides Work Site definition. Temporary signage required as part of the works are included due to the nature of the passing traffic, access for construction traffic to the site and the location and nature of the works.

All signs shall be placed on the verge adjacent to the road and made secure against wind and shall be covered when not in use and removed outside of working hours. The signs shall be uncovered before any trucks access the site.

A copy of this TCP must always be on site during the construction work.

10.6 Compliance

The traffic impact assessment prepared by Seca Solution demonstrates that the construction and operation will not have an unacceptable impact on the surrounding roads and intersections.

b) MANAGEMENT PLAN DETAILS:

i) Statutory Requirements: Prepare in accordance with Transport for NSW and Council, identify measures that are to be implemented to ensure road safety, detail heavy vehicle routes, identify driver code of conduct, minimise road impacts and environmental risks, notification of any upcoming major works to the local community.

ii) Limits & Performance Measures: No traffic control is required to manage traffic throughout construction works. Refer to the above report for further details and below for indicators.

iii) Specific Performance Indicators – None required except installation of TCGP

c) DESCRIPTION OF MEASURES USED TO COMPLY WITH STATUTORY REQUIREMENTS:

- Licenced traffic consultant and traffic controllers engaged to complete the works
- Traffic control signage and plan to be maintained throughout the works
- Maintain through access on affected roads

d) PROGRAM FOR MONITORING & REPORTING To be managed by the Construction Contractor

e) CONTINGENCY PLAN:

If the traffic control plan does not maintain the safety of road users and construction workers, the TCP is to be modified by a suitably qualified and accredited person and changes recorded within the register.

f) PROGRAM TO IMPROVE PERFORMANCE

The traffic management plan will be regularly reviewed to ensure its suitability for the works being completed.

g) PROTOCOL FOR MANAGING & REPORTING INCIDENTS & COMPLAINTS

i) All incidents and / or non-compliances that may arise will be documented and the HSEC manager notified immediately on the same business day. This will be documented within the site diary and / or raised at weekly disruption meetings.
ii) Complaints shall be directed to the nominated HSEC manager and appropriate actions taken to address any concerns raised.

h) PROTOCOL FOR PERIODIC REVIEW

Periodic review of the plan is captured above.

10.7 Daily Checklist

In accordance with the Roads and Maritime Services of New South Wales 'Traffic Control at Worksites' guidelines, the site foreman / manager should complete a daily traffic control checklist and this checklist should be filed for future reference.

Details on this checklist can be found at https://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/technical-manuals/traffic-control-at-worksites-manual.pdf

Quality Traffic Advice

10.8 Contractors Contact Details

Project Manager:	TBC
Telephone:	TBC
Mobile:	TBC
E-mail:	TBC

10.9 TCP Approval

This TCGP will be submitted to the road authority for review and approval.

Details for lodging this TCGP and the Construction Traffic Management Plan are:

Inverell Shire Council:

Inverell Shire Council Administration Offices, P O Box 138, Inverell NSW 2360

Transport for NSW (formerly RMS):

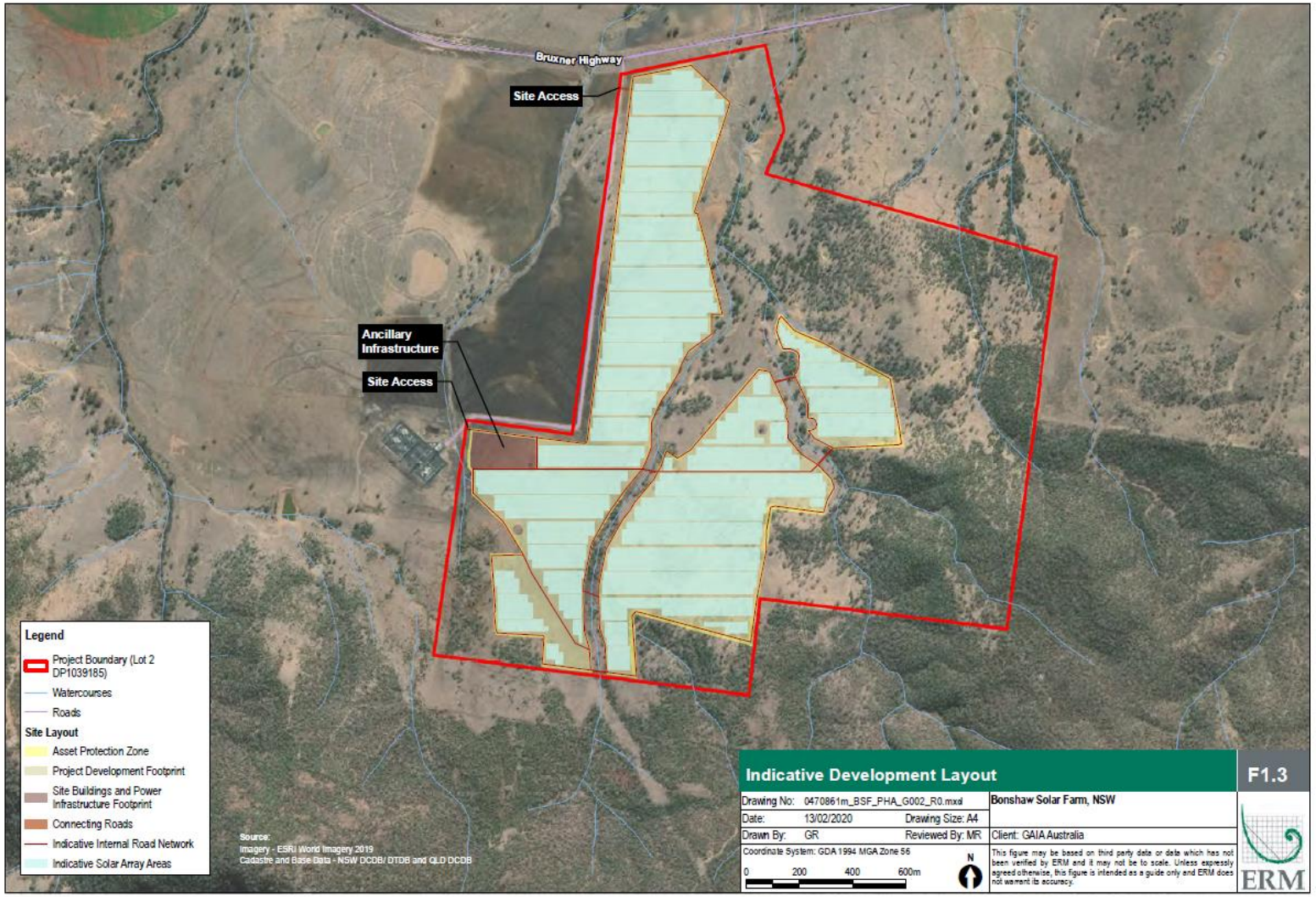
Transport for NSW, RMS, P O Box 576, Grafton NSW 2460

This Traffic Control Plan has been prepared and reviewed by suitable qualified professionals in accordance with the RMS Traffic Control at Work Sites Manual 2018 edition.

Sean Morgan (PWZTMP 0051749238)

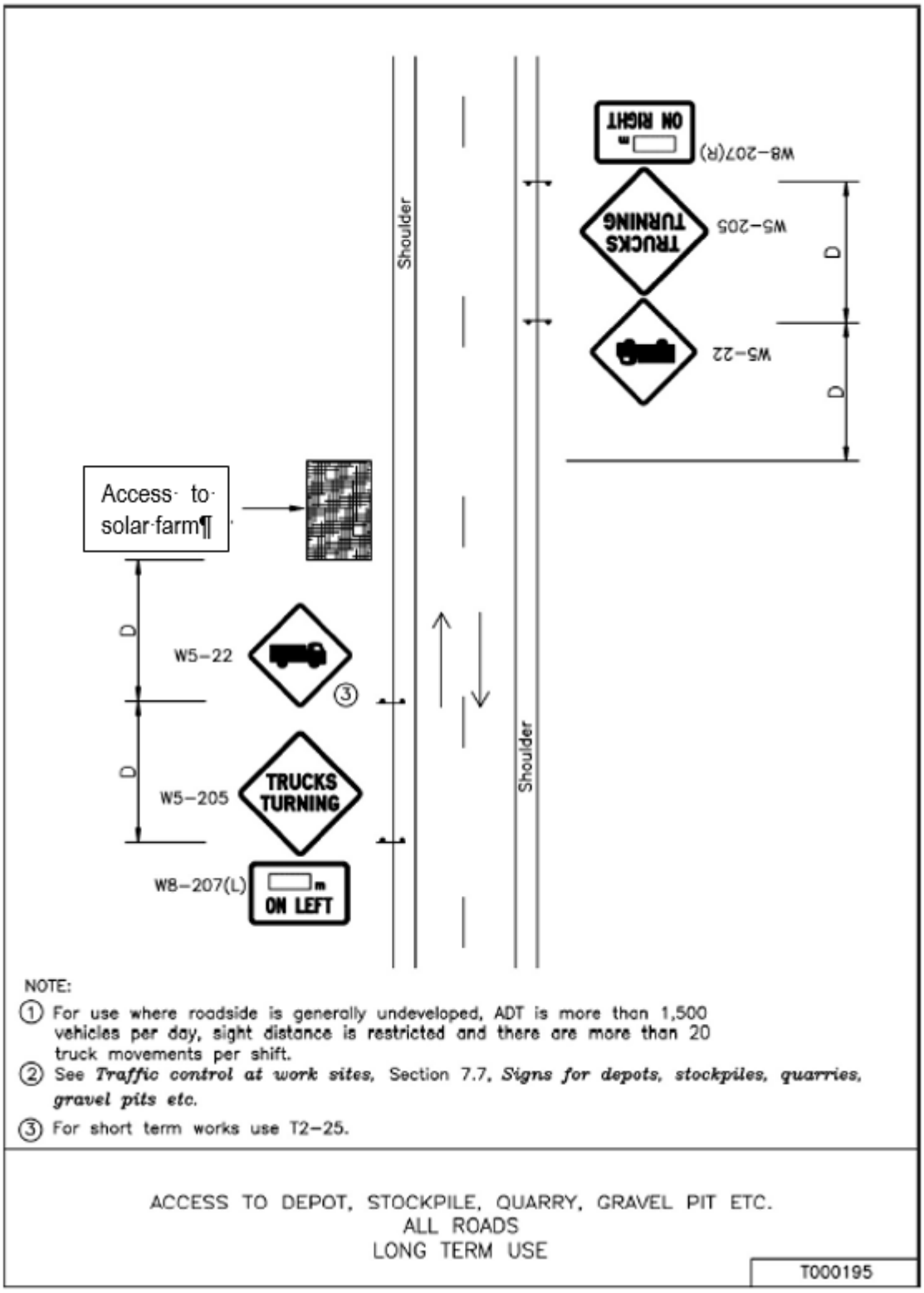
Director

Appendix A. Site Plan



Appendix B. TCP at site access on the Bruxner Highway

TCP 195



Appendix C. Driver Code of Conduct

This Drivers Code of Conduct has been established to minimise the impact of our construction on the environment and the local community whilst providing our customers with a high quality, reliable and safe service.

All persons traveling to and from the Bonshaw Solar Farm must adhere to the rules detailed in this document.

Please ensure all persons attending the construction site read, understand and sign this document and return it to the nominated site representative.

General	All vehicles / drivers accessing the site must: i) Be registered and hold a valid driver's licence for the class of vehicle being operated. ii) Operate the vehicle in a safe and appropriate manner whilst travelling to / from the site or when operating within the site. This includes obeying all New South Wales state road rules. iii) Comply with the directions of authorised personnel when operating within the site and obey any relevant signage installed along the internal roads. iv) Not use a mobile phone while operating any vehicle. v) Must always wear a seatbelt when operating any vehicle.
Times	*Construction* Construction is to be in completed in accordance with the *Interim Construction Noise Guideline* (DECC 2009) which defined standard construction work hours as: • Monday to Friday: 7am to 6pm • Saturday: 8am to 1pm • Sunday and NSW Public holidays: No work The following construction, upgrading and decommissioning activities may be undertaken outside these hours without the approval of the secretary: • The delivery of materials as requested by the NSW Police Force or other authorities for safety reasons; or • Emergency work to avoid loss of life, property and / or material harm to the environment. Vehicle movements shall be undertaken during standard construction hours (or just before to allow workers to get to site). Oversize vehicles up to 26 metres long may require access to the site after hours however this would be subject to the requirements of Transport for NSW, Inverell Shire Council or NSW Police. *Normal Operations* Daily operations and maintenance by site staff would be undertaken during standard working hours: • Monday to Friday: 7am to 6pm • Saturday: 8am to 1pm • Sunday and NSW Public holidays: No work During normal operations, all vehicle movements shall be undertaken during the standard operating hours (or just before to allow workers to get to site).

	There may be a requirement for vehicles to access the site after hours during an emergency however these would be infrequent.
Access	All heavy vehicles must adhere to the designated heavy vehicle routes as nominated in Figure 1 below. Drivers must ensure they enter and exit the site in a forward direction and are not permitted to load or unload on the Bruxner Highway.
Vehicle Departure and Arrival	Heavy vehicles departing the site shall have a minimum 5 minute separation to reduce the impacts upon the local road network. Always maintain a minimum separation of at least 50 metres between vehicles when travelling within the site. Drivers must contact the site supervisor upon arrival and await further instructions or direction before proceeding. Drivers must also report to the site supervisor prior to departure. All vehicles must enter and exit the site in a forward direction. Vehicles tyres are to be washed down and in a clean condition upon exiting the site to prevent dirt being tracked onto the public road network
Illegal and Unsafe Truck Parking	No vehicles are permitted to park on the Bruxner Highway except in designated parking bays. All parking within the site is to be as directed.
Heavy Vehicle Compression Braking	Compression braking by heavy vehicles is a source of irritation to the community. Brakes must be applied so as not to create excessive noise that could disturb residents along the haulage routes, particularly within the township of Tenterfield. Compression braking should only be used if required for safety reasons.
Load Covering and Restraint (as per NHVL and CoR Regulations)	All trucks arriving to or departing the site are required to have an effective cover over their load for the duration of the trip. Drivers must ensure that following loading or unloading that all gates and tailgates are secured and locked before leaving the site. Drivers are to ensure that their loads are secured as per the NTC Load Restraint Guide 2018 and that checks are completed on restraint equipment such as tailgates, chains, straps, ratchet dogs, tarps etc on a regular basis to ensure they are functioning correctly. Drivers must exit their vehicle to inspect the above every time they are loaded, prior to arrival at the site and following unloading at the site, prior to departure. The security of your load, your life and the life of others relies upon proper load restraint practices.
Mass and Dimension (as per NHVL and CoR Regulations)	Drivers should be aware that: • Adhering to legal axle and grow weight limits are their responsibility • Trucks accessing the site must adhere to any weight and dimension limit/restrictions that apply along the approach routes. These include those load limits applicable to roads and bridges that must be complied with.

Fatigue and License Requirements (as per NHVL and CoR Regulations)	All drivers should be aware that: • a person must not drive a heavy vehicle on a road while impaired by fatigue • managing driver fatigue is a shared responsibility by all parties in the chain • parties must take all reasonable steps to ensure a person does not drive the heavy vehicle on a road while impaired by fatigue. Drivers shall not be permitted to operate a vehicle or plant equipment when impaired by fatigue. If you suspect that you or someone else is experiencing fatigue, please inform your supervisor. Operators of heavy vehicles shall be aware of the requirements relating to fatigue as outlined in the Heavy Vehicle National Law. Drivers shall also be aware of their adopted fatigue management scheme (shown below) and ensure that they are operating within its requirements. i) Standard Hours of Operation ii) Basic Fatigue Management (BFM) iii) Advanced Fatigue Management (AFM) All drivers accessing the site must be registered and hold a valid driver's licence for the class of vehicle being operated
Vehicle Speeds	Drivers shall observe the posted speed limit along the designated transport route and adjust their vehicle speed as required to suit the road environment and prevailing weather conditions. Vehicle speeds must be appropriate to ensure the safe movements of the vehicle with consideration to the vehicle configuration. Maximum speeds limits within the project site shall be as follows: i) 40 km/hr along formed roads. ii) 20 km/hr during foggy / dusty conditions. Headlights must be on. iii) 10 km/hr when passing pedestrians or any plant equipment.
Overtaking	Overtaking shall not be permitted within the site unless the intention to overtake has been communicated to the driver of the leading vehicle and consent to overtake granted.
Breakdowns and Incidents	*Heavy Vehicles* In the case of a breakdown, the vehicle must be towed to the nearest breakdown point as soon as possible. All breakdowns must be reported to the Transport for NSW Transport Management Centre on 131 700 and the vehicle protected in accordance with the Heavy Vehicle Drivers Handbook. The relevant shift manager on site shall also be notified. If a breakdown occurs on-site please remain inside your vehicle, notify the shift manager of your location and await further instruction. If you are involved in an accident, please notify the shift manager immediately and contact emergency services if required. *Light Vehicles* In the case of a breakdown, ensure that the vehicle is secure, notify the site manager of your location and await further instruction. If you are involved in an accident, please notify the shift manager immediately and contact emergency services if required.
Signs	Comply with the directions of authorised personnel when operating within the site and obey any relevant signage installed along the internal roads.

Personal Protective Equipment (PPE)	The mandatory Protective Clothing requirement on this site is TO BE CONFIRMED • Hard Hat • Steel cap work shoes • Safety Glasses • High-Vis clothing • Ear Protection (as required) • Gloves (as required)
Mobile Phone Usage	A mobile phone is not to be used while operating any vehicle. The use of a mobile phone while operating machinery or undertaking site activities is STRICTLY PROHIBITED. Driving, operating or undertaking high risk activities must be temporarily stopped to take a call. When a call or text message is received while driving and a hands-free kit is not available or the hands free kit is not voice activated, the driver MUST pull to the side of the road when safe to do so prior to taking the call or checking the message. Where a conversation is complex, technical or requires notes to be taken is mandatory to pullover when safe to do so to continue the conversation. Any person contravening this Policy will be subject to the Company's disciplinary procedure which may include termination of Employment/Contractor contract.
Alcohol and Drug Policy	All persons are to be in a "fit for work" state. This means must not be affected by alcohol or other drugs, (including prescription medication if inhibiting ability to operate plant and equipment safely) whilst at work. It is prohibited for any person to possess, use, sell or work under the influence of Alcohol or other Drugs.
Contacts	Transport for NSW Transport Management Centre 131 700 Site Supervisor _____ Emergency 000

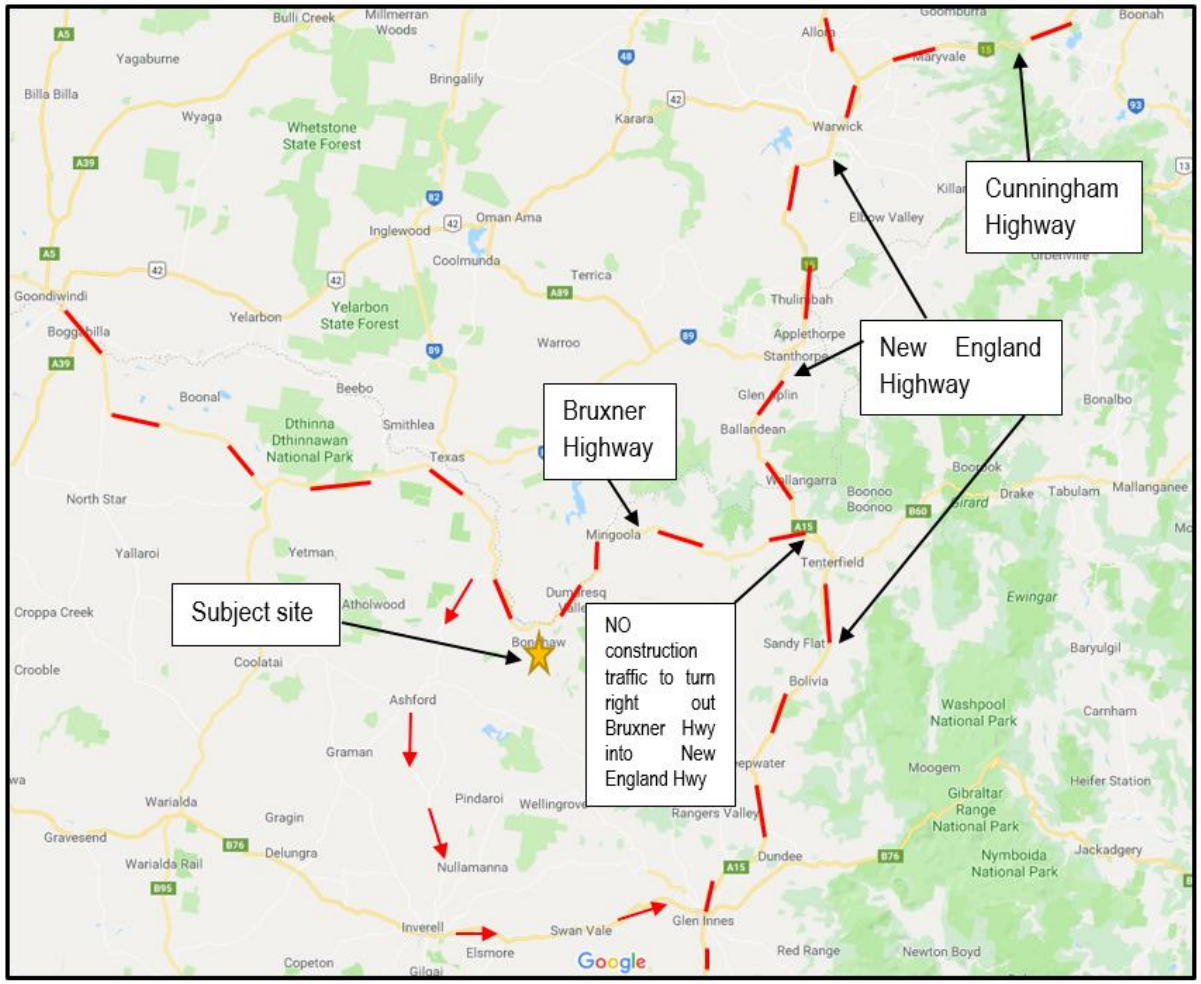


Figure 1 - Heavy and Over-Dimensional Vehicle Route

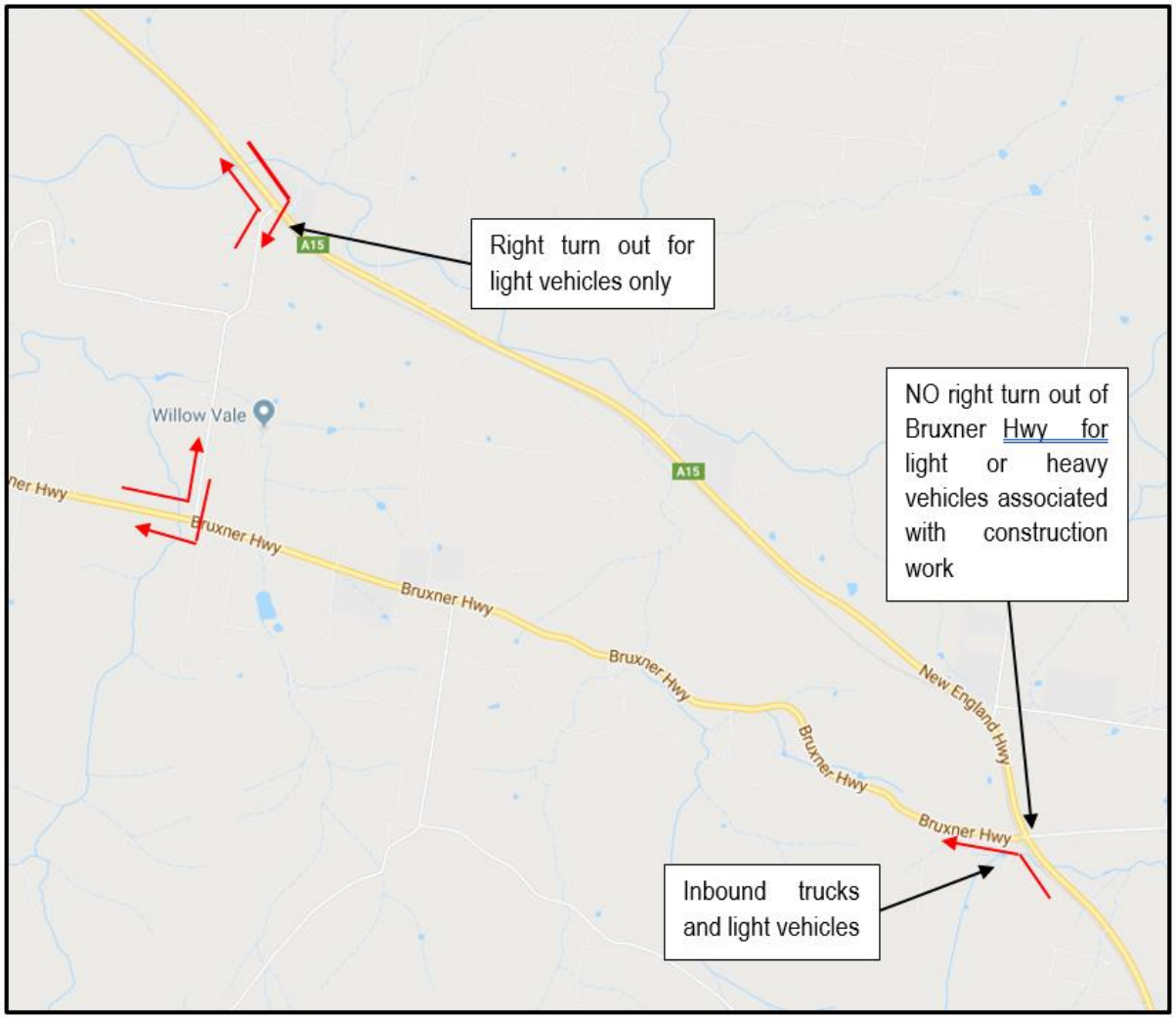


Figure 2 - Transport route to/from the site for ALL 19 m semi-trailers or greater (detail for northbound via New England Highway to use Sunnyside Platform Road)

Driver Declaration

I, the undersigned, hereby agree to abide by this Driver Code of Conduct for the transport of equipment, product or personnel to / from the construction site to the Bonshaw solar farm located off the Bruxner Highway, Bonshaw, NSW. I have read and understand the requirements outlined in the attached document and will, to the best of my ability, comply and assist with their implementation, requirements or ongoing administration.

The subject document to which this declaration relates is included as part of this overall document and signing of this declaration confirms that the signee has read and understood their requirements as outlined throughout.

Driver Details

Full Name	
Organisation	
Signature	
Date	

Representative of:

Full Name	
Signature	
Date	

Disciplinary action will be taken against drivers who do not adhere to this Code of Conduct.

ATTACHMENT B SITE ACCESS ROAD UPGRADE – BIODIVERSITY & HERITAGE ASSESSMENT

1. SITE ACCESS ROAD UPGRADE

1.1 Introduction

Access to the site will be via the existing access provided to the electric substation adjacent to the subject site. This access was constructed to allow for the construction activities associated with the Dumaresq substation, and is now used for maintenance purposes only for the substation.

This access will be upgraded to provide a left turn deceleration lane and shoulder widening to provide an auxiliary right turn treatment, both in accordance with Austroads Guidelines (refer to **Figure 1-1** below)

Environmental impacts of these road upgrades are considered herein, namely associated with biodiversity and heritage matters. However, it is highlighted that both the construction of the Bruxner Hwy and the use of the Travelling Stock Reserve (TSR) immediately south of the Bruxner Hwy have added to the highly disturbed nature of this area.

1.2 Biodiversity Impact

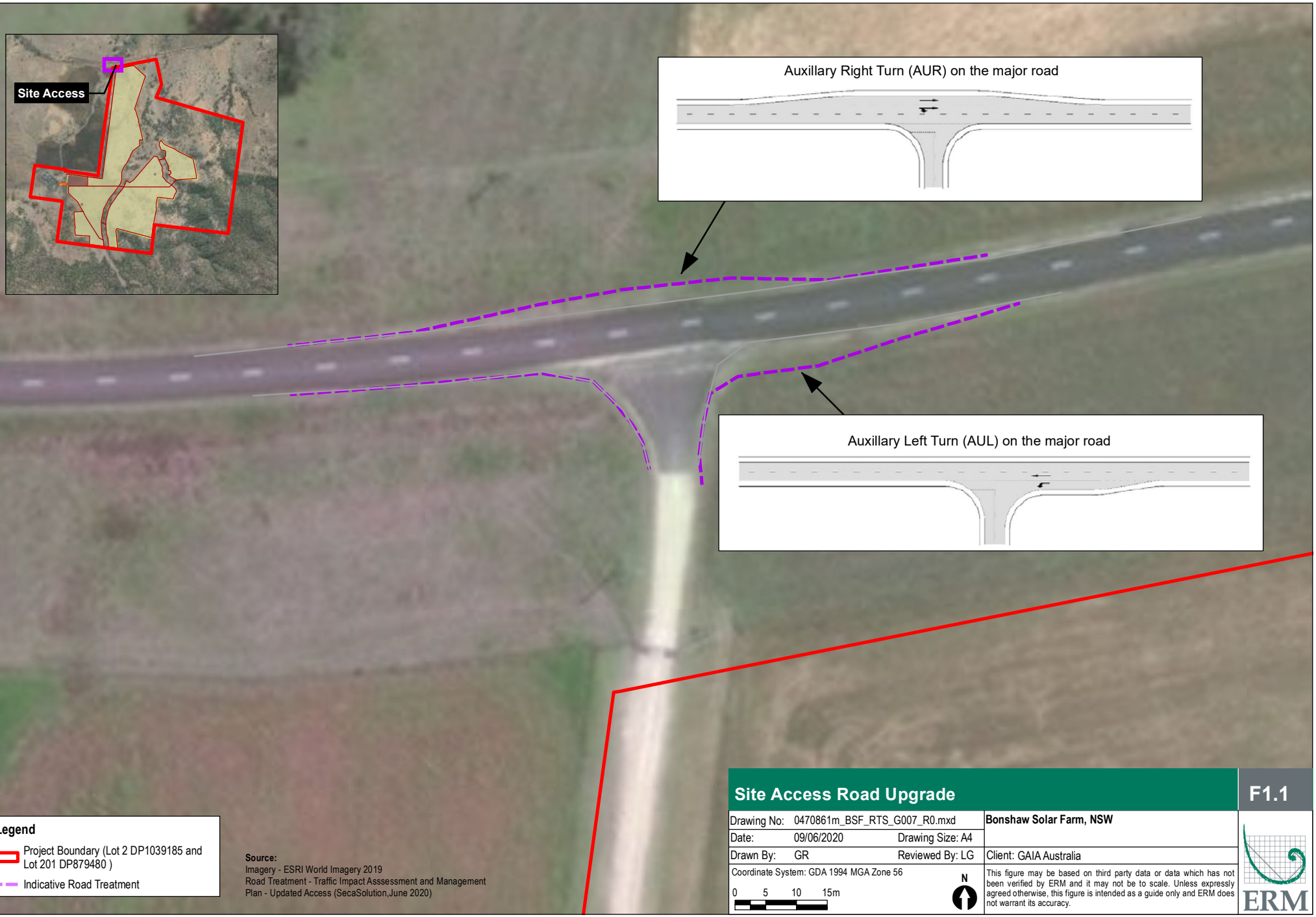
The proposed road upgrades will occur within the existing road corridor, on the shoulders of the Bruxner Hwy. This area has been cleared and is now dominated by introduced grass species. There are no anticipated impacts to biodiversity matters.

1.3 Heritage Impact

The original heritage surveys have identified Aboriginal artefacts in the northern part of the development footprint, including BSF1, a significant artefact scatter with potential archaeological deposit. This has been mapped as extending to the Bruxner Hwy corridor. However, this area is located further to the east of the site access point and does not extend to the road upgrade area.

The road shoulder is highly disturbed from the original Bruxner Hwy construction and is unlikely to contain Aboriginal heritage matters.

In the event that an Aboriginal artefact is uncovered during construction, an unexpected finds protocol will be implemented for the upgrade works, forming part of the Construction Environmental Management Plan (CEMP).



Legend

- Project Boundary (Lot 2 DP1039185 and Lot 201 DP879480)
- Indicative Road Treatment

Source:
Imagery - ESRI World Imagery 2019
Road Treatment - Traffic Impact Asssessment and Management Plan - Updated Access (SecaSolution,June 2020)

Site Access Road Upgrade

F1.1

Drawing No:	0470861m_BSF_RTS_G007_R0.mxd		**Bonshaw Solar Farm, NSW**
Date:	09/06/2020	Drawing Size: A4	
Drawn By:	GR	Reviewed By: LG	Client: GAIA Australia

Coordinate System: GDA 1994 MGA Zone 56

0 5 10 15m

N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

ATTACHMENT C UPDATED BIODIVERSITY ASSESSMENT REPORT

North Coast Ecology ABN 59 175 957 475

GAIA Bonshaw Solar EIS

Revised Biodiversity Development Assessment Report

18 May 2020

Project No.: 0470861

The business of sustainability

ERM

Document details	
Document title	GAIA Bonshaw Solar EIS
Document subtitle	Revised Biodiversity Development Assessment Report
Project No.	0470861
Date	18 May 2020
Version	4.0
Author	Matt Jenkins North Coast Ecology BAAS 18029
Client Name	GAIA Australia

Document history

				ERM approval to issue		
Version	Revision	Author	Reviewed by	Name	Date	Comments
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Final	01	Adriana Corona Mothe	Joanne Woodhouse	Paul Douglass	26 July 2019	Final to support EIS submission
Final	02	Matt Jenkins	Joanne Woodhouse	David Dique	20 February 2020	Revision based on BCD review and comment
Final	03	Matt Jenkins	Joanne Woodhouse	Henrietta Jukes	20 March 2020	Addition of overhead transmission corridor
Final	04	Matt Jenkins	Joanne Woodhouse	Henrietta Jukes	15 May 2020	Updated based on DPIE RFI

Signature Page

18 May 2020

GAIA Bonshaw Solar EIS

Revised Biodiversity Development Assessment Report

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Acronyms and Abbreviations

Name	Description
AoS	Assessment of Significance (under the EPBC Act)
AOBV	Areas of Outstanding Biodiversity Value
APZ	Asset Protection Zone
Assessment Area	Assessment Area refers to the 1,500m buffer area surrounding the Subject Land and other areas requiring consideration as part of the biodiversity values assessment in Stage 1 of the BAM
BAM	Biodiversity Assessment Method
BC Act	NSW *Biodiversity Conservation Act 2016*
BCD	Biodiversity Conservation Division of the Environment, Energy and Science Group in the NSW Department of Planning, Industry and Environment
BDAR	Biodiversity Development Assessment Report
BIA	Biodiversity Impact Assessment
BOSET	Biodiversity Offset Scheme Entry Threshold
BSA	Biodiversity Stewardship Agreement
Buffer area	All land within 1500 m of the Subject Land.
BV Map	Biodiversity Values Map
Candidate species	Threatened species requiring assessment other than 'ecosystem credit species' and 'species credit species'
Development Site	The area of land that is subject to either temporary or permanent impact. At the proposed Bonshaw solar farm, the development site includes the land proposed to install the solar arrays, perimeter fence, access roads, transmission line and ancillary construction areas. The development site is approximately 149.24 ha.
Ecosystem credits	Is a measurement of the value of threatened ecological communities, threatened species habitat for species that can be reliably predicted to occur with a PCT and PCTs generally. Ecosystem credits measure the loss in biodiversity values at a development site.
Ecosystem Credit Species	Are threatened species identified as such in the Threatened Biodiversity Data Collection and whose selection was based on the likelihood of occurrence of the species or elements of the species' habitat can be predicted by vegetation surrogates and landscape features, or for which targeted survey has a low probability of detection.
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Commonwealth Environment Protection and Biodiversity Conservation Act 1999*
ERM	Environmental Resources Australia Pty Ltd
FM Act	*NSW Fisheries Management Act 1994*
GAIA	GAIA Australia
Ha	Hectares
HBT	Hollow Bearing Tree
IBRA Bioregion	A bioregion identified under the Interim Biogeographic Regionalisation for Australia (IBRA) system, which divides Australia into bioregions on the basis of their dominant landscape-scale attributes

Name	Description
IBRA Sub-region	A sub-region of a bioregion identified under the IBRA (Interim Biogeographic Regionalisation for Australia) system
KFH	Key Fish Habitat
Km	Kilometres
LEP	Local Environmental Plan
m	Metres
NSW	New South Wales
OEH	former New South Wales' Office of Environment and Heritage
PCT	Plant Community Type
Project Boundary	Project Boundary referred to in this report refers to Lot 2 DP 1039185
SAII	Serious and Irreversible Impacts
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy (State and Regional Development) 2011
Species Credits	Species Credits is the class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates.
Species credit species	Species Credit Species are threatened species or components of species habitat that are identified in the Threatened Species Data Collection as requiring assessment for species credits.
SSD	Stage Significant Development
Subject Land	Is the land to which the BAM is applied to assess the biodiversity values. In this assessment, the Subject Land is the same area as the Development Site. It represents the development footprint of the solar farm and associated infrastructure. It is restricted to the western portion of the property and has been the subject of all detailed assessments.
TEC	Threatened Ecological Community
ToS	Test of Significance (under BC Act 2016)
The Project	The construction, operation and maintenance of a solar PV generation facility and associated infrastructure with a capacity of up to 500 MW, supplying electricity to the national electricity grid.
VIS	Vegetation Information System
WM Act	NSW Water Management Act 2000
WoNS	Weeds of National Significance

EXECUTIVE SUMMARY

Environmental Resources Australia Pty Ltd (ERM) was commissioned by GAIA Australia (GAIA) to prepare a Biodiversity Development Assessment Report (BDAR) to support an Environmental Impact Statement (EIS) for a proposed solar farm located within Lot 2 DP1039185, Bonshaw NSW.

The proposed development will involve the construction, operation and maintenance of a solar PV generation facility and associated infrastructure with a capacity of up to 200 MW and associated infrastructure, including a Lithium-ion Energy Storage System, supplying electricity to the national electricity grid. The Development Site includes all supporting infrastructure and site access points.

This BDAR was prepared in accordance with the requirements of the NSW *Biodiversity Conservation Act 2016*, including the Biodiversity Assessment Method (BAM) and Biodiversity Offsets Scheme (BOS). The BDAR also considers relevant matters associated with the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the addresses the Secretary's Environmental Assessment Requirements (SEARs) provided for the Project.

Flora and fauna surveys were undertaken at the Development Site across four survey periods (11-13 September 2018 (spring), 11-14 December 2018 (summer), 25-28 March 2019 (autumn) and 21-22 January 2020 (summer)). Flora and habitat surveys included vegetation mapping along random meander transects and over 100 vegetation community observation points and 44 BAM plots. Targeted fauna surveys included amphibian call payback (three surveys), bird surveys (eight surveys), reptile surveys (eight surveys), arboreal/tree hollow dependent fauna surveys (eight camera trap over 28 trap nights), microchiropteran bat call recording (eight SongMeters totalling 28 trap nights) and fauna habitat observations (hollow bearing trees, ant/termite mounds, rocky areas, bird nests and creek lines).

The Subject Land is comprised of highly disturbed land whose current and historical land uses include livestock grazing and cropping. Several creeks (first, second and third order), representing tributaries of the Dumaresq River, occur within the Project Boundary along with eight farm dams. The majority of the Development Site consists of cleared grazing land (72%), with the remainder comprising disturbed native woodland vegetation (28%).

A total of 143 flora species in 47 families were recorded within the assessment area. This included a total of 111 native (78%) and 32 exotic (22%) species. No threatened flora species were recorded on the Subject Land. Vegetation occurring on the Subject Land is represented by the following four Plant Community Types (PCTs):

- PCT 594 – Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion. Two vegetation zones of this PCT are present: moderate and low condition;
- PCT 596 – Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion. Four vegetation zones of this PCT are present: moderate condition, low condition, very low condition and derived grassland;
- PCT 544 - Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest/woodland of the Nandewar Bioregion and New England Tableland Bioregion. One vegetation zone of this PCT is present: low condition; and
- PCT 516 – Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion. Three vegetation zones of this PCT are present: low condition, very low condition and derived grassland.

PCT 544 is considered to represent the following Threatened Ecological Community, which is listed as Endangered under the NSW *Biodiversity Conservation Act 2016:*

- White Box Yellow Box Blakely's Red Gum Woodland

The occurrence of this TEC on the Subject Land is not considered to satisfy the minimum condition criteria for the Commonwealth listing of this TEC. This determination has been made on the basis of very small patch sizes occurring on the Subject Land, low diversity of native understorey species and absence of "important species" as described in the Threatened Species Scientific Committee listing advice and National Recovery Plan for the TEC.

A total of 75 fauna species were recorded within the Project Boundary, including thirteen threatened species. Threatened species included eight vulnerable microchiropteran bats (Little Pied Bat, Eastern Bent-wing Bat, Corben's Long-eared Bat, Yellow-bellied Sheath-tailed Bat, Eastern Cave Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat and Hoary Wattled Bat), one endangered microchiropteran bat (Bristle-faced Free-tailed bat), three vulnerable birds (Grey-crowned Babbler, Brown Treecreeper and Speckled Warbler) and one migratory bird (Cicadabird). Out of the eight Vulnerable microchiropteran bats, six were recorded as "definite" calls and two (Greater Broad-nosed Bat and Hoary Wattled Bat) were recorded as "possible" calls by a microbat call identification expert. Brown Treecreeper and Speckled Warbler were recorded within the Project Boundary but not directly on the Subject Land.

An assessment of the impacts of the project on Matters of National Environmental Significance (MNES) within the Development Site was undertaken. A likelihood of occurrence and risk assessment was undertaken for each entity identified as likely to occur within the Project's locality. It was concluded that all TECs and threatened species as identified in the PMST would have low residual risk as a result of the Project. Therefore, assessments of significance and referral for assessment of the project to the Commonwealth Minister for the Environment is not required.

GAIA has undertaken significant steps to avoid, minimise and mitigate impacts to biodiversity. As part of the project refinement process, ERM provided advice to GAIA on areas which were of the highest priority for avoidance. This led to third and second order creeks and other conservation significant areas to be avoided.

The Project will result in the following direct impacts to flora and fauna:

- Removal of 40.97 ha of disturbed native vegetation pertaining to four PCTs and representing potential habitat for a range of threatened fauna species;
- Impacts to 116.83 ha of heavily disturbed grassland with vegetation integrity score <17;
- Removal of 34 hollow-bearing trees representing potential roosting and/or breeding habitat for threatened microchiropteran bats and other hollow-dependent species including threatened forest owls;
- Impacts to suitable foraging habitat for the Eastern Cave Bat in less disturbed areas of PCTs 516, 544, 594 and 516;
- Impacts to suitable breeding and foraging habitat components for the Bristle-faced Free-tailed Bat; and
- Removal of nests, nest trees and foraging habitat for the Grey-crowned Babbler.

Potential indirect impacts associated with the proposed development have been identified, including edge effects, fragmentation, and sedimentation and pollutant run-off. With consideration of the proposed management and mitigation measures, it is expected that potential indirect impacts will be reduced to acceptable levels and any residual impacts will be negligible.

Direct impacts to native vegetation and fauna habitat requiring offsets include:

- Impacts on PCT 516 – Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion, requiring 65 ecosystem credits;
- Impacts on PCT 544 - Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest/woodland of the Nandewar Bioregion and New England Tableland Bioregion, requiring 15 ecosystem credits;

- Impacts on PCT 594 – Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion ad Nandewar Bioregion, requiring 249 ecosystems credits;
- Impacts on PCT 596 – Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion, requiring 269 ecosystem credits;
- Impacts on Bristle-faced Free-tailed Bat habitat, requiring 1,180 species credits;
- Impacts on Eastern Cave Bat foraging habitat, requiring 1,030 species credits;
- Impacts on potential (assumed) breeding habitat for the Masked Owl, requiring 680 species credits; and
- Impacts on potential (assumed) breeding habitat for the Barking Owl, requiring 680 species credits.

This assessment has been completed in accordance with the BAM (OEH 2017a, 2018a) on behalf of GAIA. Overall the Subject Land is considered to be of moderate biodiversity value with impacts related to direct removal of native vegetation and fauna habitat and displacement of resident fauna. The proposed Bonshaw Solar Farm development in its current footprint requires a total offset of 598 ecosystem credits and 3,570 species credits. Retirement of these credits will be carried out in accordance with the *Biodiversity Conservation Regulation 2017* and the NSW Biodiversity Offsets Scheme.

STAGE 1: BIODIVERSITY ASSESSMENT

1. INTRODUCTION

GAIA Australia (GAIA) is seeking to develop a large scale solar photovoltaic (PV) generation facility and associated infrastructure with the capacity of 200 megawatts (MW) situated near Bonshaw in the Inverell Shire Council (ISC) of New South Wales (NSW) (the Project).

The Project is classified as State Significant Development (SSD) in accordance with Clause 20 Schedule 1 of the State Environmental Planning Policy (State and Regional Development) 2011 (SEPP) and will be assessed under Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act). This Biodiversity Development Assessment Report (BDAR) assesses the impacts of the Project according to the NSW Biodiversity Assessment Methodology (BAM) as required by the Secretary's Environmental Assessment Requirements (SEARs) for the proposal.

The aim of this BDAR is to undertake biodiversity and impact assessment of ecological values of the Subject Land in accordance with the BC Act. This BDAR also addresses the assessment requirements of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

1.1 Assessment Requirements

On 16 August 2018, the Department of Planning and Environment (DPE) provided Secretary's Environmental Assessment Requirements (SEARs) for the Bonshaw Solar Farm (the Project).

A copy of the SEARs is attached to the EIS as Appendix A. The assessment requirements that specifically relate to biodiversity, are listed in Table 1.1.

Table 1.1 SEARs requirements and how they have been addressed.

Requirement	Section Addressed
An assessment of the biodiversity values and the likely biodiversity impacts of the project in accordance with Section 7.9 of the *Biodiversity Conservation Act 2016* (NSW) the Biodiversity Assessment Method (BAM) and documented in a biodiversity development assessment report (BDAR), unless OEH (now BCD) and DPE determine that the proposed development is not likely to have any significant impacts on biodiversity values.	This BDAR has been prepared in accordance with the *Biodiversity Conservation Act 2016*, Biodiversity Conservation Regulation 2017 and the Biodiversity Assessment Method (BAM).
The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM.	Stage 2 of this BDAR, Chapter 6 to 8.
An assessment of the likely impacts on listed aquatic threatened species, populations or ecological communities, scheduled under the *Fisheries Management Act 1994,* and a description of the measures to minimise and rehabilitate impacts.	Section 5.2.

To inform preparation of the SEARs, DPE invited other government agencies to recommend matters to be addressed in the EIS. These matters were taken into account by the Secretary for DPE when preparing the SEARs. A copy of the former NSW Office of Environment and Heritage (OEH) advice to DPE was attached to the SEARs and matters relevant to the BDAR are listed in Table 1.2.

Table 1.2 Government agency requirements

Requirement	Section Addressed
DPI Fisheries	
Aquatic Ecological Assessment The aquatic ecological environmental assessment should include the following information; ■ A recent aerial photograph (preferably colour) of the locality (or reproduction of such a photograph) should be provided. ■ Area which may be affected either by the development or activity should be identified and shown on an appropriately scaled map (and aerial photographs). ■ Waterways within the area of development are to be identified. ■ The extent of aquatic habitat removal and riparian vegetation removal or modification which may result from the proposed development, ■ Details of the location and design of the waterway crossings or underground cabling through waterways. ■ Details of the methodology (e.g. trenching, boring) for any underground cabling passing through waterways.	Aquatic habitat is described in Section 5.7.7. Waterways are shown on the aerial photo in Figure 3.2, noting that they were dry (or very low water levels) during all survey periods due to extended drought conditions. The second and third order watercourses will be avoided through detailed design (including 20-30m riparian buffer zones measured from the high bank of the streams). Any waterway crossings required as a result of the Project will be designed in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management and the Policy and Guidelines for Fish Friendly Waterway Crossings. Construction methodology is further detailed in the EIS.
Waterway Crossings The construction of permanent or temporary access tracks or underground cables through Little Oaky Creek, Little Limestone Creek and unnamed creeks running into the Beardy River should be in accordance with DPI Fisheries Guideline document: Policy and Guidelines for Fish Habitat Conservation and Management (Update 2013).	The activities at the Development Site will not require any access track or cables through Little Oaky Creek, Little Limestone Creek or tributaries to Beardy River. Any waterway crossings required as a result of the Project will be designed in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management and the Policy and Guidelines for Fish Friendly Waterway Crossings.

Requirement	Section Addressed
Threatened Species, Populations And Ecological Communities The proposal should include a threatened aquatic species assessment (as per part 7A Fisheries Management Act 1994) to address whether there are likely to be any significant impacts on listed threatened species, populations or ecological communities listed under the Fisheries Management Act 1994. It should be specifically noted that the proposal is located within an area considered habitat of the threatened species Purple Spotted Gudgeon (*Mogurnda adspersa*). This species is known or expected to occur in Little Oaky Creek and a number of nearby creeks. Threatened fish species mapping distributions are available at: http://www.dpi.nsw.gov.au/fishing/species-protection/threatened-speciesdistributions-in-nsw	A description of the aquatic habitat including consideration of the Purple Spotted Gudgeon is provided in Section 5.2 and an Assessment of Significance is provided in Appendix E.
Biodiversity Conservation Division (BCD)	
1. Biodiversity impacts related to the proposed development are to be assessed in accordance with Section 7.9 of the Biodiversity Conservation Act 2017, the Biodiversity Assessment Method and documented in a Biodiversity Development Assessment Report (BDAR). The BDAR must include information in the form detailed in the *Biodiversity Conservation Act 2016* (s.6.12), Biodiversity Conservation Regulation 2017 (s6.8) and Biodiversity Assessment Method, unless OEH (now BCD) and DPE determine that the proposed development is not likely to have any significant impacts on biodiversity values.	This BDAR has been prepared in accordance with the *Biodiversity Conservation Act 2016*, Biodiversity Conservation Regulation 2017 and the Biodiversity Assessment Method (BAM).
2. The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the Biodiversity Assessment Method.	Chapter 7
3. The BDAR must include details of the measures proposed to address the offset obligations as follows: ■ The total number and classes of biodiversity credits required to be retired for the development/project; ■ The number and classes of like-for0like biodiversity credits proposed to be retired; ■ The number and classes of biodiversity credits proposed to be retired in accordance with the variation rules; ■ Any proposal to fund a biodiversity conservation action; ■ Any proposal to conduct ecological rehabilitation (if a mining project); ■ Any proposal to make a payment to the Biodiversity Conservation Fund. If seeking approval to use the variation rules, the BDAR must contain details of the reasonable steps that have been taken to obtain requisite like-for-like biodiversity credits.	Chapter 9
4. The BDAR must be submitted with all spatial data associated with the survey and assessment as per Appendix A of the BAM.	All spatial data (ArcGIS format) will be provided to BCD in electronic format.

Requirement	Section Addressed
5. The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s.6.10 of the *Biodiversity Conservation Act 2016*.	Version 1 of this BDAR was co-prepared by Dr Adriana Corona Mothe (BAM Accreditation BAAS18113). Version 2 of this BDAR has prepared by Matt Jenkins (BAM Accreditation BAAS18029) by amending Version 1 where required to addressed comments from BCD. .

Following public exhibition of Version 1 of this BDAR, dated 26 July 2019, additional comments were received from the Biodiversity Conservation Division (BCD) of the Environment, Energy and Science Group in the NSW Department of Planning, Industry and Environment (formerly part of the Office of Environment and Heritage). This amended BDAR addresses comments and recommendations provided by the BCD in correspondence dated 2 December 2019 (refer Section 1.4 for summary of consultation and response).

1.2 The Project

The Project (Proposed Development) will involve the construction, operation and maintenance of a solar PV generation facility and associated infrastructure with a capacity of up to 500 MW, supplying electricity to the national electricity grid. The Project is located approximately 16 kilometres (km) south of Bonshaw and 66 km north of Inverell and is wholly contained within the Inverell Local Government Area (LGA) (Figure 1.1). The Project would connect directly to the 330 kilovolt (kV) Dumaresq Substation located to the immediate west of the Project boundary.

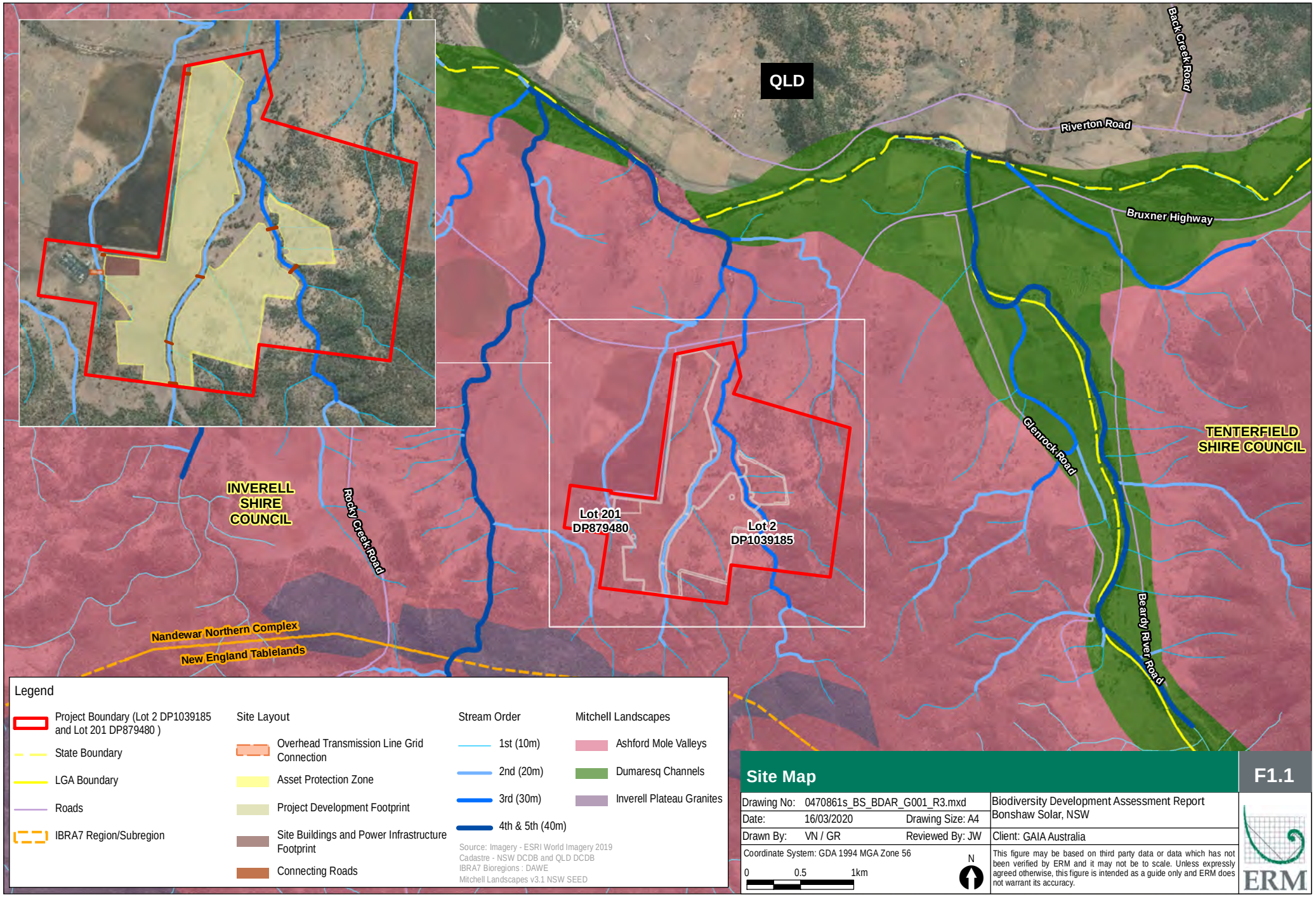
The Project incorporates arrays of PV modules (commonly referred to as “solar panels”), transmission infrastructure and substations to enable connection into the existing electricity transmission network (Figure 1.2). The exact method and point of connection is being developed with TransGrid in parallel with this planning application and the detailed infrastructure layout developed during detailed design will confirm the generating capacity of the Bonshaw Solar Farm.

The key elements of the project include the construction and operation of:

- A network of PV modules in a fixed tilt or single axis tracking arrangement;
- Associated BESS(s) / battery storage;
- A switch yard to be connected to the 330 kV TransGrid Dumaresq Substation, on the boundary of the Project Area;
- Underground or overhead cabling for connection between arrays and inverters and transformers;
- Operations and maintenance (O&M) infrastructure, including O&M buildings including a control room, meeting facilities, a temperature controlled spare parts storage facility, supervisory control and data acquisition (SCADA) facilities, a workshop and associated infrastructure (e.g. kitchen, toilets and other facilities) car parking facilities;
- Access point to the site via the Bruxner Highway;
- A new internal road network to enable access from surrounding local roads to the array areas during construction and operations including internal access tracks, creek crossing & perimeter security fencing; and
- Temporary facilities during construction.

A full description of the Project is provided in the EIS and the final layout of the Project will be dependent on detailed design, availability and commercial considerations at the time of construction, however in terms of assessing biodiversity impacts, the following project features were considered:

- Four riparian crossings (indicative location on third and second order streams shown in Figure 1.2);
- Clearing of vegetation to be restricted to the identified 149.24 ha development footprint, noting that grazing beneath the solar panels will continue during operation of the solar farm (the height of the PV panels above natural ground is approximately 1.4 to 4.2 m based on tracker option to be used);
- Excavation of trenches and the laying of power and instrumentation cables;
- Main access point to the site via the Bruxner Highway;
- An internal private road network (up to a combined total length of approximately 13.7 km) connecting the arrays and other proposed infrastructure to the public road network; and
- A 10m-20m wide bushfire asset protection zone around the perimeter of the solar farm (located inside the identified development footprint).


QLD
Back Creek Road
Riverton Road
Bruxner Highway
Glenrock Road
TENTERFIELD SHIRE COUNCIL
INVERELL SHIRE COUNCIL
Rocky Creek Road
Lot 201 DP879480
Lot 2 DP1039185
Beardy River Road
Nandewar Northern Complex
New England Tablelands
Legend
Project Boundary (Lot 2 DP1039185 and Lot 201 DP879480)
State Boundary
LGA Boundary
Roads
IBRA7 Region/Subregion
Site Layout
Overhead Transmission Line Grid Connection
Asset Protection Zone
Project Development Footprint
Site Buildings and Power Infrastructure Footprint
Connecting Roads
Stream Order
1st (10m)
2nd (20m)
3rd (30m)
4th & 5th (40m)
Mitchell Landscapes
Ashford Mole Valleys
Dumaresq Channels
Inverell Plateau Granites
Source: Imagery - ESRI World Imagery 2019
Cadastre - NSW DCDB and QLD DCDB
IBRA7 Bioregions : DAWE
Mitchell Landscapes v3.1 NSW SEED
Site Map
F1.1
Drawing No: 0470861s_BS_BDAR_G001_R3.mxd
Date: 16/03/2020
Drawing Size: A4
Drawn By: VN / GR
Reviewed By: JW
Coordinate System: GDA 1994 MGA Zone 56
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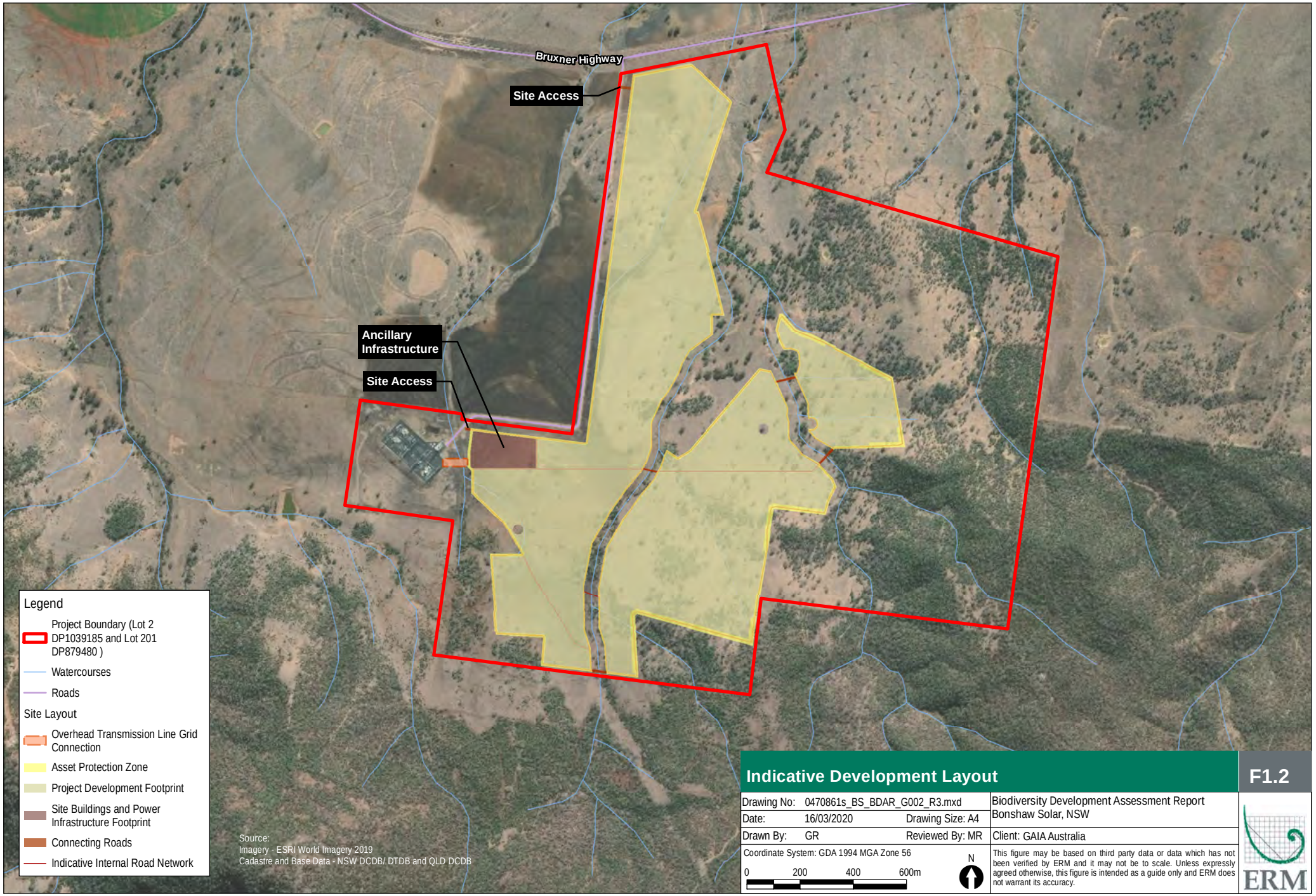
Biodiversity Development Assessment Report
Bonshaw Solar, NSW
Client: GAIA Australia
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM


Bruxner Highway
Site Access
Ancillary Infrastructure
Site Access
Legend
Project Boundary (Lot 2 DP1039185 and Lot 201 DP879480)
Watercourses
Roads
Site Layout
Overhead Transmission Line Grid Connection
Asset Protection Zone
Project Development Footprint
Site Buildings and Power Infrastructure Footprint
Connecting Roads
Indicative Internal Road Network
Source:
Imagery - ESRI World Imagery 2019
Cadastre and Base Data - NSW DCDB/ DTDB and QLD DCDB
Indicative Development Layout
F1.2
Drawing No: 0470861s_BS_BDAR_G002_R3.mxd
Date: 16/03/2020
Drawing Size: A4
Drawn By: GR
Reviewed By: MR
Coordinate System: GDA 1994 MGA Zone 56
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Biodiversity Development Assessment Report
Bonshaw Solar, NSW
Client: GAIA Australia
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

1.3 Site Description

Key features of the Subject Land are summarised in Table 1.3 below.

For the purposes of this BDAR report:

- The **Project Boundary** refers to Lot 2 DP 1039185.
- The **Subject Land** is the area that would be directly impacted by the Project. In accordance with the BAM (OEH 2017a), the term Subject Land is used in the Stage 1 – Biodiversity Assessment and the term **Development Site** is used in the Stage 2 – Impact Assessment. The terms Subject Land and Development Site are used interchangeably within this BDAR and are considered to be synonymous for the purpose of this assessment.
- The term **Assessment Area** is used in Stage 1 of this BDAR to refer to the 1,500m buffer surrounding the Subject Land and other areas requiring consideration as part of the biodiversity values assessment in Stage 1 of the BAM (OEH 2017).

Table 1.3 Key Features of the Subject Land

Key Feature	Description
Location Description	The proposed Bonshaw Solar Farm is located 16 km south of Bonshaw and 66 km north of Inverell.
Lot Description (Project Boundary)	Lot 2 DP 1039185
Subject Land	The Subject Land covers approximately 149.24 ha and corresponds to the western portion of Lot 2 DP1039185 and is partially bounded on its northern boundary by Bruxner Highway. To the south and east it is bounded by rural land and to the west, an unsealed road extends from Bruxner Highway to the existing 330kV TransGrid Dumaresq Substation located at the south-western corner.
Local Government Area	Inverell Local Government Area (LGA)
Elevation	The Project site is dominated by a gently undulating landscape to the north, forming steep slopes to the south and east dissected by second and third order streams. Based on a review of topographic maps and aerial imagery, landforms present within the Subject Land include drainage depressions, gentle to steeply inclining slopes, and upper flat ridges. The elevation at the Bruxner Highway (north boundary) is approximately 335 m and rises up to approximately 420 m in the south-western portion of the site. The ridgelines to the south of the project rise up to approximately 660 m forming the dominant landscape feature.
Previous Land Use	The Subject Land has undergone vegetation clearing associated with former land use for cropping and is currently used for sheep and cattle grazing.

1.4 Consultation

Following completion of the Spring 2018 and Summer 2018 survey periods, ERM's principal ecologist Joanne Woodhouse met with BCD (Krister Wearn) to discuss the survey methodology and preliminary survey results, particularly the positive identification of the Bristle-faced Free-tailed Bat (*Mormopterus eleryi*). The results of this meeting and follow up consultation were used to guide the Autumn 2019 survey methodology (additional BAM plots within the areas of native grasslands) and supplementary bat call analysis to confirm the positive species identification. A summary of the consultation is provided in Table 1.4 below.

Table 1.4 Summary of Consultation with BCD during preparation of the BDAR

Date	Contact Name	Summary	Response/Action
12 March 2019	Meeting at BCD Grafton Office attended by: ■ Krister Waern (BCD) ■ Joanne Woodhouse (ERM) ■ Luke Kim (GAIA, by phone)	ERM requested the meeting with BCD to discuss the survey methodology and preliminary survey results to date, particularly the positive identification of the Bristle-faced Free-tailed Bat (*Mormopterus eleryi*). Key points of discussion: Given the lack of information of the ecology of the Bristle-faced Free-tailed Bat (*Mormopterus eleryi*) ERM was seeking clarification on the species polygon determination and any additional survey requirements given that we already have a positive species identification. Given that acoustic detectors were the only survey method used, breeding habitat will be assumed to be present. Common Couch (*Cynodon dactylon*) is listed as native species in NSW however it is not listed in any of the PCT's identified within the Subject Land and has been introduced to the site as a pasture species. ERM was seeking clarification that we can exclude this species in the species richness calculations. ERM confirmed that the threatened flora surveys were undertaken as part of general observations and BAM plot areas, rather than parallel linear transect searches across the entire Subject Land.	BCD confirmed that information on the Bristle-faced Free-tailed Bat is not extensive and they would seek clarification from BCD's threatened species specialist. For other records of threatened microchiropteran bats e.g. Eastern Cave Bat (*Vespadelus troughtoni*) no additional targeted survey for breeding habitat is required although it is recommended that photographic evidence is provided as justification. Photos of rocky outcrops to be provided to confirm no viability as breeding habitat for this species. BCD will provide advice on the proposed exclusion of Common Couch as a native species within the Subject Land. Additional floristic plots required in derived native grasslands and cleared land. Derived native grassland determination to be updated based on vegetation integrity scores. Offset requirements to be determined based on integrity scores of: >15 (if PCT is a TEC), >17 (if PCT is associated with TS habitat) or >20 (if PCT is not a TEC or is associated with TS habitat). Vegetation mapping to be updated to merge PCT patches which are located within 100m of each other. BCD agreed that the threatened flora survey methodology was reasonable and should be supported by a figure to confirm that the Subject Land was effectively covered during the survey period.

Date	Contact Name	Summary	Response/Action
21 March 2019	Letter from OEH (now BCD) to ERM	BCD provided formal advice following the meeting held on 12 March and confirmed that: ■ Each vegetation zone (including areas of high weed occurrence and improved pasture areas) are required to detail the vegetation integrity survey plots as described in the BAM. ■ All native plants in NSW (including Common Couch) are required to be considered as native plants for the purposes of applying the BAM, even if they do not naturally occur within the nominated PCT. ■ The draft vegetation mapping appears to be focused on the canopy of the trees. The vegetation mapping should also consider the mid-storey and native ground cover to map the broader extent of the PCT. This is particularly important where canopy spacing within open forest and woodland communities can be up to 100m apart. ■ BCD information suggests that *Mormopterus eleryi* cannot be easily distinguished from *Scotorepens greyii* by anabat call. Catching the bat is the most reliable way to determine the species presence. If *Mormopterus eleryi* is confirmed on site, and based on ERMs current records and the habitat requirements of the species, most of the subject property may be captured when determining the species polygon.	■ ERM undertook and additional four days in the field and an additional 28 floristic survey plots to ensure effective coverage of the all areas of grassland in accordance with advice from BCD and the requirements of the BAM. ■ ERM have updated the assessment and Common Couch (*Cynodon dactylon*) is now included within the calculations. ■ Vegetation mapping and calculations of areas have been updated. ■ ERM have obtained a supplementary report to confirm the accuracy of the *Mormopterus eleryi* call identification. Greg Ford (Balance! Environmental) is a recognised expert on Australian bats, with specialist expertise in acoustic analysis of bat echolocation calls for species identification. As described in Appendix I, analysis by Balance! Environmental of numerous full-spectrum data-sets from several regions where *M. eleryi* and *S. greyii* are known to co-exist has consistently found examples of two distinctive foraging sequence types that concur with the diagnostic descriptions of Corben (2010). An overview of these findings and promotion of the inclusion of feeding buzz analysis in call identification reporting was presented recently at the International Society of Ecoacoustics Congress (Ford 2018). Support for the use of this approach has also been received from several bat-call analysis experts based throughout eastern Australia. Based on this advice, ERM has prepared this assessment based on the results of the call identification and does not consider that harp trapping is required in this instance to confirm presence. Refer to Section 5.7.4.1 and ToS in Appendix E for detailed discussion and assessment. The species polygon has been prepared based on the advice from BCD and is provided in Section 5.7.4.1.

Date	Contact Name	Summary	Response/Action
2 December 2019	Letter BCD to DPIE	BCD provided formal advice to DPIE following public exhibition of Version 1 of this BDAR, dated 26 July 2019. In summary, the following recommendations were provided in relation to biodiversity: ■ The BDAR should be reviewed, updated and certified to comply with the BC Act and resubmitted as part of the proposal. ■ The BDAR should ensure adequate consideration of the NVR mapping for the site. ■ Ensure the correct application of the streamlined assessment module – clearing paddock trees. ■ The BDAR should be updated to include reference to existing threatened species habitat mapping. ■ The BDAR should provide further justification of the Masked Owl to ensure it has been adequately considered. ■ The BDAR should be updated to remove the recommendation to change the offset requirement for vegetation zone 11. ■ The future vegetation integrity scores for all vegetation zones is to be reduced to zero. ■ The BAM Calculator is to be updated and finalised for review. ■ The mitigation measures as outlined in Table 7.1 of the BDAR should form part of any proposed development consent conditions.	■ ERM have engaged Matt Jenkins (Accredited Assessor - North Coast Ecology) to review, update and certify the BDAR and BAM Calculator assessment accordingly. ■ NVR mapping has been addressed in Section 4.1.2 of this BDAR. ■ The Streamlined assessment module – clearing of paddock trees has been removed from this BDAR due to the occurrence of threatened species habitat and application of the full BAM on the Subject Land in its entirety. ■ Existing important habitat mapping has been addressed in Section 5.1.1. ■ Masked Owl foraging and breeding habitat is assumed to be present and a species polygon has been provided as shown in Figure 5.3. ■ The vegetation integrity score for vegetation zone 11 was incorrectly calculated in BAM-C. The revised calculations are provided in Section 4.3.2. ■ Future vegetation integrity scores have been reduced to zero for all vegetation zones as shown in Section 4.3.2. ■ The BAM Calculator has been updated and will be finalised upon finalisation and certification of this BDAR. ■ The mitigation measures provided in Table 7.1 shall be used to formulate conditions of development consent.

1.5 Key Sources of Information used in the Assessment

The following key information sources were used in preparation of this BDAR: Proposed development layers and project footprint as provided by GAIA.

Key Sources of Information used in the Assessment
Online Resources
Australian Government's Species Profiles and Threats (SPRAT) database. Accessed online at http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl
NSW Department of Planning, Industry and Environment (DPIE) Threatened Biodiversity Profile Search. Accessed online at http://www.environment.nsw.gov.au/threatenedspeciesapp/
NSW Department of Primary Industry (DPI) profiles of threatened species, populations and ecological communities. Accessed online at https://www.dpi.nsw.gov.au/fishing/threatened-species
Commonwealth Department of Environment, Climate Change & Water (DECCW) National Recovery Plan. White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland. A critically endangered ecological community. May 2011.
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NSW Department of Planning, Industry and Environment (DPIE) Vegetation Classification Database. Accessed online via login at http://www.environment.nsw.gov.au/NSWVCA20PRapp/LoginPR.aspx
NSW Department of Planning, Industry and Environment (DPIE) VIS mapping. Accessed online via http://www.environment.nsw.gov.au/research/VISmap.htm
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Key Sources of Information used in the Assessment
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NSW Biodiversity Values Map. Accessed online via https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BVMap
Threatened Species Scientific Committee (TSSC) Advice to the Minister for the Environment and Heritage from the TSSC on Amendments to the List of Ecological Communities under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) – Box Gum Grassy Woodland.
Literature Review
OEH (2015) BRG-Namoi Regional Native Vegetation Mapping. Technical Notes. NSW Office of Environment and Heritage, Sydney.
Peacock R., Rolhauser A., Thönell J. and Law E. (2009) Extant and potential natural vegetation of Yallaroi, Ashford, Bingara and Inverell 1:100,000 scale map sheet, NSW. NSW Department of Environment, Climate Change and Water.

Other literature consulted during preparation of this BDAR is referenced within the text.

The aerial imagery used in this BDAR is sourced from ESRI World Imagery (DigitalGlobe) dated 27 November 2016. Mapping has been produced using Geographic Information System (GIS). The following maps and data are provided:

- Digital mapping with aerial photography showing 1:1000 or fine
- Site Map (Figure 1.1) as described in subsection 4.2.1.1 and 4.2.1.3 of the BAM
- Location Map (Figure 3.2) as described in subsection 4.2.1.2 and 4.2.1.3 of the BAM

2. LEGISLATIVE CONTEXT

The project has been assessed against key biodiversity legislation and government policy, including:

- Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act);
- NSW Environmental Planning and Assessment Act 1979 (EP&A Act);
- NSW Biodiversity Conservation Act 2016 (BC Act);
- NSW Local Land Services Act 2013 (LLS Act);
- NSW Fisheries Management Act 1994 (FM Act); and
- NSW Biosecurity Act 2015 (BS Act).

Table 2.1 Applicable Legislation, Plan and Guidelines

Commonwealth Legislation

Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires approval of the Commonwealth Minister for Environment (formerly the Minister of Sustainability, Environment, Water, Population and Communities) for actions that may have a significant impact on Matters of National Environmental Significance (MNES). The EPBC Act is administered by the Commonwealth Department of Environment and Energy (DoEE) and lists threatened species, ecological communities and other MNES. Any proposed action that is expected to have an impact on MNES must be referred to the Minister for assessment under the EPBC Act, or assessed under the accredited process between the Commonwealth and the State of NSW.

Matters of National Environmental Significance	Application to the Subject Land	Addressed
World heritage properties	Not identified within the Subject Land	Not applicable
National heritage places	Not identified within the Subject Land	Not applicable
Ramsar wetlands of international importance	Not identified within the Subject Land	Not applicable
Listed threatened species and communities	Threatened species have been recorded within the locality and have potential habitat available within the Subject Land (Development Site). No Threatened Ecological Communities (TEC) are present.	*Chapter 5 and Appendix C & D*
Internationally protected migratory species	Migratory species are identified as potentially occurring within the Subject Land.	*Appendix C & D*
Commonwealth marine areas	Not identified within the Subject Land	Not applicable
The Great Barrier Reef Marine Park	Not identified within the Subject Land	Not applicable
Nuclear actions	Not applicable	Not applicable
A water resource, in relation to coal seam gas development and large coal mining development	Not applicable	Not applicable

Statutory Legislation and Guidelines

Biodiversity Conservation Act 2016 (BC Act)

The NSW *Biodiversity Conservation Act 2016* came into effect on 25 August 2017. The BC Act replaced the NSW *Threatened Species Conservation Act 1995*, the NSW *Nature Conservation Trust Act 2001* and parts of the NSW *National Parks and Wildlife Act 1974*. The BC Act establishes mechanisms for:

- The management and protection of listed threatened species of native flora and fauna (excluding fish and marine vegetation) and threatened ecological communities (TECs).
- The listing of threatened species, TECs and key threatening processes.
- The development and implementation of recovery and threat abatement plans.
- The declaration of critical habitat.
- The consideration and assessment of threatened species impacts in development assessment process.
- Biodiversity Offsets Scheme, including the Biodiversity Values Map and method to identify serious and irreversible impacts (SAII).

The BC Act establishes a new regulatory framework for assessing and offsetting biodiversity impacts on proposed developments. Where development consent is granted, the authority may impose as a condition of consent an obligation to retire a number and type of biodiversity credits determined under the Biodiversity Assessment Method (BAM). A Biodiversity Values Map and Biodiversity Offsets Scheme Entry Threshold (BOSET) tool are available to identify the presence of mapped biodiversity values within land proposed for development as well as the clearing thresholds that would trigger application of the BAM.

The Biodiversity Offsets Scheme applies to all local developments, major projects or the clearing of native vegetation where the State Environmental Planning Policy (Vegetation in Non‐Rural Areas) 2017 applies. Any of these will also require entry into the Biodiversity Offsets Scheme if they occur on land mapped on the Biodiversity Values Map. ERM has reviewed and can confirm that part Lot 202 DP874273, is not currently mapped on the Biodiversity Values Map (see BOSET report in *Appendix A*) although as a major project, it does trigger the Biodiversity Offsets Scheme.

In terms of the proposed solar farm, the proposed development must take into account species likely to occur within available habitat based on existing records of threatened species and ecological communities, as well as those species likely to occur based on geographic distribution and presence of potential habitat (refer to *Appendix D*)

Water Management Act 2000

A controlled activity approval under the *Water Management Act 2000* (WM Act) is required for certain types of developments and activities that are carried out in or within 40 m of a river, lake or estuary.

The WM Act provides a number of mechanisms for protection of water sources via the water management planning process. If a ‘controlled activity' is proposed on ‘waterfront land', an approval is required under Section 91(2) of the WM Act. ‘Controlled activities' include; the construction of buildings or carrying out of works; the removal of material or vegetation from land by excavation or any other means; the deposition of material on land by landfill or otherwise. ‘Waterfront land' is defined as ‘the bed of any river or lake, and any land lying between the river or lake and a line drawn parallel to and 40 metres inland from either the highest bank or shore’.

Major projects are exempt from requiring approvals under the Water Management Act 2000.

Biosecurity Act 2015

The NSW *Biosecurity Act 2015* came into effect on 1 July 2017, effectively replacing the *Noxious Weeds Act 1993*, and 13 other Acts, with a single Act. Under the Noxious Weeds Act all landowners have a responsibility to control noxious weeds on their property. Under the Biosecurity Act the same responsibility will apply and will be known as a General Biosecurity Duty.

The General Biosecurity Duty states "Any person who deals with biosecurity matter or a carrier and who knows, or ought reasonably to know, the biosecurity risk posed or likely to be posed by the biosecurity matter, carrier or dealing has a biosecurity duty to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated or minimised." The general biosecurity duty applies to all weeds listed in Schedule 3 of the Biosecurity Act (also included as Weeds of National Significance (WoNS).

As detailed in Section 5.7.1, a total of 32 exotic species, including five high threat exotic (HTE) were recorded within the Subject Land. Two of those exotic species, Tiger Pear (*Opuntia aurantiaca*) and Velvet Tree Pear (*Opuntia tomentosa*) are listed as WoNS. A weed species of genus *Senecio* was also recorded, and the potential presence of Fireweed (*Senecio madagascariensis*) cannot be precluded.

A strategic plan for each WoNS has been developed to define responsibilities and identify strategies and actions to control the weed species. These can be downloaded from:
http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html

Fisheries Management Act 1994

The *Fisheries Management Act 1994* provides for the conservation, protection and management of fisheries, aquatic systems and habitats in NSW. Similar to the BC Act, the Fisheries Management Act 1994 lists threatened species, populations and ecological communities of fish and marine vegetation. Consideration of likely occurrence of threatened fish in the waterways in the Subject Land is provided in Section 5.2.

Any waterway crossings along the internal access roads will need to consider an appropriately designed structure that does not obstruct fish passage and will be designed in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management and the Policy and Guidelines for Fish Friendly Waterway Crossings. Notwithstanding this, it is noted that a permit under section 219 would not be required for waterway crossings as section 89J(e) of the EP&A Act excludes projects approved under Part 4 of the EP&A Act from requiring "a permit under section 201, 205 or 219 of the Fisheries Management Act 1994".

SEPP No. 44 – Koala Habitat Protection

SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline. A review of SEPP 44 is currently under consideration. The key changes proposed in the amended SEPP 44 relate to the definitions of koala habitat; list of tree species; list of councils; and development assessment process.

SEPP 44 currently applies to land in relation to which a development application has been made within the LGAs as listed in Schedule 1, which includes Inverell LGA. An assessment of Koala habitat values has been provided in Section 5.1.

Local Land Services Act 2013

The Native Vegetation Regulatory (NVR) Map designates areas of NSW to which Part 5A of the *Local Land Services Act 2013* applies. NVR mapping guides the application of the land management code and allowable activities as part of the land management framework for NSW.
An assessment of NVR mapping and relevant land categories is provided in Section 4.1.2.

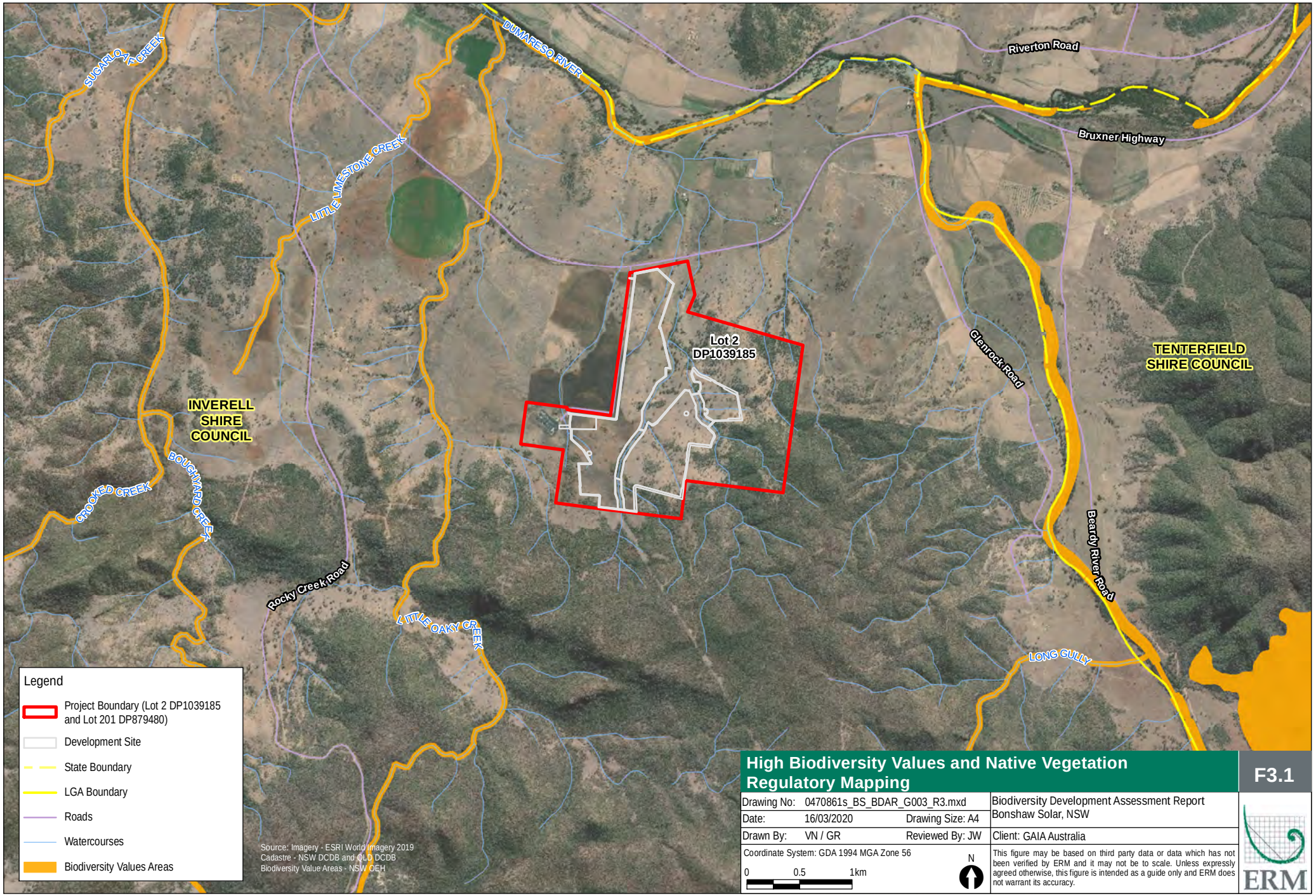
3. LANDSCAPE FEATURES

The identification of landscape features within the Subject Land was determined in accordance with Section 4 of the BAM (OEH 2017a), as summarised in Table 3.1 below.

Table 3.1 Summary of Landscape Features

Landscape Feature	Description
IBRA Bioregion	Bioregions are large, geographically distinct areas of land with common characteristics such as geology, landform patterns, climate, ecological features, and flora and fauna communities. The Subject Land is located within the NSW Nandewar Bioregion. The Nandewar region consists of hills on Palaeozoic sediments; lithosols and earths, including *Eucalyptus albens* woodlands. This region is characterized by summer rainfall (Environment Australia 2000).
IBRA Subregion	The Subject Land is located within the NSW Nandewar Northern Complex subregion. This subregion is described as low hills and ranges with abundant rock (granite) outcrop and tors. Short, steep gorges of major rivers. Karst landscapes on limestone. This IBRA Subregion is mapped as a Priority 4 investment region (OEH 2017b).
NSW Landscape Regions and Area	The Subject Land is mapped in the Ashford Mole Valleys Mitchell Landscape.
Percent Native Vegetation	A combination of existing mapping and ground truthed vegetation was used to estimate the Percent Native Vegetation Cover as follows: ■ Existing vegetation mapping was used to estimate the percent native vegetation within the 1500 m buffer area surrounding the Subject Land (see Figure 3.2). In the buffer area, PCTs were allocated based on existing vegetation mapping of the Inverell Shire as mapped by Peacock et. al. (2009) (VIS ID 3794) and aerial imagery. GIS was used to estimate the area. ■ Ground-truthed vegetation was used to estimate the portion of native vegetation within the Subject Land. PCT allocation was based on existing mapping and current vegetation condition (see Chapter 4). ■ The Percent Native Vegetation Cover was calculated by estimating the percent cover of native vegetation in the buffer area and Subject Land relevant to the benchmark for the PCT. Ten PCTs are mapped in the 1500 m buffer area (Table 4.1), covering approximately 1,273.70 ha. This represents 67.63% native vegetation cover within the assessment area (1,883.30 ha).
Cleared Areas	Approximately 107.79 ha (72 %) of land within the Subject Land represents cleared grazing land. Cleared areas are primarily grazed land (cattle and sheep), which provides limited foraging habitat for native species. Sheep can graze very close to the ground and like other livestock can lead to loss of vegetation and soil erosion particularly during the dry conditions encountered during the survey period.

Landscape Feature	Description
Rivers, Streams and Estuaries	Three major un-named creeks (tributaries of the Dumaresq River) are present within the Project Boundary (Lot 2 in DP 1039185). The largest of these creeks traverses the development site in a general north-southerly direction and is mapped as a third order stream (Strahler, 1952). The other two creeks are mapped as First Order Streams, and are located to the east and west of the third order stream. These streams were all noted to be dry (or very low water levels) at the time of the survey due to extended drought conditions. A review of the NSW Department of Infrastructure (DPI) threatened freshwater fish records (accessed via SEED), confirms that these creeks are not mapped as habitat of threatened aquatic species. The nearest creek with threatened aquatic species habitat is Little Oak Creek, located approximately 1.7 km west from the Subject Land. Aquatic habitat is described further in Section 5.2 and a preliminary aquatic impact assessment is provided in Section 5.7.7.
Wetlands	No wetlands occur in or adjacent to the Development Site. Aerial photographs show six farm dams are present within the Subject Land. These dams were all noted to be dry (or very low water levels) at the time of the survey due to extended drought conditions.
Connectivity Features	A wildlife corridor is a link of wildlife habitat, generally native vegetation, which joins two or more larger areas of similar wildlife habitat. Corridors are critical for the maintenance of ecological processes including allowing for the movement of animals and the continuation of viable populations. The Subject Land is located immediately north of a regional vegetated corridor that connects Crooked Creek National Park and Torrington State Conservation Area. Isolated paddock trees scattered across the development site also represent limited connectivity features for highly mobile species to travel across the landscape. The creeks present within the Subject Land have the potential to provide aquatic connectivity to Dumaresq River although it is noted that these streams were all dry (or very low water levels) at the time of the survey due to extended drought conditions and any connectivity would be seasonal at best. The Subject Land is not located within (or close to) any identified migratory bird flyways including the East Asian – Australasian Flyway and the West Pacific Flyway.
Areas of Geological Significance	No karsts, caves, crevices or cliffs or other areas of geological significance occur within the Development Site or are likely to occur within the broader Subject Land.
Areas of Outstanding Biodiversity Value (AOBV)	No Areas of Outstanding Biodiversity Value occur within the Development Site or the broader Subject Land.
High Biodiversity Values Map	In accordance with the NSW Biodiversity Values Map (See Figure 3.1 and BOSET report in Appendix A), the Subject Land does not contain high biodiversity values. The nearest area mapped with high biodiversity values are Little Oak Creek and Beardy River, located at approximately 1.7 km to the west and 2.3 km to the east, respectively.
Native Vegetation Regulatory (NVR) Mapping	The *Local Land Services Act 2013* (LLS Act) sets out several land categories that appear on the Native Vegetation Regulatory Map (NVR Map). The main purpose of this map is to govern clearing of vegetation associated with agricultural activities in rural areas. NVR mapping is shown in Figure 3.1 and addressed in detail in Section 4.1.2.

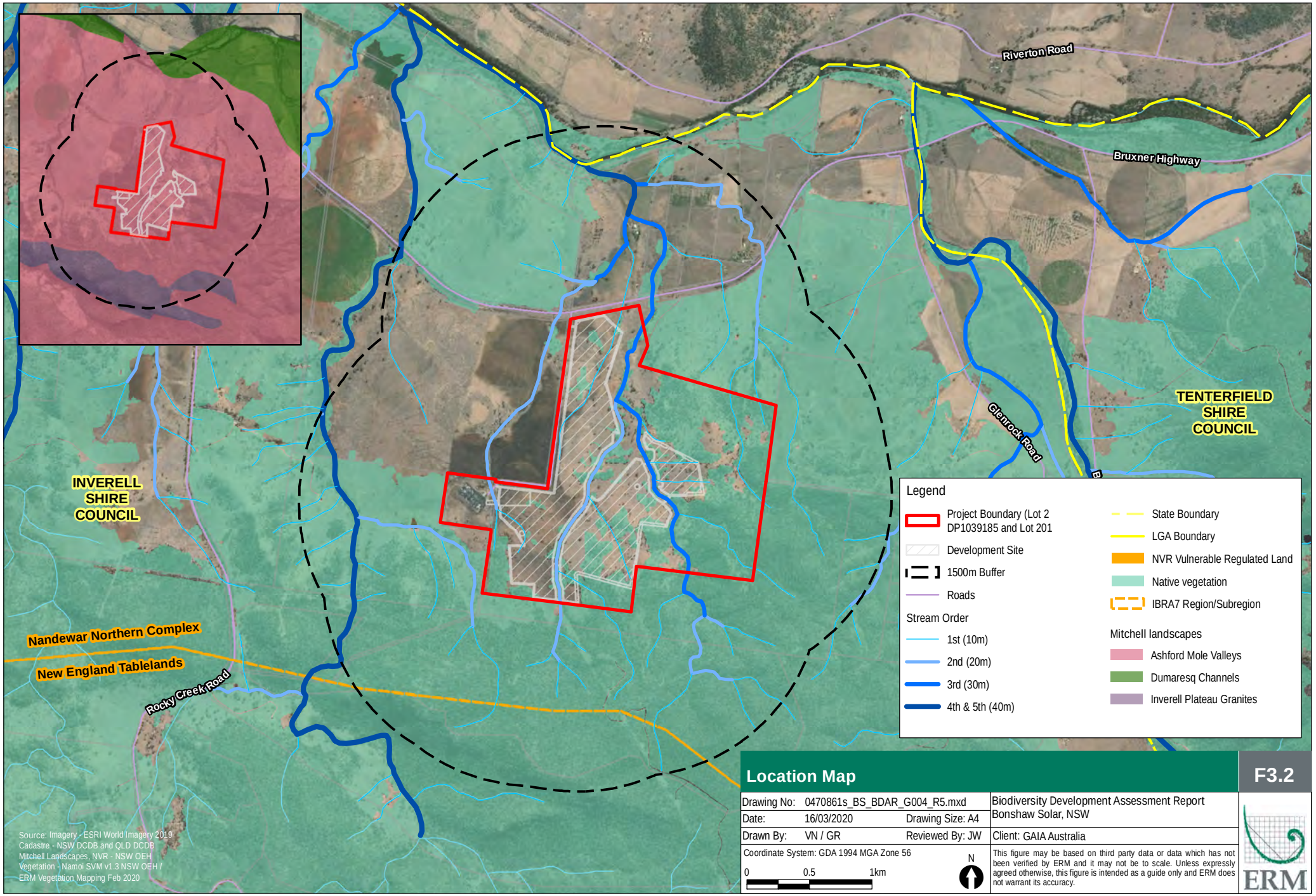


High Biodiversity Values and Native Vegetation Regulatory Mapping

F3.1

Drawing No:	0470861s_BS_BDAR_G003_R3.mxd		Biodiversity Development Assessment Report Bonshaw Solar, NSW
Date:	16/03/2020	Drawing Size: A4	
Drawn By:	VN / GR	Reviewed By: JW	Client: GAIA Australia
Coordinate System: GDA 1994 MGA Zone 56			This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



Location Map

F3.2

Drawing No:	0470861s_BS_BDAR_G004_R5.mxd		Biodiversity Development Assessment Report Bonshaw Solar, NSW
Date:	16/03/2020	Drawing Size: A4	
Drawn By:	VN / GR	Reviewed By: JW	Client: GAIA Australia

Coordinate System: GDA 1994 MGA Zone 56

0 0.5 1km

N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

4. NATIVE VEGETATION

The extent of native vegetation within the development site was determined in accordance with Section 5 of the BAM (OEH 2017a).

The development site is currently primarily used for sheep and cattle grazing. Native vegetation is highly modified by both historical and ongoing management practices including clearance of the original vegetation type, livestock grazing and weed invasion. A large portion of the development site is cleared and disturbed land, the majority of which no longer reflects the species composition of the community from which it was likely derived. Forb diversity and coverage is very low, dominated by those species tolerant of heavy grazing.

Woodland areas show evidence of varying degrees of impact, the most notable being on-going clearing and presence of monospecific stands (e.g. White Cypress Pine) due to a long history of timber removal. Vegetation within the development site comprises:

- 29.17 ha Native Vegetation;
- 11.80 ha Derived Native Grasslands; and
- 107.79 ha Disturbed Grasslands.

These vegetation areas total 148.76 ha. The remaining 0.48 ha of the development footprint include cleared lands and six farm dams.

4.1 Native Vegetation Assessment Methodology

4.1.1 Review of Existing Information

A search was undertaken of the NSW Department of Planning, Industry and Environment (DPIE) Vegetation Information System (VIS) database and NSW SEED (Sharing and Enabling Environmental Data) mapping to access existing vegetation mapping information within the Subject Land. The State Vegetation Type Map – Borders Rivers Gwydir / Namoi (VIS ID 4681) provides vegetation mapping for the Inverell Shire. This state vegetation type map (SVTM) is based on regional mapping in Peacock *et. al.* (2009) (VIS ID 3794) and identifies seven Plant Community Types (PCTs) within the Subject Land and eleven PCTs within the 1,500m buffer area as listed in Table 4.1 below and depicted in Figure 4.1.

Table 4.1 Mapped Vegetation Communities (SVTM VIS 4681) within the Buffer Area and Subject Land (not ground-truthed)

PCT ID	PCT Name	Extent in Buffer Area (ha)	Extent in Development Site (ha)
NA	Cleared Land	609.60	108.03
1	Candidate Native Grasslands	389.86	0
78	River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	27.38	0
84	River Oak – Rough-barked Apple – Red Gum – Box riparian tall woodland (wetland) of the Brigalow Belt South and Nandewar Bioregions	14.73	0
505	Black Cypress Pine - Tumbledown Red Gum - Narrow-leaved Ironbark - Stringybark She Oak open forest on acid volcanics of the western New England Tableland Bioregion	1.07	0
516	Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion	42.04	3.00

PCT ID	PCT Name	Extent in Buffer Area (ha)	Extent in Development Site (ha)
544 *	Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / Woodland of the Nandewar Bioregion and New England Tableland Bioregion	8.37	0.83
549	Silver-leaved Ironbark – Black Cypress Pine +/- White Box shrubby open forest mainly in the northern Nandewar Bioregion	194.97	0
578	Tumbledown Red Gum - Black Cypress Pine - Caley's Ironbark shrubby open forest of the Nandewar Bioregion and western New England Tableland Bioregion	2.96	0
594	Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion	225.39	13.65
596	Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	366.21	11.70
599	Blakely's Red Gum - Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion and Nandewar Bioregion	0.71	0

** PCT 544 corresponds to the BC Act listed endangered ecological community (EEC) "White Box Yellow Box Blakely's Red Gum Woodland", which also corresponds to part of the EPBC listed critically endangered ecological community (CEEC) "White Box Yellow Box Blakely's Red Gum Woodland".*

4.1.2 Native Vegetation Regulatory Mapping

The *Local Land Services Act 2013* (LLS Act) sets out several land categories that appear on the Native Vegetation Regulatory Map (NVR Map). The main purpose of this map is to govern clearing of vegetation associated with agricultural activities in rural areas. However, there are important implications that affect DA assessment for one of the land categories: Category 1 – Exempt Land. This category is broadly intended to identify land that has been previously legally cleared or that comprises low conservation value grasslands. The Category 1 layer has not yet been released, but will appear as a blue layer on the completed map. While the map is being finalised, rural landholders are responsible for determining the categorisation of their land based on the criteria listed in the LLS Act.

Clearing of native vegetation for development on land that meets the definition of Category 1 land does not require assessment or offsetting under the BAM. In practice, this means that native vegetation on Category 1 land is not included in any area clearing calculations when determining whether a BDAR should be prepared. A BDAR may still be required if the development will result in:

- A prescribed impact (these are listed in clause 6.1 of the Biodiversity Conservation Regulation), not including native vegetation clearing associated with the prescribed impact
- A likely significant impact on threatened species or ecological community based on the threatened species test of significance

As identified in Section 60F of the LLS Act (Transitional arrangement until preparation of maps), an area is taken, during the transitional period, to be low conservation value grasslands if it comprises only groundcover whose clearing was permitted by section 20 of the Native Vegetation Act 2003, as in force immediately before the repeal of that Act. Note. Generally that section permitted clearing if the vegetation comprised less than 50% of indigenous species of vegetation.

Disturbed grassland areas of the Subject Land (i.e. previously cleared grazing land) are not considered to represent Category 1 – exempt land as they do not meet the definition provided for low conservation value grasslands (i.e. remaining groundcover vegetation is generally not comprised of <50% of indigenous species). Furthermore, given the presence of some threatened species habitat components (e.g. scattered hollow-bearing trees and stags) the application of the BAM to the entirety of the Subject Land is considered to be appropriate in this instance.

The Subject Land is therefore considered to represent Category 2 – Regulated Land. Some areas of steep land in the south-eastern portion of Lot 2 DP1039185 are currently mapped as Vulnerable Regulated Land, as shown in Figure 3.1.

4.1.3 Targeted Floristic Survey

Based on the results of the desktop assessment presented in Table 4.1 above, flora surveys were undertaken in September 2018, December 2018, March 2019 and January 2020 as follows:

- The first survey was undertaken between the 10th and 14th September 2018 by ERM ecologists, Joanne Woodhouse and Dr Adriana Corona Mothe. The aim of the initial survey was to determine the PCTs on the development site and their condition on site. Random meander transects were conducted in areas of native vegetation and rapid vegetation assessments were undertaken to record the presence of native vegetation, threatened flora and to ground-truth existing mapping. PCT's were identified from the native species present, landforms and physiography and location within the IBRA subregion with reference to the BioNet Vegetation Classification Database. The Subject Land was then stratified into areas of similar condition class to determine vegetation zones for each PCT and detailed floristic surveys were undertaken on 11 - 12 September 2018.
- The second survey was undertaken between the 10th and 14th December 2018 by ERM ecologists Tom Cotter and Dr Adriana Corona Mothe. Vegetation integrity plots (20m by 50m) were established in each vegetation zone over three days on the 11 - 13 December 2018. Data was collected on the composition, structure and function of the vegetation in accordance with the methodology presented in the BAM 2017 and under the directions of persons accredited under the BAM. The number of plots for each zone was based on the area of each zone and the minimum number of plots and transects required per zone area as specified by the BAM.
- The third survey was undertaken between the 25 and 29 March by Dr Toivo Zoete and Dr Adriana Corona Mothe and included additional vegetation integrity plots over four days from 25 to 28 March 2019.
- The fourth survey was undertaken on 21 and 22 January 2020 by accredited assessor Matt Jenkins (North Coast Ecology) and ecologist Chloe Hanrahan (ERM). This survey was completed in order to review existing PCT and vegetation zone mapping prepared during previous surveys.

A total of four PCTs comprising 12 vegetation zones were identified on the Subject Land as listed in Table 4.4 and mapped in Figure 4.2. Based on the assessment of each PCT, it was decided to stratify each of the four PCTs based on the following:

- Absence of upper stratum, condition of the stratum and composition. Due to the high level of disturbance at the Development Site, treed areas were commonly represented by a single species of trees or the presence of trees were significantly reduced when compared with tree composition and structure as per PCTs descriptions.
- Structure and function of the vegetation in other stratum, e.g. ground cover.
- Presence of exotic species and their abundance/cover as well as bare ground.

Each vegetation zones was considered homogeneous and well represented by the plot data. As outlined in Table 4.2, a total of 42 flora plots were collected in accordance with section 5 of the BAM (OEH 2017) by ecologists trained in the BAM (Joanne Woodhouse and Adriana Corona Mothe) and under the direction of Dr Adriana Corona Mothe who is accredited under the BAM. An additional two plots were completed during the January 2020 survey by Matt Jenkins (accredited under the BAM) and Chloe Hanrahan (ERM ecologist). At each plot location the following was undertaken:

- one 20 x 20 m plot for assessment of composition and structure; and
- one 20 x 50 m plot for assessment of function, including a series of five 1 x 1 m plots to assess average leaf litter cover.

The assessment of composition and structure recorded species name, stratum, growth form, cover and abundance rating for each species present within the plot. Cover (foliage cover) was estimated for all species rooted in or overhanging the plot, and recorded using decimals (if less than 1%, rounded to whole number (1 - 5%) or estimated to the nearest 5% (5 - 100%). Abundance was counted (up to 20) and estimated above 20.

The assessment of function recorded the number of large trees, the presence of tree stem size class, tree regeneration, number of trees with hollows and length of fallen logs, as well as leaf litter cover within the 20 x 50 m plot and five 1 x 1 m subplots. The minimum number of plots and transects per vegetation zone was determined using Table 4 of the BAM (OEH 2017a). Portions of the land within the study area are either cleared land, cropped or consist of exotic grassland. Under the BAM (OEH 2017a), land not containing native vegetation is not subject to assessment beyond Section 5.4 (determination of a vegetation integrity score). A large proportion of grassland occurs within the development site, ranging from exotic with few native grass species, to areas of low diversity native pasture. Cleared land and disturbed grasslands were assigned to the most likely PCT and mapped as “Disturbed Grasslands”.

4.1.4 PCT Identification

The method used for PCT identification included the following:

- Use of the BioNet Vegetation Classification’s Community Identification keys. Search Criteria used included Vegetation Formation, Vegetation Class, IBRA Region and selected community species in the upper / mid / low stratum. This search produced a shortlist of potential PCTs.
- Selection of the PCT was undertaken by comparing the descriptions of each potential PCT with characteristics of the vegetation such as landform location, species composition and other landscape features relevant to the vegetation community. When the vegetation community under assessment was likely to conform to more than one PCT, the decision on a given PCT over other options was based on presence of characteristic species, species richness and other aspects of the PCT description.
- The condition of the PCT was defined based on the absence of upper stratum, dominance of exotics over natives and percentage bare land present.
- Where derived grasslands were identified, the most likely PCT was allocated based on number of native species shared with a given PCT, its location, landscape features and the neighbouring PCTs.

4.2 PCTs Identified in the Subject Land

Determination of PCTs within the Subject Land identified the presence of four Plant Community Types (PCT) as shown in Table 4.2 below.

Table 4.2 Plant Community Types Occurring within the Subject Land

Plant Community Type		Vegetation Formation	Vegetation Class
ID No	Name		
516	Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands
544	Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands
594	Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	North-west Slopes Dry Sclerophyll Woodlands
596	Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	North-west Slopes Dry Sclerophyll Woodlands

A detailed description of each of these PCTs follows in Table 4.3 to Table 4.6.

Table 4.3 PCT 594: Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion

PCT 594: Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion		
Vegetation Formation	Dry Sclerophyll Forest (Shrub/grass sub-formation)	
Vegetation Class	North-west Slopes Dry Sclerophyll Woodlands	
Vegetation Type	PCT ID:	594
	PCT's Common Name:	Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion
	Condition	Moderate Low
Description	Tall woodland to open forest dominated by Silver-leaved Ironbark (*Eucalyptus melanophloia*) and Black Cypress Pine (*Callitris endlicheri*). Other trees may include White Box (*Eucalyptus albens*), White Cypress Pine (*Callitris glaucophylla*), Tumbledown Red Gum (*Eucalyptus dealbata*), Narrow-leaved Ironbark (*Eucalyptus crebra*) and less often Smooth-barked Apple (*Angophora leiocarpa*) The shrub layer is sparse to mid-dense and includes *Olearia elliptica*, *Notelaea microcarpa var. microcarpa*, *Hibbertia obtusifolia*, *Melichrus urceolatus*, *Xanthorrhoea johnsonii*, *Acacia elongata*, *Breynia cernua*,	

PCT 594: Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion

	Acacia leiocalyx subsp. leiocalyx, *Acacia penninervis* var. *penninervis*, *Beyeria viscosa* and *Pimelea neo-anglica*. The ground layer is sparse with frequent grass species including *Eragrostis leptostachya*, *Enneapogon gracilis*, *Aristida ramosa*, *Cymbopogon refractus*, *Austrostipa scabra* and *Aristida vagans*. Forb species include *Dichondra repens*, *Vittadinia cuneata*, *Brunoniella australis*, *Dichondra* sp. A, *Rostellularia adscendens* subsp. *adscendens*, *Scleria mackaviensis* and *Phyllanthus virgatus*. The rock ferns *Cheilanthes sieberi* subsp. *sieberi* and *Cheilanthes distans* are common. Climbers include *Parsonsia eucalyptophylla*, *Desmodium brachypodum* and *Desmodium varians*. Occurs on shallow loamy sand soils mostly derived from sandstone on hills with rocky outcrops mainly in the northern Nandewar Bioregion from north of Bingara to Arakoola with outliers in the Mole River district. The PCT is found on conglomerate and sandstone on hills and low hills. At the Subject Land the PCT is present in both moderate and low condition. Dominant tree species recorded were Silver-leaved Ironbark, White Box and White Cypress Pine. Some areas of the community lack Eucalypt trees completely and identification of likely PCT was based on landform and characterisic ground cover species. Species characteristic of the community include *Oxalis perennans*, Poison Pimelea (*Pimelea neo-anglica*), *Mielichrus urceolatus*, Purple Wiregrass (*Aristida ramosa*), Speargrass (*Austrostipa scabra subsp. scabra*), Yellow Burr-daisy (*Calotis lappulacea*), Slender Flat-sedge (*Cyperus gracilis*), Barbed Wrie Grass (*Cymbopogon refractus*), *Cheilates sieberi*, *Glycine clandestina* and Corrugated Sida (*Sida corrugata*).
Approximate extent within Subject Land	Moderate: 4.10 ha Low: 9.54 ha
BAM Plots in PCT	Moderate: Four plots (P2, P7, P15 and P16) Low: five plots (P1, P9, P17, P21 and P40)
Justification of evidence used to identify the PCT	PCTs 594 and 596 had similar distributional patterns and a total of nine species characteristic of each PCT was recorded in some of these plots, including White Cypress Pine, which is listed as a dominant species in both PCTs. The decision was made to select PCT 594 based on the abundance of *Austrostipa scabra* subsp. *scabra*, *Sporobolus creber* and/or Poison Pimelea which is are characteristic species of PCT 594 and are absent in PCT 596. This PCT was identified relying on the presence of species typical of the PCT as follows: Upper stratum: dominated by Silver-leaved Ironbark Mid-stratum: presence of White Cypress Pine and/or Poison Pimelea Ground stratum: presence of *Oxalis perennans*, *Austrostipa scabra* subsp. *scabra, Cymbopogon refractus* and *Aristida ramosa* The condition of this PCT was selected based on the presence of upper stratum, cover of exotic species (e.g. Tiger Pear) and intensity of sheep and cattle grazing.
TEC Status	PCT 594 is not associated with a TEC
Estimate of percent cleared	53%

PCT 594: Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion

Images of PCT within the Subject Land

Photograph 4-1 View of PCT 594 in Plot 2

Photograph 4-2 View of PCT 594 in Plot 21

PCT – Plant Community Type; TEC – Threatened Ecological Community

Table 4.4 PCT 596: Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion

PCT 596: Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion

Vegetation Formation	Dry Sclerophyll Forest (Shrub/grass sub-formation)	
Vegetation Class	North-west Slopes Dry Sclerophyll Woodlands	
Vegetation Type	PCT ID:	596
	PCT's Common Name:	Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion
	Condition	Moderate Low Very Low Derived Native Grassland
Description	Mid-high to low woodland or open forest dominated by Tumbledown Red Gum (*Eucalyptus dealbata*), White Cypress Pine (*Callitris glaucophylla*) and Silver-leaved Ironbark (*Eucalyptus melanophloia*). Other tree species may include Caley's Ironbark (*Eucalyptus caleyi subsp. caleyi*), Rough-barked Apple (*Angophora floribunda*), Long-fruited Bloodwood (*Corymbia dolichocarpa*), Black Cypress Pine (*Callitris endlicheri*) and Rusty Fig (*Ficus rubiginosa*). There is usually a dense shrub/small tree layer of species such as *Leptospermum brevipes*, *Acacia cheelii*, *Notelaea microcarpa var. microcarpa*, *Melichrus urceolatus*, *Xanthorrhoea johnsonii* and *Leucopogon muticus*. The vine *Pandorea pandorana* is often abundant. The ground layer is sparse with *Cheilanthes distans*, *Cheilanthes sieberi subsp. sieberi*, *Aristida vagans*, *Cymbopogon refractus*, *Entolasia stricta* and *Aristida ramosa* most frequent. Forb species include *Plectranthus parviflorus*, *Commelina cyanea*, *Scleria mackaviensis*, *Dichondra* species A, *Calotis lappulacea*, *Phyllanthus virgatus*, *Vittadinia sulcata* and *Galium guadichaudii*. Occurs on shallow loamy sand soils in hilly areas at low altitudes. At the Subject Land, the PCT is present in a disturbed state due to the long history of clearing, grazing and timber removal. Upper stratum is represented by Tumbledown Red Gum (*Eucalyptus dealbata*), Silver-leaved Ironbark (*Eucalyptus melanophloia*), Black Cypress Pine (*Callitris endlicheri*) and White Cypress Pine (*Callitris glaucophylla*). Other species present include: Purple Wiregrass (*Aristida ramosa*), Bristly Cloak Fern (*Cheilanthes distans*), Barbed Wire Grass (*Cymbopogon refractus*), Slender Flat-sedge (*Cyperus gracilis*), Slender Tick-trefoil (*Desmodium varians*), Urn-heath (*Melichrus urecolatus*), Thargomindah Nightshade (*Solanum sturtianum*), Yellow Burr-daisy (*Calotis lappulacea*), Johnson's Grass Tree (*Xanthorrhoea johnsonii*), *Glycine clandestina* and *Vittadina sulcata*.	
Approximate extent within the Subject Land	Moderate: 11.15 ha Low: 0.25 ha Very Low: 0.30 ha Derived Grassland in Low condition: 9.04	
BAM Plots in PCT	Moderate: four plots (P8, P10, P11 and P12) Low: two plots (P3 and P5) Very Low: one plot (P41) Derived Grassland in Low condition: four plots (P14, P23, P26 and P29)	

PCT 596: Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion

Justification of evidence used to identify the PCT	This PCT was identified relying on the presence of dominant tree species and other typical species of the PCT as follows: ■ Upper stratum: dominated by Tumbledown Red Gum and Silver-leaved Ironbark ■ Mid-stratum: dominated by White Cypress Pine, presence of other species such as Black Cypress Pine ■ Ground stratum: presence of *Cheilantes distans*, a frequent species in the PCT; along with other species such as Thargomindah Nighshade. The condition of this PCT was selected based on the presence of upper stratum, cover of exotic species (e.g. Tiger Pear) and intensity of sheep and cattle grazing.
Species relied upon for PCT identification	Tumbledown Red Gum, Silver-leaved Ironbark, Black Cypress Pine, White Cypress Pine, Barbed Wire Grass and Bristly Cloak Fern (*Cheilantes distans*).
TEC Status	PCT 596 is not associated with a TEC
Estimate of percent cleared	38%
Images of PCT within the Development Site	

Photograph 4-3 View of PCT 596 in Plot 10

PCT 596: Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion

Photograph 4-4 View of PCT 594 in Plot 5

Notes: PCT – Plant Community Type; TEC – Threatened Ecological Community

Table 4.5 PCT 516: Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion

PCT 516: Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion

Vegetation Formation	Grassy Woodlands	
Vegetation Class	Western Slopes Grassy Woodlands	
Vegetation Type	PCT ID:	516
	PCT's Common Name:	Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion
	Condition	Moderate (occurring adjacent to Subject Land) Very Low (occurring within Subject Land) Derived Native Grasslands in Moderate condition (occurring within Subject Land)
Description	This PCT is described as widespread, mid-high to very tall woodland or open forest occurring on flat to undulating sites at low to mid elevation, mainly on fine-grained soils on sedimentary and metasedimentary substrates. It is dominated by Grey Box	

PCT 516: Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion

	(*Eucalyptus moluccana*) (crossing with *Eucalyptus albens* at sites with basalt influence) which is associated with Blakely's Red Gum (*Eucalyptus blakelyi*), Yellow Box (*Eucalyptus melliodora*) and/or White Cypress Pine (*Callitris glaucophylla*), with occasional Rough-barked Apple (*Angophora floribunda*). A sparse shrub layer of *Notelaea microcarpa var. microcarpa* and/or *Dodonaea viscosa subsp. spatulata* is sometimes present. The ground layer is dense and diverse, containing a mix of grasses and forbs including *Cymbopogon refractus*, *Austrostipa scabra subsp. scabra*, *Aristida ramosa*, *Asperula conferta*, *Bothriochloa decipiens*, *Daucus glochidiatus*, *Dichanthium sericeum subsp. sericeum*, *Carex inversa*, *Chrysocephalum apiculatum*, *Cymbonotus lawsonianus*, *Dichondra* sp. A, *Glycine tabacina*, *Poa sieberiana*, *Desmodium varians*, *Eremophila debilis*, *Austrodanthonia racemosa var. obtusata, Austrostipa verticillata, Dichondra repens, Hydrocotyle laxiflora, Plantago debilis, Rostellularia adscendens subsp. adscendens, Chloris ventricosa, Geranium solanderi var. solanderi, Cyperus gracilis, Hypericum gramineum*, and (rarely) *Panicum paludosum*. This community is found in the undulating floors of the major river valleys of the Nandewar and far western New England bioregions. At the Subject Land, the community is highly disturbed with few characteristic species present, including: White Cypress Pine (*Callitris glaucophylla*), Silver-leaved Ironbark (*Eucalyptus melanophoia*), Small-leaf Bluebush (*Maireana microphylla*), Purple Wiregrass (*Aristida ramosa*), *Dichondra* sp. A, Red Grass (*Botriochloa decipiens*) and Speargrass (*Austrostipa scabra subsp. scabra*),
Approximate extent within the Subject Land	Moderate: 0 ha Very Low: 3.00 ha Derived Grassland in Moderate condition: 2.76 ha
BAM Plots in PCT	Moderate: one plot (P38) Very Low: three plots (P31, P39 and P42) Derived Grassland in Moderate condition: two plots (P28 and P32)
Justification of evidence used to identify the PCT	PCT 516 was identified based on the presence of characteristic species of this vegetation community and its distribution at landform elements such as drainage depression. This PCT was identified relying on the presence of species typical of the PCT as follows: ■ Upper stratum: Grey Box ■ Mid-stratum: presence of Small-leaf Bluebush ■ Ground stratum: presence of Dichondra sp. A, Purple Wiregrass, Speargrass and Red GrassDistribtuion near drainage depression The condition of this PCT was selected based on the presence of upper stratum, cover of exotic species (e.g. Tiger Pear) and intensity of sheep and cattle grazing.
Species relied upon for PCT identification	Grey Box, Small-leaf Bluebush, Purple Wiregrass, *Dichondra* sp. A, Red Grass and Speargrass
TEC Status	PCT 516 is not associated with a TEC
Estimate of percent cleared	85%

PCT 516: Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion

Images of PCT within the Subject Land

Photograph 4-5 View of Moderate Condition PCT 516 in Plot 38

Photograph 4-6 View of Very Low Condition PCT 516 in Plot 42

Notes: PCT – Plant Community Type; TEC – Threatened Ecological Community

Table 4.6 PCT 544: Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion

PCT 544: Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion

Vegetation Formation	Grassy Woodlands	
Vegetation Class	Western Slopes Grassy Woodlands	
Vegetation Type	PCT ID:	544
	PCT's Common Name:	Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion
	Condition	Moderate (occurring adjacent to Subject Land) Low (occurring within Subject Land)
Description	This PCT is described as tall open forest to woodland dominated by Rough-barked Apple (*Angophora floribunda)* in association with Blakely's Red Gum (*Eucalyptus blakelyi*), White Cypress Pine (*Callitris glaucophylla*) or Yellow Box (*Eucalyptus melliodora*) or Black Cypress Pine (*Callitris endlicheri*) or White Box (*Eucalyptus albens*). The shrub layer is sparse comprising species such as *Notelaea microcarpa var. microcarpa, Leptospermum polygalifolium* subsp. *transmontanum, Olearia ellitptica, Leptospermum brevipes, Beyeria viscosa, Cassinia quinquefaria, Dodonaea viscosa* subsp*. angustifolia, Pimelea neo-anglica, Maireana microphylla* and *Acacia neriifolia.* The ground layer is often dense and is comprised of the mat-rush (*Lomandra longifolia*) and a range of grasses including *Microlaena stipoides* var. *stipoides, Bothriochloa macra, Austrostipa verticillata, Echinopogon caespitosus, Eragrostis leptostachya and* blady grass (*Imperata cylindrica*). Forb species include *Dichondra* sp. A, *Dichondra repens, Plantago debilis, Oxalis perennans, Rostellularia adscendens* subsp*. adscendens, Swainsonia galegifolia, Urtica incisa, Cynoglossum australe* and *Vittadinia dissecta.* Sedges include *Cyperus gracilis* and *Carex inversa.* The invasive weed Coolatai grass (*Hyparrhenia hirta*) occurs at some sites. Occurs on a variety of alluvial or colluvial soils from sand to loamy-clay soil along stream banks and on valley flats throughout the Nandewar and west New England Tableland Bioregions. Grades into ID84 River Oak Riparian Woodland or ID78 River Red Gum woodland. Similar to the Rough-barked Apple woodland ID281 in the BBS Bioregion. Mainly cleared and often weed infested. A threatened community. At the Subject Land the PCT is present in low condition. Dominant tree species recorded were Rough-barked Apple (*Angophora floribunda),* Yellow Box (*Eucalyptus melliodora*) and White Cypress Pine (*Callitris glaucophylla*). Other characteristic species included *Notelaea microcarpa var. microcarpa, Beyeria viscosa, Maireana microphylla, Pimelea neo-anglica, Microlaena stipoides* var. *stipoides* and *Austrostipa verticillata.*	
Approximate extent within the Subject Land	Moderate: 0 ha Low: 0.83 ha	
BAM Plots in PCT	Moderate: one plot (P43) Low: one plot (P44)	
Justification of evidence used to identify the PCT	PCT 544 was identified based on the presence of characteristic species of this vegetation community and its distribution at landform elements such as bank (streambank), stream bed, stream channel.	

PCT 544: Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion

	This PCT was identified relying on the presence of species typical of the PCT as follows: ■ Upper stratum: Rough-barked apple and Yellow box ■ Mid-stratum: presence of *Notelaea microcarpa var. microcarpa, Beyeria viscosa, Maireana microphylla, Pimelea neo-anglica* ■ Ground stratum: presence of *Microlaena stipoides* var. *stipoides* and *Austrostipa verticillata* The condition of this PCT was selected based on the cover/integrity of upper stratum.
Species relied upon for PCT identification	As above
TEC Status	PCT 544 corresponds to the NSW listed endangered ecological community (EEC) "White Box Yellow Box Blakely's Red Gum Woodland". The occurrence of this TEC on the Subject Land is not considered to satisfy the minimum condition criteria for the Commonwealth listing of this TEC. This determination has been made on the basis of very small patch sizes occurring on the Subject Land, low diversity of native understorey species and absence of "important species" as described in the Threatened Species Scientific Committee listing advice and National Recovery Plan for the TEC.
Estimate of percent cleared	65%
Images of PCT within the Subject Land	 **Photograph 4-7 View of Moderate Condition PCT 544**

PCT 544: Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion

Photograph 4-8 View of Low Condition PCT 544

Notes: PCT – Plant Community Type; TEC – Threatened Ecological Community

4.2.1 Cleared and Disturbed Land

Cleared and disturbed land within the Subject Land has a long history of heavy grazing and does not correspond to any recognisable PCT. However to facilitate this assessment and in accordance with the BAM (and advice from BCD confirming that Common Couch is to be included in the BAM calculator as a native species), these areas have been assigned a likely PCT based on surrounding vegetation and location within the landscape. Three vegetation zones for cleared and disturbed land were assessed:

- 516_Disturbed Grassland: a total of 7.39 ha of cleared and/or highly disturbed land. A total of three BAM plots were assessed in this vegetation zone (P27, P33 and P35).
- 594_Disturbed Grassland: a total of 48.81 ha of cleared and/or highly disturbed land. A total of eight BAM plots were assessed in this vegetation zone (P6, P18, P19, P22, P24, P25, P36 and P37).
- 596_Disturbed Grassland: a total of 50.59 ha of cleared and/or highly disturbed land. A total of five BAM plots were assessed in this vegetation zone (P4, P13, P20, P30 and P34).

Cleared and disturbed land was widespread across the Subject Land which is consistent with its historical and current land uses which include clearing, cropping and grazing. Cattle, sheep and goats were present across the Subject Land and a very intense level of grazing was observed. Flora species included a mix of native and exotic species, including high threat exotics (see flora list in Appendix H). Upper and mid-stratum were generally absent, with the exception of some isolated scattered trees as shown in Photographs 4-7 to 4-10.

4.3 Vegetation Integrity Assessment

4.3.1 Vegetation Zones and Survey Effort

The random meander surveys and detailed floristic plots have been used to assist the delineation of zones. Each of the identified PCTs were stratified into zones with a similar broad condition state. These zones were defined based on the overstorey condition, understorey condition and observed land management practices.

A total of 9 native vegetation zones plus cleared land were identified in the development site as listed in Table 4.6 and mapped in Figure 4.2.

A total of 44 vegetation integrity plots were collected in accordance with section 5 of the BAM (OEH 2017) to determine their condition.

Photograph 4-7: View of cleared land in plot P4

Photograph 4-8: View of cleared land in plot P13

Photograph 4-9: View of cleared and disturbed land in plot P35

Photograph 4-10: View of cleared and disturbed land in plot P22

Table 4.7 Vegetation Zones on the Subject Land

Zone ID	PCT ID	Stratification Unit / Condition Class	Extent within development site	BAM plots required	Survey effort (number of Plots)	Patch Size (ha) (Number of patches)	Reference
Native Vegetation							
1	594_ Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion	Moderate	4.10 ha	2	4	>1000 ha (1)	Table 4.3
2	594_ Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion	Low	9.54 ha	3	5	<5 ha (3); >1000 ha (1)	
3	596_ Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	Moderate	11.15 ha	3	4	>1000 ha (1)	Table 4.4
4	596_ Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	Low	0.25 ha	1	2	>1000 ha (1)	
5	596_ Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	Very Low	0.30 ha	1	1	>1000 ha (1)	
6	596_Derived Grassland	Low	9.04 ha	3	4	<5 ha (5)	
7	516_Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion	Very Low	3.00 ha	2	3	>1000 ha (1)	Table 4.5

Zone ID	PCT ID	Stratification Unit / Condition Class	Extent within development site	BAM plots required	Survey effort (number of Plots)	Patch Size (ha) (Number of patches)	Reference
8	516_Derived Grassland	Moderate	2.76 ha	2	2	<5 ha (7)	
9	544_Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion	Low	0.83 ha	1	1	>1000 ha (1)	Table 4.6
Predominantly Cleared and Disturbed land							
NA	516_Disturbed Grassland	Other	7.39 ha	3	3	N/A	Refer Section 4.2.1
10	594_Disturbed Grassland	Other	49.81 ha	4	8	N/A	
11	596_Disturbed Grassland	Other	50.59 ha	5	5	N/A	
12	Cleared Land / Dams	Other	0.48 ha	-	-	N/A	

4.3.2 Vegetation Integrity Assessment Results

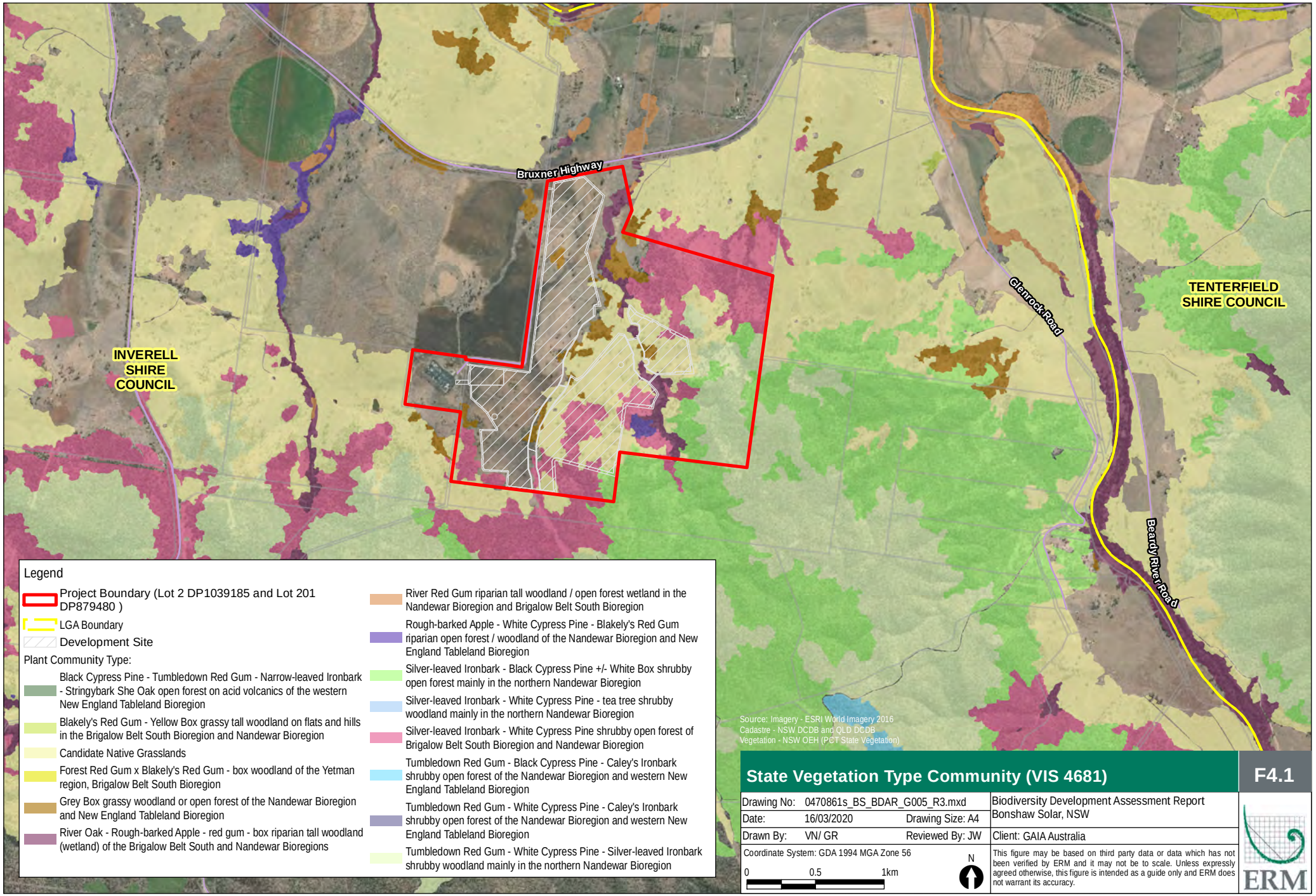
A total of 134 plant species were recorded within the 44 vegetation integrity survey plots (see Table H.6 in Appendix H). The field data sheets with results of the vegetation plots and photos of each plot are shown in Appendix G.

The plot data from the vegetation integrity survey plots were entered into the BAM calculator. The results of the vegetation integrity assessment are provided in

Table 4.6.

Table 4.6 Summary of Vegetation Integrity Scores

No	Vegetation Zone ID	Composition Score	Structure Score	Function Score	Vegetation Integrity Score
1	PCT 594_Moderate	52.9	43.6	99.8	61.3
2	PCT 594_Low	39.3	18.4	50.9	33.3
3	PCT 596_Moderate	67.4	52.3	69.4	62.6
4	PCT 596_Low	18.9	40.9	71.8	38.2
5	PCT 596_Very Low	18.4	22.7	31.6	23.6
6	*PCT 596_Derived_Low*	*48.7*	*0.4*	*29.3*	*8*
7	PCT 516_Very Low	31.6	11.2	24.9	20.7
8	PCT 516_Derived_Moderate	20	50.3	15	24.7
9	PCT 544_Low	26.7	24.3	65.9	35
10	*516_Disturbed Grasslands*	*19.3*	*13.5*	*15*	*15.8*
11	*594_Disturbed Grasslands*	*25.7*	*2.4*	*26.2*	*11.8*
12	*596_Disturbed Grasslands*	*17.7*	*0.9*	*11*	*5.6*


Bruxner Highway
Glenrock Road
Beardy River Road
INVERELL SHIRE COUNCIL
TENTERFIELD SHIRE COUNCIL
Legend
Project Boundary (Lot 2 DP1039185 and Lot 201 DP879480)
LGA Boundary
Development Site
Plant Community Type:
Black Cypress Pine - Tumbledown Red Gum - Narrow-leaved Ironbark - Stringybark She Oak open forest on acid volcanics of the western New England Tableland Bioregion
Blakely's Red Gum - Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion and Nandewar Bioregion
Candidate Native Grasslands
Forest Red Gum x Blakely's Red Gum - box woodland of the Yetman region, Brigalow Belt South Bioregion
Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion
River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt South and Nandewar Bioregions
River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion
Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion
Silver-leaved Ironbark - Black Cypress Pine +/- White Box shrubby open forest mainly in the northern Nandewar Bioregion
Silver-leaved Ironbark - White Cypress Pine - tea tree shrubby woodland mainly in the northern Nandewar Bioregion
Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion
Tumbledown Red Gum - Black Cypress Pine - Caley's Ironbark shrubby open forest of the Nandewar Bioregion and western New England Tableland Bioregion
Tumbledown Red Gum - White Cypress Pine - Caley's Ironbark shrubby open forest of the Nandewar Bioregion and western New England Tableland Bioregion
Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion
Source: Imagery - ESRI World Imagery 2016
Cadastre - NSW DCDB and QLD DCDB
Vegetation - NSW OEH (PCT State Vegetation)
State Vegetation Type Community (VIS 4681)
F4.1
Drawing No: 0470861s_BS_BDAR_G005_R3.mxd
Date: 16/03/2020
Drawing Size: A4
Drawn By: VN/ GR
Reviewed By: JW
Coordinate System: GDA 1994 MGA Zone 56
0 0.5 1km
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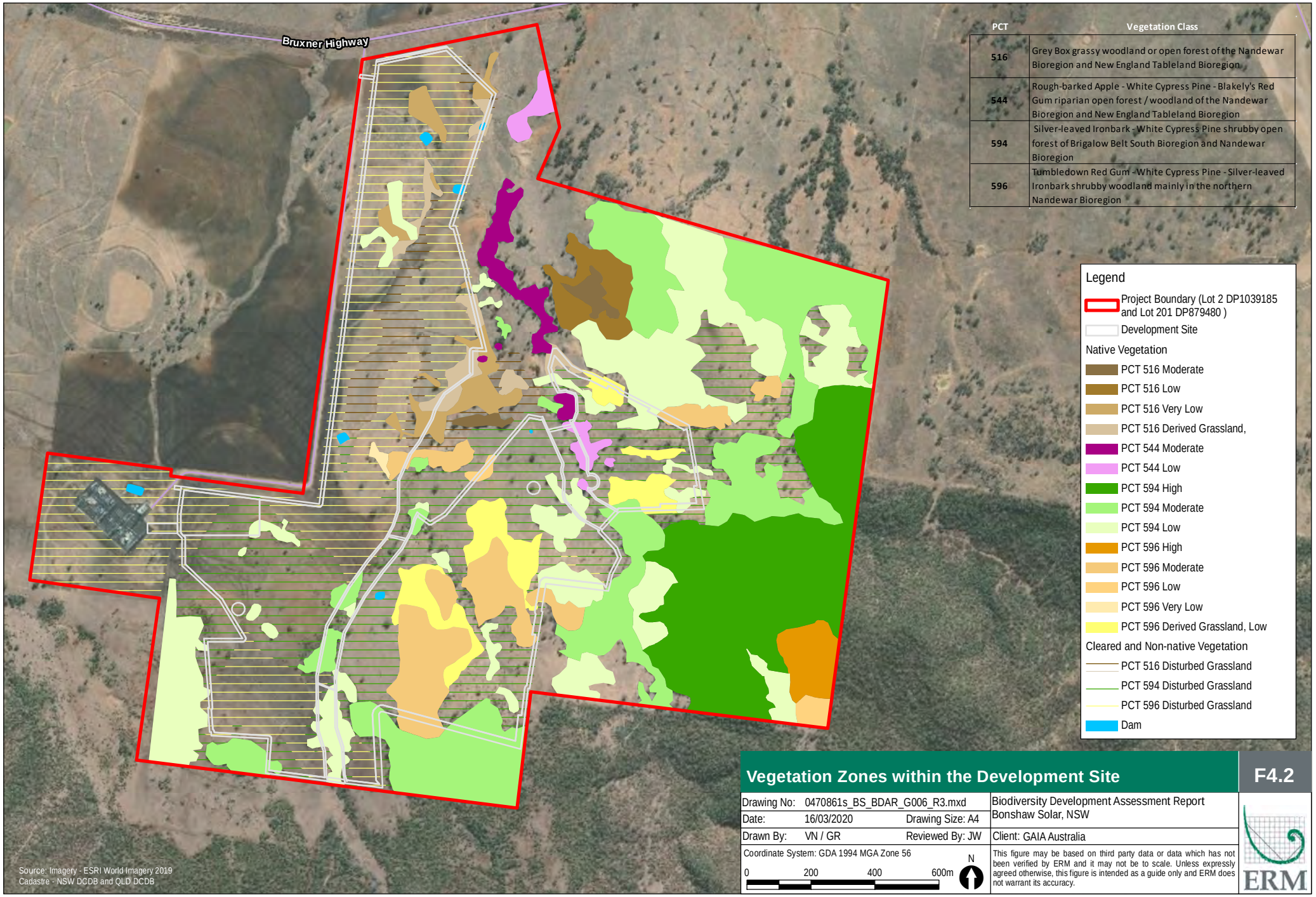
Biodiversity Development Assessment Report
Bonshaw Solar, NSW
Client: GAIA Australia
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM



Vegetation Zones within the Development Site

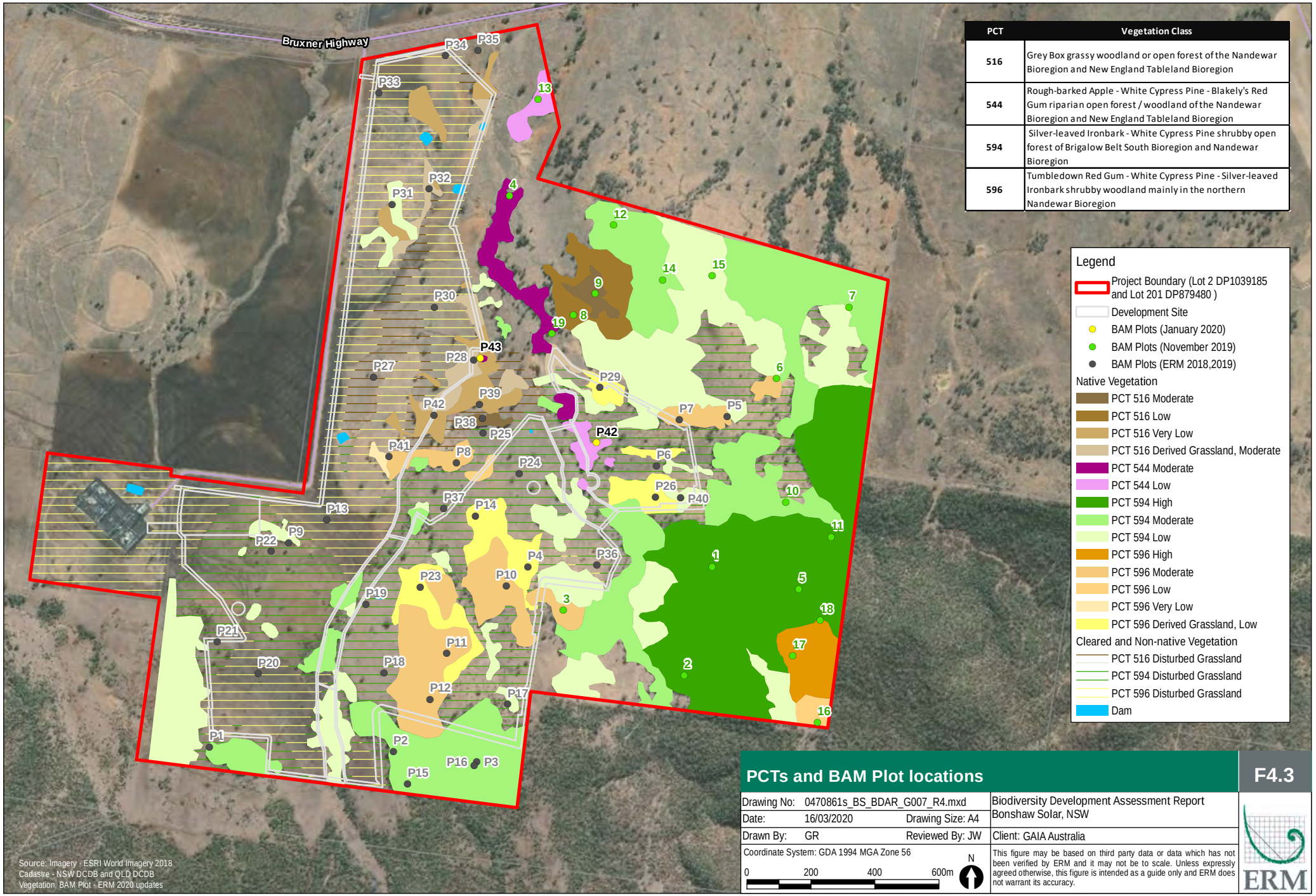
F4.2

Drawing No:	0470861s_BS_BDAR_G006_R3.mxd		Biodiversity Development Assessment Report Bonshaw Solar, NSW
Date:	16/03/2020	Drawing Size: A4	Client: GAIA Australia
Drawn By:	VN / GR	Reviewed By: JW	

Coordinate System: GDA 1994 MGA Zone 56

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



PCT	Vegetation Class
516	Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion
544	Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion
594	Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion
596	Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion

Legend

- Project Boundary (Lot 2 DP1039185 and Lot 201 DP879480)
- Development Site
- BAM Plots (January 2020)
- BAM Plots (November 2019)
- BAM Plots (ERM 2018,2019)

Native Vegetation

- PCT 516 Moderate
- PCT 516 Low
- PCT 516 Very Low
- PCT 516 Derived Grassland, Moderate
- PCT 544 Moderate
- PCT 544 Low
- PCT 594 High
- PCT 594 Moderate
- PCT 594 Low
- PCT 596 High
- PCT 596 Moderate
- PCT 596 Low
- PCT 596 Very Low
- PCT 596 Derived Grassland, Low

Cleared and Non-native Vegetation

- PCT 516 Disturbed Grassland
- PCT 594 Disturbed Grassland
- PCT 596 Disturbed Grassland
- Dam

Source: Imagery - ESRI World Imagery 2018
Cadastre - NSW DCDB and QLD DCDB
Vegetation, BAM Plot - ERM 2020 updates

PCTs and BAM Plot locations

F4.3

Drawing No:	0470861s_BS_BDAR_G007_R4.mxd		Biodiversity Development Assessment Report Bonshaw Solar, NSW
Date:	16/03/2020	Drawing Size: A4	
Drawn By:	GR	Reviewed By: JW	Client: GAIA Australia

Coordinate System: GDA 1994 MGA Zone 56

0 200 400 600m

N

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ERM

5. THREATENED SPECIES

5.1 Fauna Habitat Assessment

5.1.1 Important Habitat Mapping

For a small number of threatened species, a habitat constraint may refer to a mapped location that identifies areas that are considered important for those species. Maps currently available include important areas for the Swift Parrot (*Lathamus discolor*) and Regent Honeyeater (*Anthochaera phrygia*). These maps have been reviewed and the Subject Land does not form part of the important habitat mapping for either of these species.

5.1.2 Onsite Habitat Assessment

A habitat assessment was undertaken onsite seeking to identify the following fauna habitat features within the Subject Land:

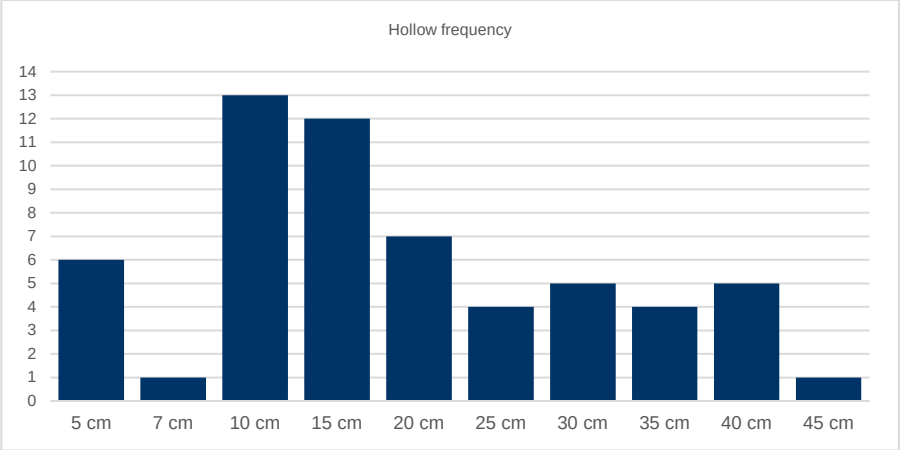
- Habitat trees including hollow-bearing trees and nest trees;
- Foraging resources including fruiting and flowering plants and other feed tree species;
- Waterbodies including condition assessment;
- Rocks, ground litter and logs;
- Burrows, dens, nests and dreys; and
- Koala food trees.

Searches were also completed for indirect evidence of fauna habitat including scats, bones, tracks and trails.

The onsite habitat assessment identified that the majority of the Subject Land is highly disturbed, only supporting fauna species which are able to persist in highly modified agricultural landscapes and within woodland remnants. Additional habitat features assessed are provided in Table 5.1.

Table 5.1 Additional Habitat Features Considered

Habitat Features	Available with the Development Site
Occurrences of Karst, Caves, Crevices and Cliffs	Not present within the Development Site
Occurrences of Rock	A total of eleven rocky areas were recorded within the Subject Land (see Figure 5.b). Targeted reptile searches were undertaken in six of those rocky areas. Rocky areas were present on crests and hillsides as shown in Photograph 5-1 to Photograph 5-4 below. Threatened species that could occur in these rocky outcrops are the: ■ Pink - tailed Legless Lizard (*Aprasia parapulchella*) ■ Rodd's Star Hair (*Astrotricha roddii*) ■ Border Thick-tailed Gecko (*Uvidicolus sphyrurus*) As these species were not detected, the rocky outcrops were considered unlikely to provide habitat for threatened species.

Habitat Features	Available with the Development Site
Occurrences of Human made structures and Non-native Vegetation	The only human made structures present within the Subject Land are fences, gates and stockyards. No built structures, such as sheds or dwellings, are present.
Termite/ ant mounds	A total of 39 ant/termite mounds were observed across the Subject Land as shown in Figure 5.b. An example of mounds found within the Subject Land are shown in Photograph 5-5 and Photograph 5-6 below.
Hollows and Hollow Bearing Trees	A total of 60 hollow bearing trees were recorded across the Subject Land (see Table H.7 in Appendix H and Figure 5.b). Trees with hollows were eucalypt trees and stags (see Photograph 5-7 to Photograph 5-10). As shown in **Graph 5-1** below, most hollows were medium size of less than or equal to 20cm diameter, followed by large hollows (greater than 20cm diameter) and small hollows (less or equal to 5cm diameter).  **Graph 5-1** Tree hollow sizes and their frequency
Bird nests	Numerous bird nest were observed across the Subject Land (see Photograph 5-11 to **Photograph 5-14**). Grey-crowned Babbler were observed actively adding sticks to one nest which indicates that the Subject Land is occupied by a breeding population of this species. Twenty-one nests were considered likely to be used by the Grey-crowned Babbler. The distribution of bird nests is shown in Figure 5.b and Figure 5.2.
Koala Habitat Values	Only nine records of koala exists within the 10km locality as per BioNet atlas. The nearest records were recorded in 1999 at approximately 1.5km south from the Subject Land. Threatened species surveys indicated that no koalas, koala scats or evidence of koala scratches were observed within the Subject Land. This is not unexpected due to the high level of clearance and disturbance at the Subject Land. Only one species listed as Koala Feed Tree (SEPP44), White Box (*Eucalyptus albens*), was recorded in low numbers within the Subject Land.

Photograph 5-1 View of rocky are on a hillside

Photograph 5-2 View of rocky area on a hillside

Photograph 5-3 View of rocky area on a hillside and crest

Photograph 5-4 View of rocky area on a hill crest

Photograph 5-5 Example of termite/ant mound

Photograph 5-6 Example of termite/ant mounds

Photograph 5-7 View of tree with hollow

Photograph 5-8 View of stag with hollow

Photograph 5-9 View of tree with hollows

Photograph 5-10 View of hollowed stag

Photograph 5-11 View of Grey-crowned Babbler nest

Photograph 5-12 Bird's nests on tree

Photograph 5-13 Tree with bird nest

Photograph 5-14 View of bird's nest on Eucalypt tree

5.2 Rivers, Streams and Wetlands

Riparian areas and farm dams were inspected along random meander transects in the assessment area surrounding the Subject Land.

5.2.1 Creek Lines

Third, second and first order un-named creek lines are present within Lot 2 in DP1039185 and are mapped tributaries of the Dumaresq River (see Figure 3.2). The creeks within the Project Boundary can be grouped as follows:

- Western Creek: This is a first order creek located within the Subject Land. This creek was dry during all the three survey periods (September 2018, December 2018 and March 2019) and provides very limited, if any aquatic habitat value.
- Central Creek and tributaries: This is a third order creek within the northern portion of the Project boundary and then diverges into a third order (eastern arm) and second order (western arm) to the south. These creeks were dry during all the three survey periods (September 2018, December 2018 and March 2019) and provides limited, seasonal aquatic habitat value only. Approximately six first order streams also converge into this central creek and provide very limited, if any aquatic habitat value.
- Eastern Creek: The southernmost portion of a first order stream is located on the eastern portion of the Project boundary (Lot 2 DP1039185) and outside of the Subject Land. This creek was not surveyed and will not be affected as part of the proposed development.

The overall condition of creek lines within the development footprint and the Project boundary is poor. Creek lines were dry during all three survey periods and erosion was noted along their banks (see **Photograph 5-15** to **Photograph 5-18**). Clearly defined river banks and channels are evident within the western, central and eastern creek lines indicating that at some point, these areas do contain large amounts of water and would provide some limited aquatic habitat for those species not dependent on a permanent water resource. The remaining 1st order creek lines within the Subject Land do not have conspicuous banks and bed and are not considered an aquatic habitat resource.

Riparian vegetation is mostly absent with scattered trees or patches of trees present. However, remnants of the Threatened Ecological Community – White Box Yellow Box Blakely's Red Gum Woodland were observed in several locations in association with stream banks and channels. Several vehicle crossing are present on creek lines within the Project Boundary.

It is worth noting that in natural conditions, when an aquatic species is present in a major river, that species is expected to also be distributed in the tributaries of that river because the river system is connected and water flows freely across the tributaries of the system. Where natural connectivity in riparian systems occur, naturally occurring restrictions to aquatic biodiversity are related to species-specific habitat and ecological requirements. Natural connectivity between the Dumaresq River and its tributaries at the Project Boundary no longer exists based on the presence of Bruxner Way, which runs in a general east-west direction along the northern boundary of the Project Boundary and beyond. It is worth noting that bridges were built on the highway at some of the major creeks and rivers intersections, such as Little Oaky Creek and Beardy River. This was not the case for tributaries crossing the Project Boundary.

Given that no connectivity exists between other tributaries of the Dumaresq River/Beardy River system and the creeks present at the Project Boundary, it is unlikely for those creeks to currently represent suitable habitat for aquatic biodiversity from the Dumaresq River.

Photograph 5-15 View of riparian area on the Project Boundary

Photograph 5-16 View of riparian area with vegetated bed.

Photograph 5-17 View of dry and eroded creek line with sparse trees on river bank

Photograph 5-18 View of creek near vehicle crossing

5.2.2 Farm Dams

A total of six farm dams are located within the Subject Land. Most of the farm dams were dry during surveys although they would provide a catchment for overland flow. As shown in photographs below, no fringing or submerged aquatic vegetation was present in these farm dams. An unidentified turtle was observed.

Photograph 5-19 View of a farm dam with water within the assessment area

Photograph 5-20 View of a small farm dam within the assessment area

Photograph 5-21 View of dry farm dam within the assessment area

Photograph 5-22 View of farm dam within the assessment area

5.3 Ecosystem Credit Species

A list of ecosystem credit species predicted to occur within the Subject Land, based on the PCTs present and generated by the calculator associated within the BAM (OEH 2017a) is provided in Table 5.2. The potential for these species to occur within the Subject Land was assessed in accordance with Section 6.2 of the BAM (OEH 2017a).

Two ecosystem credit species, the Glossy Black Cockatoo and White-bellied sea-eagle, were excluded from the assessment based on lack of foraging habitat across the Subject Land, all other species have been assumed to occur and contribute to ecosystem credits.

Table 5.2 Ecosystem Credit Species (BAM Calculator)

Ecosystem Credit Species	BC Act Listing	EPBC Act Listing	Justification for inclusion/exclusion
Anomalopus mackayi Five-clawed Work skink	E	V	Included. Potential habitat for the species is present within fallen logs and open paddocks with scattered trees.
Anthochaera phrygia Regent Honeyeater (Foraging)	CE	CE	Included. Potential foraging habitat is present. This woodland bird species forages in woodlands with significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. No habitat is available within the disturbed grasslands.
Artamus cyanopterus cyanopterus Dusky Woodswallow	V	-	Included. Potential foraging habitat is present in most woodland vegetation zones, excluding grasslands, cleared and disturbed land.
Calyptorhynchus lathami Glossy Black-Cockatoo (Foraging)	V	-	Excluded as the Subject Land does not contain preferred foraging resources (*Allocasuarina* or C*asuraina* sp) for the species
Chalinolobus picatus Little Pied Bat	V		Included. The species' calls were recorded in the assessment area and hollow bearing trees are present across the Subject Land.
Chthonicola sagittata Speckled Warbler	V	-	Included. This species was recorded adjacent to the Subject Land during potential offset site investigations. Suitable habitat for the species is considered to occur in woodland PCTs. Grasslands and cleared land (disturbed grasslands) do not represent suitable habitat for the species.
Circus assimilis Spotted Harrier	V	-	Included. Potential habitat for the species occurs across all vegetation zones in the Subject Land.
Climacteris picumnus victoriae Brown Treecreeper (eastern subspecies)	V	-	Included. This species was recorded adjacent to the Subject Land during potential offset site investigations. Suitable habitat for the species is considered to occur in woodland PCTs. Grasslands and cleared land (disturbed grasslands) do not represent suitable habitat for the species.
Daphoenositta chrysoptera Varied Sittella	V	-	Included. Potential habitat for the species occurs in woodland vegetation within the Subject Land.
Glossopsitta pusilla Little Lorikeet	V	-	Included. Potential habitat for the species occurs in Eucalypt trees across all vegetation zones within the Subject Land.
Grantiella picta Painted Honeyeater	V	V	Included. Potential habitat for the species occurs in Box and Ironbark trees across the Subject Land.

Ecosystem Credit Species	BC Act Listing	EPBC Act Listing	Justification for inclusion/exclusion
Haliaeetus leucogaster White-bellied Sea-eagle (Foraging)	V	-	Excluded. Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. No foraging habitat available within the Subject Land.
Hieraaetus morphnoides Little Eagle (Foraging)	V	-	Included. Potential foraging habitat for the species occurs in woodland areas within the Subject Land.
Lathamus discolour Swift Parrot (Foraging)	E	CE	Included. Potential foraging habitat for the species occurs in Eucalypt trees in treed vegetation zones within the Subject Land. Derived grasslands and cleared (disturbed grasslands) excluded.
Lophoictinia isura Square-tailed Kite (Foraging)	V	-	Included. Potential foraging habitat for the species occurs over the canopy of woodlands along riparian zones within the Subject Land.
Macropus dorsalis (Black-striped Wallaby)	E		Included. Potential foraging habitat for the species occurs across the Subject Land.
Melanodryas cucullata cucullata Hooded Robin (south-eastern form)	V	-	Included. Potential foraging habitat is present in woodland vegetation zones within the Subject Land.
Melithreptus gularis gularis Black-chinned Honeyeater (eastern subspecies)	V	-	Included. Potential foraging habitat is present in woodland vegetation zones within the Subject Land.
Miniopterus orinae oceanensis Large Bent-winged bat (Foraging)	V	-	Included. The species' calls were recorded within the Subject Land. The species forages over the canopy of trees, so suitable habitat is present in woodland vegetation zones within the Subject Land.
Neophema pulchella Turquioise Parrot	V	-	Included. Suitable habitat for the species includes woodlands and native grasslands. Roosting and breeding habitat for this woodland bird are hollow-bearing trees in woodlands. It forages in woodlands and native grasslands.
Ninox connivens Barking Owl (Foraging)	V	-	Included. Potential foraging habitat is present in woodland vegetation zones within the Subject Land.
Nyctophilus corbeni Corben's Long-eared Bat	V	-	Included. The species' calls were recorded in the assessment area and hollow bearing trees are present across the Subject Land.
Petroica boodang Scarlet Robin	V	-	Included. Limited suitable habitat for the species occurs in woodlands with fallen logs and timber wtihtin the Subject Land.

Ecosystem Credit Species	BC Act Listing	EPBC Act Listing	Justification for inclusion/exclusion
Petroica phoenicea Flame Robin	V	-	Included. Limited potential habitat is present in woodland vegetation zones within the Subject Land.
Phascolarctos cinereus Koala (Foraging)	V	-	Included. A small number of suitable feeding trees (i.e. *E. albens*) were recorded within the Subject Land. Koalas, or evidence of Koala activity, were not recorded during surveys.
Pomatostomus temporalis temporalis Grey-crowned Babbler (eastern subspecies)	V	-	Included. Recorded on site. Foraging and breeding habitat for the species is present in woodland vegetation zones. Cleared land (i.e. disturbed grasslands) excluded.
Pteropus poliocephalus Grey-headed Flying-fox (Foraging)	V	V	Included. Potential foraging habitat is present in canopy of Eucalypt trees. Grasslands and cleared land excluded as potential foraging habitat.
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	V	-	Included. The species' calls were recorded in the assessment area and hollow bearing trees are present across the Subject Land.
Stagonopleura guttata Diamond Firetail	V	-	Included. Potential roosting and breeding habitat for the species occurs in woodlands, foraging habitat for the species occurs across the entire Subject Land.
Tyto novaehollandiae Masked Owl (Foraging)	V	-	Included. Potential foraging habitat is present in eucalypt forests/woodlands and along their edges within the Subject Land.

5.4 Species Credit Species

An assessment of habitat constraints for threatened species was undertaken in accordance with Step 2 of Section 6.4 of the BAM (OEH 2017a). For those threatened species predicted to occur and for which habitat constraints are listed, an assessment was undertaken of the presence of the habitat features within the development site.

The species generated by the calculator with habitat constraints, as well as the results of the habitat constraints assessment, are shown in Table 5.3.

Under Section 6.4.1.17 of the BAM, a species credit species can be considered unlikely to occur on a development site (or within specific vegetation zones) if following field assessment, it is determined that the habitat is substantially degraded such that the species is unlikely to utilise the development site (or specific vegetation zones).

A total of eight candidate species credit species were excluded as no suitable habitat is present within the Subject Land (see Table 5.3). The species excluded are: Regent Honeyeater (Breeding), White-bellied Sea Eagle (Breeding), Swift Parrot (Breeding), Square-tailed Kite (Breeding), Grey-headed Flying Fox (Breeding), Eastern Bentwing Bat (Breeding), Koala (Breeding) and Ovenden's Ironbark.

Table 5.3 Species Credit Species

Species Credit Species	BC Act Listing	EPBC Act Listing	Habitat components and geographic restrictions	Sensitivity to gain class	Included or Excluded	Reason for inclusion or exclusion
Adelotus brevis Tusked Frog population in the Nandewar and New England Tableland Bioregion	E	-	-	Very High	Included	Six first order streams and several farm dams are present within the Subject Land although they do not provide any preferred habitat for this species. This species are usually found near creeks, ditches and ponds, and call while hidden amongst vegetation or debris. Limited riparian or and no fringing vegetation was noted in creeks and near the dams, respectively. Therefore, aquatic habitat is marginal at best
Amalosia rhombifer Zigzag Velvet Gecko	E	-	-	High	Included	Suitable habitat for the species occurs within the woodland habitats. This species is largely arboreal, living and foraging in trees.
Anthochaera phrygia Regent Honeyeater (Breeding)	CE	CE	-	High	Excluded	The Subject Land is not considered to be used as breeding or foraging habitat for the species. There are four known key breeding areas for this species, three of them in NSW - Capertee Valley, Bundarra-Barraba and Hunter Valley districts. For the Bundarra-Barraba area, three subsidiary foraging and breeding areas are known, Inverell-Ashford-Emmaville, Pilliga and Warrumbungles.
Astrotricha roddii Rodd's Star Hair	E	E	Rocky areas, Granite or acid volcanic outcrops	High	Included	A total of eleven rocky areas were recorded within the Subject Land and provide potential habitat for the species.
Burhinus grallarius Bush Stone-curlew	E	-	Fallen/standing dead timber including logs	High	Included	This species inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Potential habitat is available within the grassy woodlands only. The heavily grazed areas do not constitute preferred habitat.

Species Credit Species	BC Act Listing	EPBC Act Listing	Habitat components and geographic restrictions	Sensitivity to gain class	Included or Excluded	Reason for inclusion or exclusion
Calyptorhynchus lathami Glossy Black-Cockatoo (Breeding)	V	-	-	High	Included	Suitably sized hollows have been recorded within the Subject Land although no preferred foraging habitat has been recorded which would limit the likelihood of this species nesting on site.
Dichanthium setosum Bluegrass	V	V	-	High	Included	The species has potential to occur in the Subject Land.
Digitaria porrecta Finger panic Grass	E	-	-	Moderate	Included	The species has potential to occur in the Subject Land.
Eucalyptus caleyi subsp. ovendenii Ovenden's Ironbark	V	V	-	High	Excluded	The preferred altitudes for the species are between 610 and 820 m, on granitic substrates. The Subject Land in located at much lower elevations between 335 and 420 m.
Geophaps scripta scripta Squatter Pigeon (southern)	CE	V	-	High	Included	The species has potential to occur within the woodland habitats although the species prefers sandy areas and usually close to water (within 3 km of water bodies or courses).
Haliaeetus leucogaster White-bellied Sea-Eagle (Breeding)	V	-	-	High	Excluded	Breeding habitat for this species consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat (not available within the Subject Land). Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'.
Hieraaetus morphnoides Little Eagle (Breeding)	V	-	-	Moderate	Included	Potential breeding habitat is available within the woodland habitats. This species nests in tall living trees within remnant vegetation where pairs build a large stick nest in winter.

Species Credit Species	BC Act Listing	EPBC Act Listing	Habitat components and geographic restrictions	Sensitivity to gain class	Included or Excluded	Reason for inclusion or exclusion
Homopholis belsonii Belson's Panic	E	V	-	NA	Included	Grows in dry woodland (e.g. Belah) often on poor soils, although sometimes found in basalt-enriched sites north of Warialda and in alluvial clay soils. The species has potential to occur in the Subject Land
Hoplocephalus bitorquatus Pale-headed Snake	V	-		High	Included	Suitable habitat for the species occurs within the Subject Land. A small number of historical records are known for the New England Tableland from Glenn Innes and Tenterfield; however, the majority of records appear to be from sites of lower elevation. The species is found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest. It has limited potential to occur in the Subject Land
Indigofera baileyi Bailey's Indigo	E	-	-	High	Included	The species is known from around Inverell and Ashford in the western inland slopes. It prefers open woodlands on loam and clay loam soils, typically from granite or basalt, and has potential to occur in the Subject Land
Lathamus discolour Swift Parrot (Breeding)	E	CE	-	Moderate	Excluded	The species breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia.

Species Credit Species	BC Act Listing	EPBC Act Listing	Habitat components and geographic restrictions	Sensitivity to gain class	Included or Excluded	Reason for inclusion or exclusion
Lophoictinia isura Square-tailed Kite (Breeding)	V	-	-	Moderate	Excluded	No suitable breeding habitat for the species is present within the Subject Land, as the species prefers coastal and subcostal environments and inland wooded watercourses. Second and third order streams are excluded from the Subject Land. Scattered records of the species throughout NSW indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.
Miniopterus orinae oceanensis Large Bent-winged bat (Breeding)	V	-	-	Very High	Excluded	Caves are the breeding habitat for the species. Caves, suitable for maternity areas, are not present within the Subject Land. Being a dual credit species, foraging habitat resources are already accounted for in the ecosystem credits.
Ninox connivens Barking Owl (Breeding)	V	-	Hollow bearing trees. Living or dead trees with hollows greater than 20cm diameter and greater than 4m above the ground	High	Included	Hollow bearing trees occur within woodland habitats and also as isolated trees within highly disturbed vegetation zones on the Subject Land. However, only a small number of these trees are likely to represent suitable breeding habitat for this species due to limiting factors associated with hollow size and height above ground. Potential breeding habitat is considered to comprise Vegetation Zones 594_Moderate, 594_Low, 596_Moderate, 544_Low and 516_Very low given that hollow-bearing trees (with suitable hollows) were observed to be concentrated within these zones.

Species Credit Species	BC Act Listing	EPBC Act Listing	Habitat components and geographic restrictions	Sensitivity to gain class	Included or Excluded	Reason for inclusion or exclusion
Petaurus norfolcensis Squirrel Glider	V	-	-	High	Included	Substandard suitable habitat is present in Eucalypt trees in the Subject Land.
Phascolarctos cinereus Koala (Breeding)	V	V	-	High	Excluded	Breeding habitat is not considered to be present on the Subject Land. This determination has been made on the basis that no koalas, or evidence of koala activity, has been recorded on the Subject Land and given that recognised feed trees occur only in very low numbers onsite.
Polygala linariifolia Native Milkwort	E	-	-	High	Included	The species has potential to occur in the Subject Land
Pomaderris queenslandica Scant Pomaderris	E	-	-	High	Included	The species has potential to occur in the Subject Land
Pteropus poliocephalus Grey-headed Flying-fox (Breeding)	V	V	-	High	Excluded	No known breeding camp is present within the Subject Land.
Swainsona sericea Silky Swainson-pea	V	-	-	High	Included	The species has the potential to occur within the Subject Land.
Thesium austral Austral Toadflax	V	V	-	Moderate	Included	The species has potential to occur in the Subject Land

Species Credit Species	BC Act Listing	EPBC Act Listing	Habitat components and geographic restrictions	Sensitivity to gain class	Included or Excluded	Reason for inclusion or exclusion
Tyto novaehollandiae Masked Owl (Breeding)	V	-	-	High	Included	The Masked Owl is a large forest owl and prefers uncleared or lightly cleared areas with high densities of old hollow bearing trees. Given that habitat is present on site that meets the breeding habitat constraint for this species (living or dead trees with hollows greater than 20cm diameter), breeding habitat has been assumed to be present for this species. Potential breeding habitat is assumed to occur within Vegetation Zones 594_Moderate, 594_Low, 596_Moderate, 544_Low and 516_Very low given that hollow-bearing trees (with suitable hollows) were observed to be concentrated within these zones. However, it is considered unlikely that the Masked Owl would use these habitat features given the highly disturbed and highly fragmented context in which theses habitat features occur.
Uvidicolus sphyrurus Border Thick-tailed Gecko	V	V	-	High	Included	The species has potential to occur in the Subject Land

5.5 Additional Species Considered

Based on results of the BioNet Atlas search (see Appendix B), the PMST (see Appendix C) and the likelihood of occurrence assessment undertaken during desktop review (see Appendix D), the following species were also considered for assessment:

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- Bristle-faced Free-tailed Bat (*Setirostris eleryi* – previously *Mormopterus eleryi*);
- Eastern Cave Bat (*Vespadeuls vulturnus*);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*);
- Narrow-leaved Black Peppermint (*Eucalyptus nicholii*); and
- Heath Wrinklewort (*Rutidosis heterogama*).

5.6 Candidate Species Surveyed

The species listed in Table 5.4 are those that are considered to have habitats present at the Subject Land. Surveys have been conducted for these species. The results are summarised in Table 5.5.

Details of the survey methodologies for each surveyed species are provided in Appendix F and Appendix H. Targeted survey locations are mapped on Figure 5.1a.

Species polygons have been defined for relevant species credit species that have been confirmed, or are assumed, to be present on the Subject Land as mapped on Figure 5.3.

Table 5.4 Candidate Species Surveyed

Species Credit Species	BC Act Listing	EPBC Act Listing	Biodiversity Risk	Biodiversity Risk Weighting	Survey Time	Assumed to occur/survey/ expert report	Recorded during field surveys	Species polygon area or count
Adelotus brevis Tusked Frog population in the Nandewar and New England Tableland Bioregion	E	-	Very High	3	December	No	No	No
Amalosia rhombifer Zigzag Velvet Gecko	E	-	High	2	December	No	No	No
Anthochaera phrygia Regent Honeyeater	CE	CE	Very High	3	December	No	No	No
Astrotricha roddii Rodd's Star Hair	E	E	High	2	September December	No	No	No
Burhinus grallarius Bush Stone-curlew	E	-	High	2	December	No	No	No
Calyptorhynchus lathami Glossy Black-Cockatoo	V	-	High	2	No	No	No	No
Dichantium setosum Bluegrass	V	V	High	2	December March	No	No	No
Digitaria porrecta Finger Panic Grass	E	-	High	2	December March	No	No	No
Geophaps scripta scripta Squatter Pigeon (southern)	CE	V	Very High	3	December	No	No	No
Hieraaetus morphnoides Little Eagle	V	-	Moderate	1.5	December	No	No	No
Homopholis belsonii Belson's Panic	E	V	N/A	1	December March	No	No	No

Species Credit Species	BC Act Listing	EPBC Act Listing	Biodiversity Risk	Biodiversity Risk Weighting	Survey Time	Assumed to occur/survey/ expert report	Recorded during field surveys	Species polygon area or count
Hoplocephalus bitorquatus Pale-headed Snake	V	-	High	2	December	No	No	No
Indigofera baileyi Bailey's Indigo	E	-	High	2	September December	No	No	No
Lophoictinia isura Square-tailed Kite	V	-	Moderate	1.5	December	No	No	No
*Mormopterus eleryi (*syn. *Setirostris eleryi)* Bristle-faced Free-tailed Bat	E	-	High	2.0	December	Survey	Yes	Yes
Miniopterus orianae oceanensis Large Bent-winged bat	V	-	Very High	3.0	December	Survey	Yes	No
Ninox connivens Barking Owl	V	-	High	2	None	Assumed Present	N/A	Yes
Petaurus norfolcensis Squirrel Glider	V	-	High	2	December	No	No	No
Phascolarctos cinereus Koala	V	V	High	2	December	No	No	No
Polygala linariifolia Native Milkwort	E	-	High	2	December January	No	No	No
Pomaderris queenslandica Scant Pomaderris	E	-	High	2	September December March	No	No	No
Pteropus poliocephalus Grey-headed Flying-fox	V	V	High	2	December	No	No	No
Swainsona sericea Silky Swainson-pea	V	-	High	2	September December	No	No	No

Species Credit Species	BC Act Listing	EPBC Act Listing	Biodiversity Risk	Biodiversity Risk Weighting	Survey Time	Assumed to occur/survey/ expert report	Recorded during field surveys	Species polygon area or count
Thesium austral Austral Toadflax	V	V	Moderate	1.5	September December	No	No	No
Tyto novaehollandiae Masked Owl	V	-	High	2	None	Assumed Present	N/A	Yes
Uvidicolus sphyrurus Border Thick-tailed Gecko	V	V	High	2	December	No	No	No
Vespadeuls vulturnus Eastern Cave Bat	V	-	Very High	3.0	December	Survey	Yes	Yes

5.7 Targeted Survey Results

Targeted surveys for flora and fauna species were completed across the Subject Land. A description of survey methodology and effort is provided in Appendix F. Figure 5.1a shows the location of survey tracks across the Subject Land.

5.7.1 Flora Species Recorded

No threatened flora species were recorded during site surveys. A complete list of flora species recorded on the Subject Land is provided in Table H.6 (Appendix H).

A total of 143 flora species in 47 families were recorded within the assessment area. This included a total of 111 native (78 %) and 32 exotic (22 %) species. The most numerous families were Poaceae (30 species), Asteraceae (21 species) and Fabaceae (Faboideae) (10 species).

Exotic species included two HTE and WoNS, Tiger Pear (*Opuntia aurantiaca*) and Velvet Tree Pear (*Opuntia tomentosa*). Due to the high level of grazing and lack of reproductive material, identification of some flora specimens was only viable to genus level, including *Senecio* sp., *Hypericum* sp. and *Solanum* sp. Therefore, presence of an additional WoNS, Fireweed (*Senecio madagascariensis*), cannot be precluded. Fireweed is also listed as a Priority Weed in the Northern Tablelands. Similarly, exotic species within genera *Hypericum* and *Solanum* were recorded. Therefore, potential presence of priority weeds St John's Wort (*Hypericum perforatum*) and Silverleaf Nightshade *(Solanum elaeagnifolium*), cannot be precluded. As per the Biosecurity Act, all exotic species require management and preparation of a Weed Management Plant for the proposed solar farm will be required.

5.7.2 Fauna Species Recorded

A total of 78 fauna species were recorded on and adjacent to the Subject Land. A summary of faunal groups recorded is presented in Table 5.5 and a complete fauna species list is provided in Appendix H.

A total of eleven threatened species were recorded within the Subject Land (see Table 5.5 below). The species included eight vulnerable microchiropteran bats (Little Pied Bat, Eastern Bentwing-bat, Corben's Long-eared Bat, Yellow-bellied Sheath-tailed Bat, Eastern Cave Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat and Hoary Wattled Bat), one endangered microchiropteran bat (Bristle-faced Free-tailed bat), one vulnerable bird (Grey-crowned Babbler) and one migratory bird (Cicadabird). Out of the eight Vulnerable microchiropteran bats, six were definite call identifications and two (Greater Broad-nosed Bat and Hoary Wattled Bat) were potential calls. Two additional Vulnerable bird species (Brown Treecreeper and Speckled Warbler) were also recorded adjacent to the Subject Land during potential offset site investigations.

Table 5.5 Summary of Fauna Species Recorded

Fauna Type	Number of Species	BC Act	EPBC Act
Woodland Birds	46 on the Subject Land and an additional 7 adjacent to the Subject Land	One species, the Grey-crowned Babbler is listed as Vulnerable and has been further assessed in Section 5.7.3 Two additional Vulnerable species were recorded adjacent to the Subject Land during potential offset site investigations – Brown Treecreeper (*Climacteris picmnus victoriae*) and Speckled Warbler (*Chthonicola sagittata*)	One species, the Cicadabird is listed as Marine and has been further assessed in Section 5.7.6
Raptors	2 flying over Subject Land	No	No
Forest Owls	0	No	No
Reptiles	9	No	No
Amphibians	3	No	No
Terrestrial Mammals	11 including 5 introduced species	No	No
Arboreal Mammals	1	No	No
Microchiropteran Bats	12 definite + 6 potential	Six Vulnerable species: Little Pied Bat, Eastern Bentwing-bat, Corben's Long-eared Bat, Yellow-bellied Sheath-tailed Bat, Eastern Cave Bat (this species has been further assessed in Section 5.7.4) and Eastern False Pipistrelle Two potential Vulnerable species: Greater Broad-nosed Bat and Hoary Wattled Bat. One Endangered species: Bristle-faced Free-tailed Bat. This species has been further assessed in Section 5.7.4.	One vulnerable species: Corben's Long-eared Bat

Results of each threatened species recorded on the Subject Land are summarised in sub-sections below.

5.7.3 Grey-crowned Babbler

The Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) is listed as an ecosystem credit species.

It inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions. Its flight is laborious so birds prefer to hop to the top of a tree and glide down to the next one. Birds are generally unable to cross large open areas. It lives in family groups that consist of a breeding pair and young from previous breeding seasons. A group may consist of up to fifteen birds. All members of the family group remain close to each other when foraging. It is insectivorous and it forages on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses. It builds nests that are used as dormitory and roosting and uses them all year round. It breeds between July and February. Territory ranges from one to 50 hectares (usually ten hectares) and are defended all year (OEH 2019).

Grey-crowned Babblers are obligate communal breeders that form a family group, in which offspring from the previous season and other unrelated birds help to raise the current's year's brood. Young birds stay with the family group for at least one year after fledging and may remain for two or more years acting as non-breeding helpers. As breeding spaces become available in the population, some helpers may disperse to establish their own breeding group. In some populations, breeding success is related to the number of helpers. Population viability studies in Victoria suggests that a viable population is likely to contain more than ten family groups, while populations with less than ten family groups are likely to have high rate of extinction. In NSW, the species breeds between July and February (OEH 2019).

It has been suggested that cooperative breeder species, such as the Grey-crowned Babbler, are more sensitive to habitat fragmentation and loss (including loss due to fire) as availability of resources for breeding decreases (Fischer 2011). Habitat fragmentation and predation by introduced species being the major threats to the species. The species is reported to survive in disturbed landscapes, such as urban areas, where proportion of ground cover and leaf litter provides sufficient food (Lambert and Ford 2016, Stevens *et. al*. 2015).

The Grey-crowned Babbler was observed during surveys in September and December 2018, heard during the March 2019 survey and observed more recently during surveys in November 2019 and January 2020. In December 2018, the Grey-crowned Babbler was recorded at 20 points within the Subject Land and a total of 21 bird nests likely to belong to the species were observed (see Figure 5.2). The records included up to 15 individuals observed, 21 calls heard with an additional two potential calls heard at distance. Also, a pair was observed adding twigs to a nest located on the lower branches of a Silver-leaved Ironbark (*Eucalyptus melanophloia*).

The Grey-crowned Babbler was observed in the following vegetation zones:

- 594_Moderate (Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion). A total of 4.1 ha of this vegetation zone is present across the Subject Land;
- 596_Moderate (Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion). A total of 11.15 ha of this vegetation zone is present across the Subject Land;
- 544_ Low (Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion). A total 0.83 ha are present within the Subject Land;
- 516_Very Low (Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion), a total of 3.00 ha of this vegetation zone is present across the Subject Land; and
- 516_Disturbed Grasslands (Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion). A total 7.39 ha of this vegetation zone is present within the Subject Land.

A Test of Significance for the species was undertaken and is included in Appendix E.

5.7.4 Microchiropteran Bats

A total of nine threatened microchiropteran bat species were recorded within the assessment area, including eight vulnerable species and one endangered species. In accordance with the '*Species Credit' threatened bats and their habitats* guide (OEH 2018b), the species fall into the following credit species types:

- Ecosystem Credit Species:
  - Little Pied Bat (*Chalinolobus picatus*) (V)
  - Large Bent-winged Bat (*Miniopterus orianae oceanensis*) (V) – Foraging Habitat only
  - Corben's Long-eared Bat (*Nyctophilus corbeni*) (V)
  - Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) (V)
  - Greater Broad-nosed Bat (*Scoteanax rueppellii*) (V)
  - Hoary Wattled Bat (*Chalinolobus nigrogriseus*) (V)
  - Yellow-bellied Sheath-tailed Bat (*Saccolaimus flaviventris*) (V)
- Species Credit Species:
  - Bristle-faced Fee-tailed Bat (*Mormopterus eleryi*) (E)
  - Eastern Cave Bat (*Vespadeuls vulturnus*) (V)
  - Large Bent-winged Bat (*Miniopterus orianae oceanensis*) (V) – Breeding habitat only listed as SCS

Habitat polygons for Species Credit Species (SCS) have been assessed in accordance with Step 5 of Section 6.4 of the BAM (OEH 2017a and OEH 2018a). Based on the analysis of habitat availability for SCS within the Subject Land (see Table 5.6), a species polygon has been prepared for the Eastern Cave Bat and the Bristle-faced Free-tailed Bat.

Suitable breeding habitat is not considered to occur on the Subject Land for the Eastern Bentwing Bat or Eastern Cave Bat.

Table 5.6 Habitat Summary for Microchiropteran Bat Species Credit Species

Scientific Name Common Name	BC Act Listing	Habitat as per TBDC					Habitat Constraints		PCTs	Comments
		Roosting	Breeding	Foraging	Are paddock trees important habitat?	Patch Size	Description	Present		
Mormopterus eleryi (syn. Setirostris eleryi) Bristle-faced Free-tailed Bat	E	Hollows and tree fissures. Habitat is within 500m of riparian areas (including dry river/creek beds) and water bodies within the PCTs associated with the species.	Tree hollows (Ellis 2006)	Insectivorous species that forage typically well-above the canopy and only coming low in relatively open areas (Ellis and Wilson 1992)	No	5-24 ha	Land within 500 m of watercourses or dams surrounded by eucalypts containing hollows.	Yes	516, 544, 594, 596	Hollow bearing trees within 500m of watercourses and dams are the relevant habitat component for the species.
Vespadelus troughtoni Eastern Cave Bat	V	Caves, Scarps, cliffs, disused mine workings.	Potential breeding habitat is the PCTs associated with the species (as per the TBDC) within 100m of rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within potential habitat.	Found in dry open forests and woodland, near cliffs or rocky overhangs.	No	5-24 ha	Caves within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds.	No	516, 544, 594, 596	Trees and treed areas represent potential foraging habitat for the species within the Subject Land. No roosting or breeding habitat is present.
Miniopterus orianae oceanensis Large Bent-winged Bat	V	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures	Maternity caves. Potential breeding habitat is caves, tunnels, mines or other structures known or suspected to be used by the species	Being an insectivorous species it is assumed foraging habitat is treed areas. Within 300km range of maternity caves.	No	<5 ha	Breeding: Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave;" observation type code "E nest-roost;" with numbers of individuals >500	No	516, 544, 594, 596	Trees and treed areas represent potential foraging habitat for the species within the Subject Land. No roosting or breeding habitat is present.

5.7.4.1 Bristle-faced Free-tailed Bat

As described in Table 5.6, the Bristle-faced Free-tailed Bat roosts in tree hollows and tree fissures, breeds in tree hollows and forages for insects over the canopy of trees (Ellis 2001, NSW SC 2004, OEH 2019). In defining the habitat polygon for the Bristle-faced Free-tailed Bat, ecological information from the TBDC and scientific literature was taken into account including the following from BioNet:

> *This species may move distances greater than 10km, dispersal distance of 100m - 10km was selected as this is the distance at which females regularly move to establish new colonies in available habitat. Additionally, selected <1 for average number of offspring because females do not give birth every (often miscarry etc).*
>
> *Potential habitat is riparian areas (including dry river/creek beds) within the PCTs associated with the species. Survey should sample the available range of suitable vegetation along riparian areas on the Subject Land. Traps or nets should be set near water holes (especially if isolated), under/beside large trees, in/beside creek beds, or in 'flyway' spaces between vegetation. NB. Use of acoustic detection alone is not suitable for this species as the call is difficult to distinguish from other common species. Refer to Threatened Bat Survey Guide.*
>
> *All habitat on the Subject Land where the Subject Land is within 500m of a river, creek or riparian area must be mapped. Use aerial imagery to map river, creek or riparian areas (including dry creek channels, former creek channels, billabongs etc.) on or within 500m of the Subject Land. Species polygon boundaries should align with PCTs on the Subject Land to which the species is associated that are within 500m of waterbodies mapped.*

In accordance with Table 1 of the OEH (2018b) '*Species Credit' threatened bats and their habitats guide*, the species polygon for the Bristle-faced Free-tailed Bat has been prepared and includes the following features:

- *All habitat on the Subject Land where the Subject Land is within 500m of a river, creek or riparian area*.

A review of information on the Bristle-faced Free-tailed Bat has been undertaken and is presented in Appendix E. It is acknowledged that little information is available regarding the ecology and biology of this species. It is assumed that the species roosts and breeds on tree hollows and tree fissures. Based on feeding behaviour of species within the *Mormopterus* / *Setirostris* genus, it is assumed that the species is aerial insectivorous and that is a vegetation dependent species which forage typically well above the canopy of any vegetation type when feeding. Therefore, suitable roosting, breeding and foraging habitat for the species within the Subject Land includes individual trees (particularly hollow-bearing trees, trees with fissures and tree canopies) and woodland areas within 500m of riparian areas. Cleared areas are not considered to represent suitable habitat for the species.

A species habitat polygon for the Bristle-faced Free-tailed Bat is provided in Figure 5.3.

5.7.4.2 Eastern Cave Bat

As described in Table 5.6, the Eastern Cave Bat roosts in Caves, Scarps, cliffs, disused mine workings. Potential breeding habitat is the PCTs associated with the species (as per the TBDC) within 100m of rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within potential habitat.

The BioNet Atlas indicates that the Eastern Cave Bat:

- "*Any impacts on breeding habitat could be considered potentially serious and irreversible. This species is retained as dual credit because foraging habitat is broad ranging but breeding habitat is highly specific. At lower altitudes this species is usually more abundant during winter months, the lower numbers of individuals from October to February are due to females moving to maternity sites. Additionally, selected <1 for average number of offspring because females do not give birth every (often miscarry etc)*."

- "*All breeding habitat including the cave, or other features, used for breeding and the area immediately surrounding this feature must be mapped. Species polygon boundaries should have a 100m radius buffer around an accurate GPS point location centred on the cave/feature entrance*."

In accordance with Table 1 of the OEH (2018b) '*Species Credit' threatened bats and their habitats guide*, a species polygon for the Eastern Cave Bat would need to be prepared that includes the following features:

- "*All habitat on the Subject Land where the Subject Land is within 2km of caves, scarps, cliffs, rock overhangs and disused mines*."
- "*Note: any breeding habitat identified for this species (see Table 2) is a potential serious and irreversible impact*."

In accordance with Table 2 of the OEH (2018b), the features and approach required to develop the species polygon for the Eastern Cave Bat, a species that require identification of breeding habitat are:

- "*All breeding habitat on or within 100m of the Subject Land and the area immediately surrounding the feature. Artificial structures should be inspected and included if the species is using these features for breeding (see Section 3.2)*."
- "*Note all habitat for this species should also be mapped if present (i.e. including that described in Table 1)*."

Roosting and/or breeding habitat for the Eastern Cave Bat does not occur on the Subject Land. Aerial images covering an area of 2km surrounding the Project Boundary were assessed for the potential presence of caves, cliffs, rock overhangs and disused mines. No suitable breeding and/or roosting habitat features were identified. However, rocky areas containing boulder piles and crevices were observed within 2km of the Subject Land.

It is considered that only foraging resources for the Eastern Cave Bat are available on the Subject Land. In accordance with the TBDC, the four PCTs identified at the Subject Land (i.e. PCT 516, 544, 594 and 596) represent potential foraging habitat. The profile for the species (OEH 2019) indicates that "little is understood of its feeding or breeding requirements or behaviour". All vegetation zones, with the exception of disturbed and derived grasslands, have therefore been considered as potential foraging habitat for the Eastern Cave Bat. A species habitat polygon for the Eastern Cave Bat is provided in Figure 5.3.

A test of significance for the species is presented in Appendix E. Given the absence of roosting and/or breeding habitat for the species at the Subject Land, it is considered that the proposed development does not represent a significant impact on this species.

5.7.5 Owls

5.7.5.1 Barking Owl

The TBDC provides the following information regarding the preferred habitat of the Barking Owl:

- Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend into closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils.
- Roosts in shaded portions of tree canopies, including tall mid storey trees with dense foliage such as *Acacia* and *Casuarina* species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance.
- Preferentially hunts small arboreal mammals such as Squirrel Gliders and Common Ringtail Possums, but when loss of tree hollows decreases these prey populations the owl becomes more

reliant on birds, invertebrates and terrestrial mammals such as rodents and rabbits. Can catch bats and moths on the wing, but typically hunts by sallying from a tall perch.

- Requires very large permanent territories in most habitats due to sparse prey densities. Monogamous pairs hunt over as much as 6000 hectares, with 2000 hectares being more typical in NSW habitats.
- Two or three eggs are laid in hollows of large, old trees. Living eucalypts are preferred though dead trees are also used. Nest sites are used repeatedly over years by a pair, but they may switch sites if disturbed by predators (e.g. goannas).
- Nesting occurs during mid-winter and spring, being variable between pairs and among years. As a rule of thumb, laying occurs during August and fledging in November. The female incubates for 5 weeks, roosts outside the hollow when chicks are 4 weeks old, then fledging occurs 2-3 weeks later. Young are dependent on their parents for several months.

The TBDC also provides that where a breeding site has been identified in accordance with the BAM the species polygon should be established by providing a circular buffer with a 100m radius around the nest tree. This includes suitable habitat for male roosts, feeding/grooming perches and fledgling requirements. It does not account for foraging habitat. The shape of the buffer can be modified where evidence indicates an alternative shape would better meet the species needs in the context of the assessment site.

As no targeted surveys (e.g. call playback and identification of nest trees) were completed for this dual credit species, breeding habitat has been assumed to be present by identifying suitable habitat. As described in Table 5.3, a species polygon has been mapped for this species by including entire vegetation zones in which hollow-bearing trees were concentrated and contained hollows of a suitable size (i.e. >20cm wide) and height above the ground (i.e. >4m) in accordance with breeding habitat constraints provided in BAM-C.

Potential breeding habitat is therefore assumed to occur within the following Vegetation Zones as shown in Figure 5.3:

- PCT 594_Moderate;
- PCT 594_Low;
- PCT 596_Moderate;
- PCT 544_Low; and
- PCT 516_Very low.

Given the approach described above, the species polygon for Barking Owl is considered to represent a conservative overestimate of actual/potential breeding habitat in that only a small proportion of hollow-bearing trees within the polygon are suitable for nesting.

5.7.5.2 Masked Owl

The TBDC provides the following information regarding the preferred habitat of the Masked Owl:

- Lives in dry eucalypt forests and woodlands from sea level to 1100 m.
- A forest owl, but often hunts along the edges of forests, including roadsides.
- The typical diet consists of tree-dwelling and ground mammals, especially rats.
- Pairs have a large home-range of 500 to 1000 hectares.
- Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. Although there is no evidence to suggest that caves are utilised for nesting in NSW.
- Dead stags are especially popular for roosting/breeding habitat.

The TBDC also provides that where a breeding site has been identified in accordance with the BAM the species polygon should be established by providing a circular buffer with a 100m radius around the nest tree. This includes suitable habitat for male roosts, feeding/grooming perches and fledgling requirements. It does not account for foraging habitat. The shape of the buffer can be modified where evidence indicates an alternative shape would better meet the species needs in the context of the assessment site.

As no targeted surveys (e.g. call playback and identification of nest trees) were completed for this dual credit species, breeding habitat has been assumed to be present by identifying suitable habitat. Although no breeding habitat constraints are explicitly identified in BAM-C for this species, the Approved Recovery Plan for Large Forest Owls (DEC 2006) states that the Masked Owl nests in hollows greater than 40cm wide and greater than 100cm deep, with hollow entrances at least 3m above ground, in trees of at least 90cm diameter at breast height. As described in Table 5.3, a species polygon has been mapped for this species by including entire vegetation zones in which hollow-bearing trees were concentrated and contained hollows of a suitable size and height above ground.

Potential breeding habitat is therefore assumed to occur within the following Vegetation Zones as shown in Figure 5.3:

- PCT 594_Moderate;
- PCT 594_Low;
- PCT 596_Moderate;
- PCT 544_Low; and
- PCT 516_Very low.

Given the approach described above, the species polygon for Masked Owl is considered to represent a conservative overestimate of actual/potential breeding habitat, particularly given that this species is generally known to roost and breed in more forested habitats in NSW. The Approved Recovery Plan for Large Forest Owls (DEC 2006) also provides that the Masked Owl prefers unlogged or lightly logged forest with high densities of old hollow trees and avoids young regrowth.

5.7.6 Cicadabird

One individual of the Cicadabird (*Coracina tenuirostris*) was observed within the Subject Land during surveys. A significant impact assessment for the species was undertaken (see Appendix E) and it was concluded that significant impacts on this migratory/marine species are unlikely to result due to the proposed solar farm development. The Cicadabird is not further assessed.

5.7.7 Threatened Aquatic Species

No threatened aquatic species are considered likely to occur within the Development Site.

Threatened species maps prepared by the NSW Department of Primary Industries were reviewed (https://www.dpi.nsw.gov.au/fishing/species-protection/threatened-species-distributions-in-nsw/freshwater-threatened-species-distribution-maps) via the SEED Portal. The following threatened species listed under the NSW Fisheries Management Act have been considered:

- Southern Purple Spotted Gudgeon (*Mogurnda adspersa*): The Subject Land is located within the indicative distribution area of the Southern Purple Spotted Gudgeon, which is listed as Endangered under the FM Act. DPI's indicative distribution map indicates that none of the creeks within the Subject Land are mapped as habitat for the species (see Figure 5.4)The nearest creeks mapped as habitat for the Southern Purple Spotted Gudgeon are:
  - Dumaresq River: it is located at approximately 1.2 km north from the Development Site. This river runs in a general east-west direction.

- Little Oaky Creek: it is located at approximately 1.7 km west from the Development Site. Little Oaky Creek is a tributary of Dumaresq River.
- Crooked Creek: it is located at approximately 4.5 km west from the Development Site and 2.5 km west from Little Oaky Creek. Crooked Creek is a tributary of Dumaresq River.
- Beardy River: is located to the east from the Development Site. The nearest point is located at approximately 3 km from the development footprint. Beardy River runs on a general north-south direction from its convergence with Dumaresq River. None of the first order tributaries of Beardy River are located within the Development Site.

All creeks within the Development Site were dry during the three survey periods in September 2018, December 2019 and March 2019 and have low habitat value for the Southern Purple Spotted Gudgeon.

- Eel Tailed Catfish (*Tandanus tandanus*): The Subject Land is located within the indicative distribution area of the Murray-Darling Basin population of Eel Tailed Catfish (Endangered Population). DPI's indicative distribution map indicates that none of the creeks within the Subject Land are mapped as habitat for the species (see Figure 5.4). The nearest creeks mapped as habitat for the Eel Tailed Catfish are:
  - Dumaresq River: it is located at approximately 1.2 km north from the Subject Land. This river runs in a general east-west direction.
  - Beardy River: is located to the east of the Subject Land. The nearest point is located at approximately 3 km from the development footprint. Beardy River runs on a general north-south direction from its convergence with Dumaresq River. None of the first order tributaries of Beardy River are located within the Subject Land.
- Olive Perchlet (*Ambassis agassizii*): The Development Site is located within the indicative distribution area of the Western Population of Olive Perchlet which is listed as an endangered population under the FM Act. The nearest creeks mapped as habitat for the Olive Perchlet are:
  - Dumaresq River: it is located at approximately 1.2 km north from the Subject Land. This river runs in a general east-west direction.
  - Beardy River: is located to the east from the Subject Land. The nearest point is located approximately 3 km from the development footprint. Beardy River runs on a general north-south direction from its convergence with Dumaresq River. None of the first order tributaries of Beardy River are located within the Subject Land.

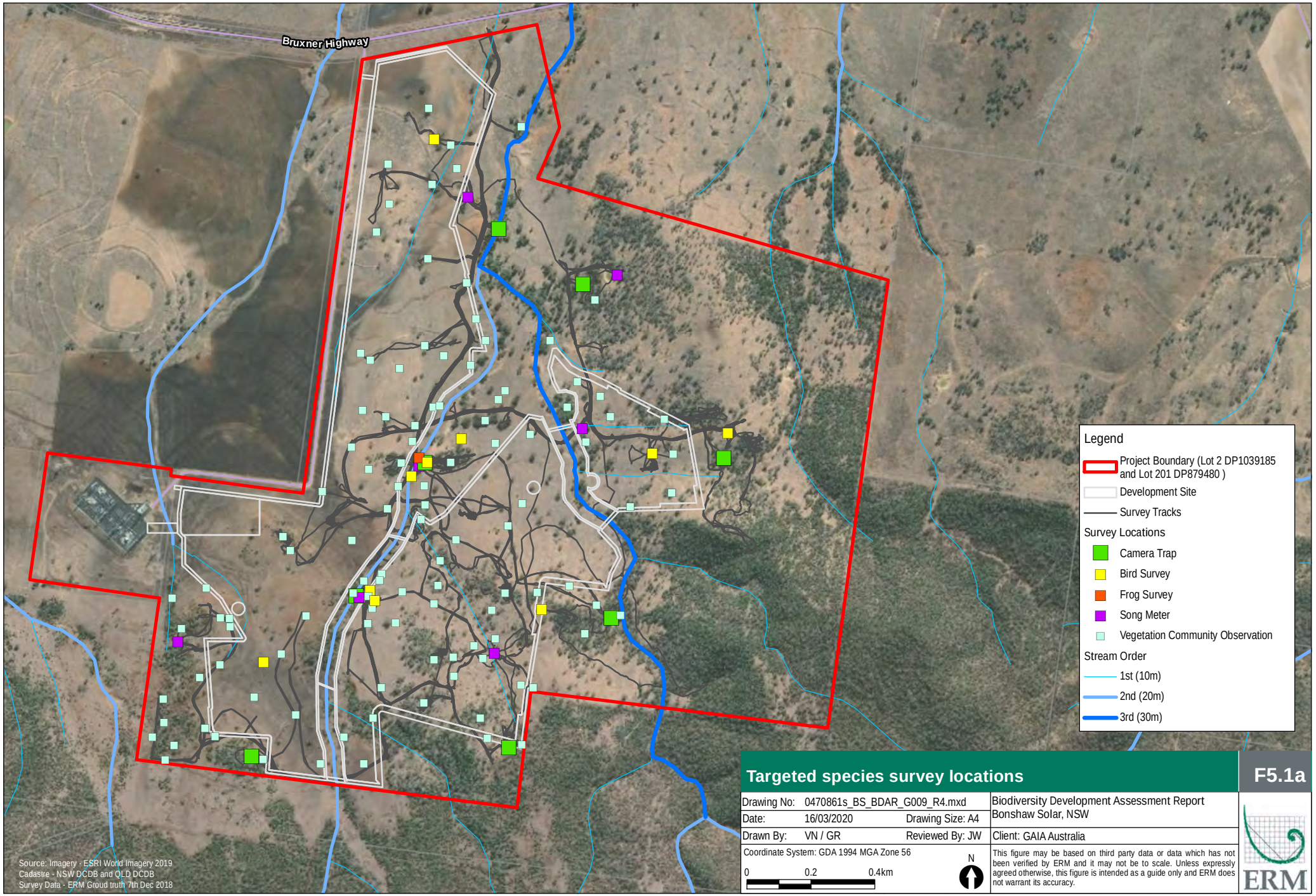
5.8 Limitations To Data

It is possible that some species were not detected on the Subject Land due to surveys being completed outside of the appropriate/recommended survey period for those species. Where survey effort or timing is not consistent with the BAM or relevant guidelines, this is stated explicitly in the assessment and measures identified to address the limitation (e.g. assumed presence of Masked Owl and Barking Owl breeding habitats).

The calculation of hollow-bearings trees, in particular the size and number of hollows, was made from ground level. It is possible that some hollows are present that were not visible from ground level, which may result in underestimates.

The combined impacts of intensive livestock grazing and extended drought period may have altered the visible foliage cover of native grasses, forbs and high threat exotic species. Some native grasses and/or forbs may not have been present/visible at the time of survey. Likewise, some heavily grazed grasses were unidentifiable to species level.

It is also noted that at the time of surveys, all streams were dry and no detailed aquatic assessment has been undertaken on the Subject Land.



Targeted species survey locations

F5.1a

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Date:	16/03/2020	Drawing Size: A4	
Drawn By:	VN / GR	Reviewed By: JW	Client: GAIA Australia

Coordinate System: GDA 1994 MGA Zone 56

0 0.2 0.4km

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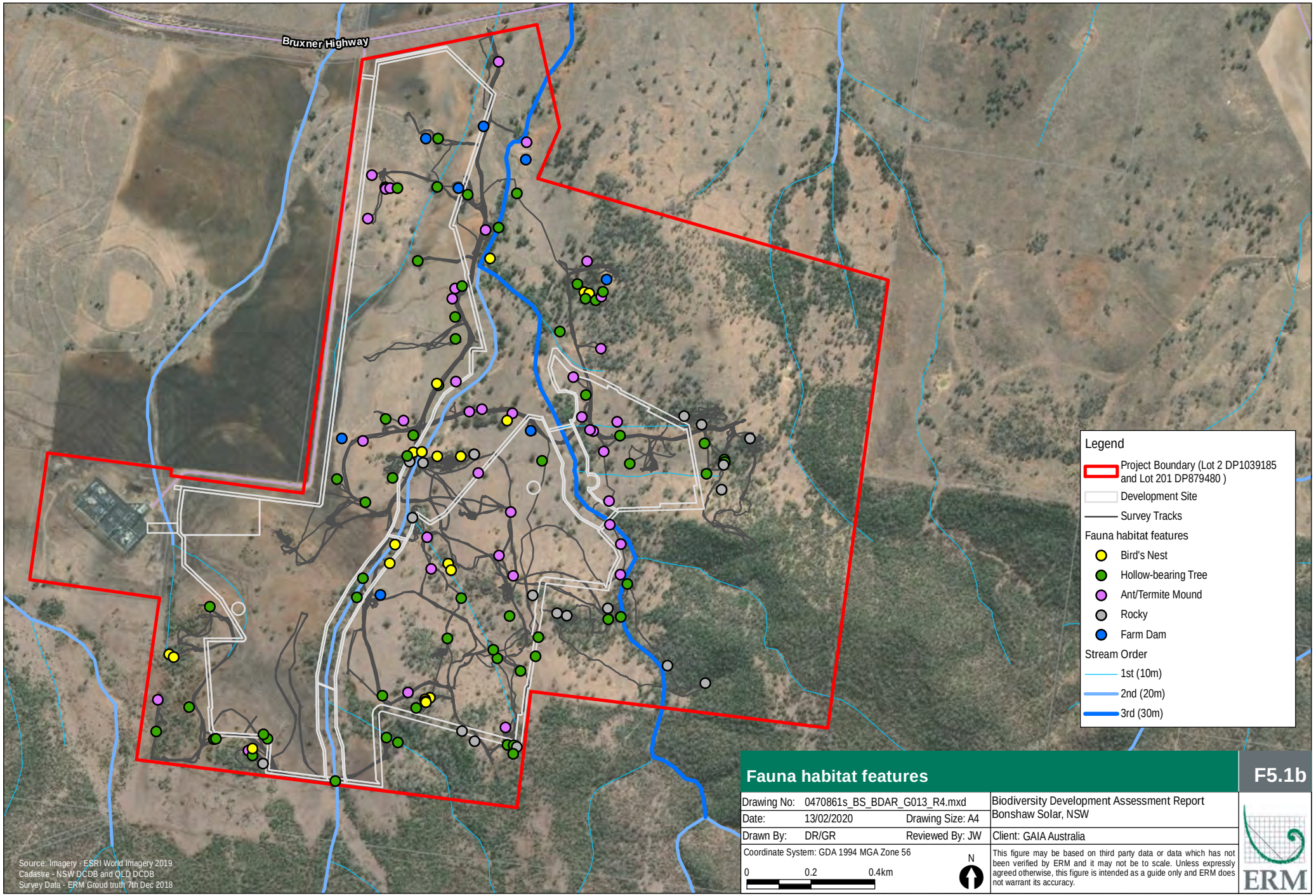
Bruxner Highway
Legend
Project Boundary (Lot 2 DP1039185 and Lot 201 DP879480)
Development Site
Survey Tracks
Fauna habitat features
Bird's Nest
Hollow-bearing Tree
Ant/Termite Mound
Rocky
Farm Dam
Stream Order
1st (10m)
2nd (20m)
3rd (30m)
Source: Imagery - ESRI World Imagery 2019
Cadastre - NSW DCDB and QLD DCDB
Survey Data - ERM Groud truth 7th Dec 2018
Fauna habitat features
F5.1b
Drawing No: 0470861s_BS_BDAR_G013_R4.mxd
Date: 13/02/2020
Drawing Size: A4
Drawn By: DR/GR
Reviewed By: JW
Coordinate System: GDA 1994 MGA Zone 56
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Biodiversity Development Assessment Report
Bonshaw Solar, NSW
Client: GAIA Australia
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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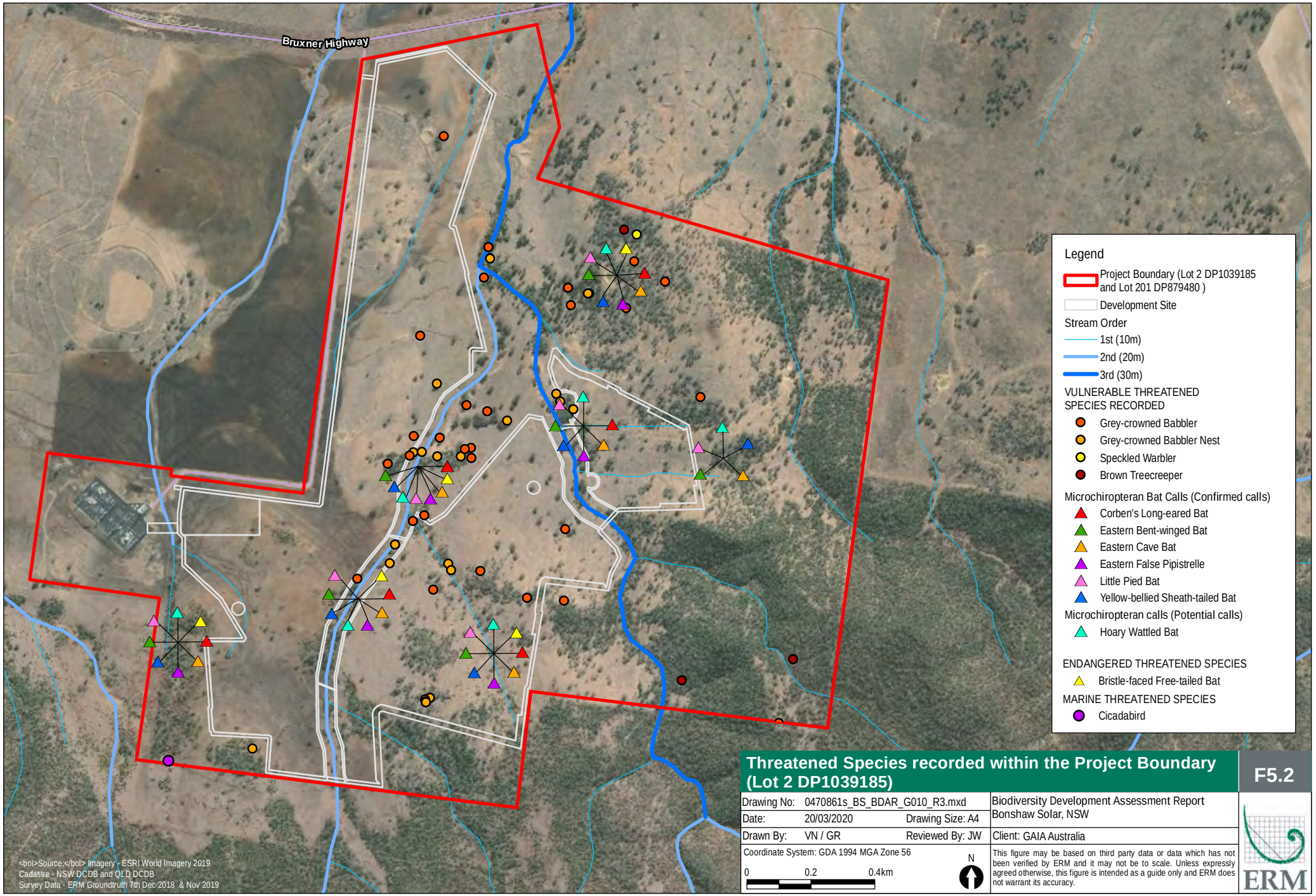

Threatened Species recorded within the Project Boundary (Lot 2 DP1039185)

F5.2

Drawing No:	0470861s_BS_BDAR_G010_R3.mxd		Biodiversity Development Assessment Report Bonshaw Solar, NSW
Date:	20/03/2020	Drawing Size: A4	
Drawn By:	VN / GR	Reviewed By: JW	Client: GAIA Australia

Coordinate System: GDA 1994 MGA Zone 56

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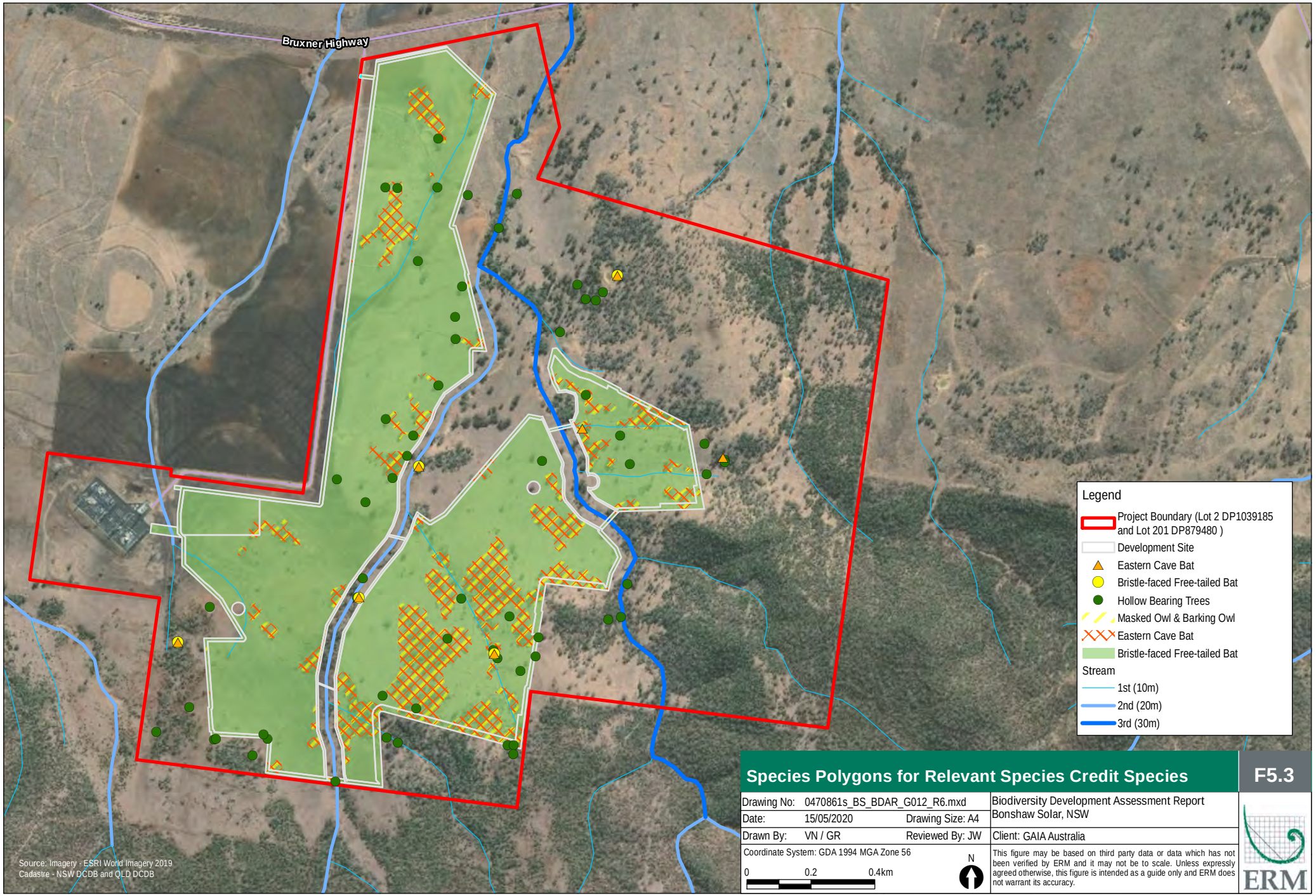

Species Polygons for Relevant Species Credit Species

F5.3

Drawing No:	0470861s_BS_BDAR_G012_R6.mxd		Biodiversity Development Assessment Report Bonshaw Solar, NSW
Date:	15/05/2020	Drawing Size: A4	
Drawn By:	VN / GR	Reviewed By: JW	Client: GAIA Australia

Coordinate System: GDA 1994 MGA Zone 56

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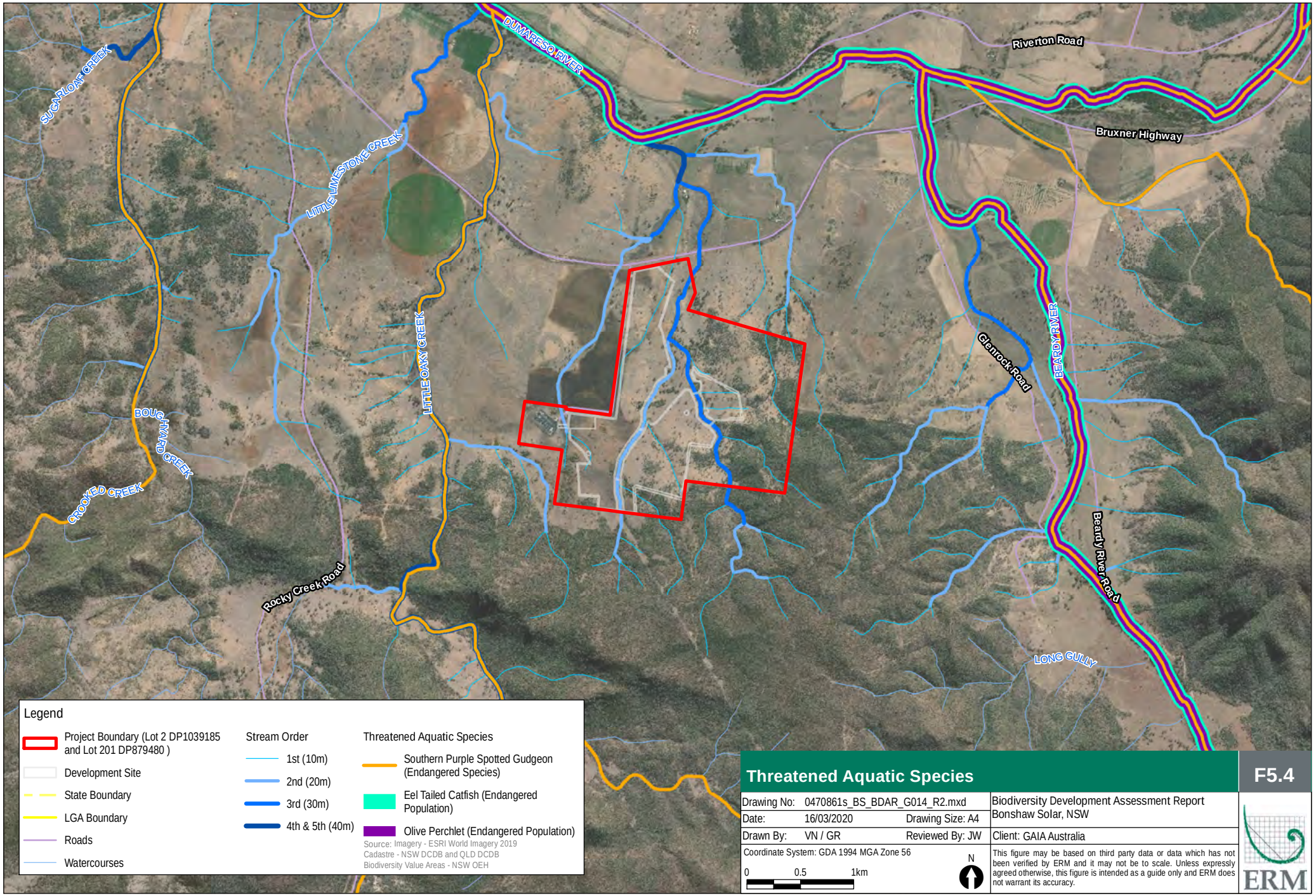
DUMARESQ RIVER
Riverton Road
Bruxner Highway
SUGARLOAF CREEK
LITTLE LIMESTONE CREEK
LITTLE OAKY CREEK
BEARDY RIVER
Glenrock Road
BOUCHARD CREEK
CROOKED CREEK
Rocky Creek Road
Beardy River Road
LONG GULLY
Legend
Project Boundary (Lot 2 DP1039185 and Lot 201 DP879480)
Development Site
State Boundary
LGA Boundary
Roads
Watercourses
Stream Order
1st (10m)
2nd (20m)
3rd (30m)
4th & 5th (40m)
Threatened Aquatic Species
Southern Purple Spotted Gudgeon (Endangered Species)
Eel Tailed Catfish (Endangered Population)
Olive Perchlet (Endangered Population)
Source: Imagery - ESRI World Imagery 2019
Cadastre - NSW DCDB and QLD DCDB
Biodiversity Value Areas - NSW OEH
Threatened Aquatic Species
F5.4
Drawing No: 0470861s_BS_BDAR_G014_R2.mxd
Date: 16/03/2020
Drawing Size: A4
Drawn By: VN / GR
Reviewed By: JW
Coordinate System: GDA 1994 MGA Zone 56
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1km
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Biodiversity Development Assessment Report
Bonshaw Solar, NSW
Client: GAIA Australia
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

STAGE 2: IMPACT ASSESSMENT (BIODIVERSITY VALUES)

6. IMPACT ASSESSMENT (BIODIVERSITY VALUES)

This chapter identifies the potential impacts of the project on the biodiversity values of the Development Site. Measures taken to date to avoid and minimise impacts are summarised and recommendations are provided, which will assist GAIA to design a development that further avoids, minimises and mitigates impacts.

6.1 Avoiding and Minimising Impacts On Native Vegetation and Habitat

As discussed in the EIS, various options relating to location, technology and scale of the project were evaluated in developing the proposal. The site was selected as being a suitable site for a solar plant based on;

- A mostly cleared landscape with minimal vegetation removal required;
- Compatible land use zoning of the land; and
- Proximity to the transmission network.

The development footprint is of a scale that allows for flexibility in the design, allowing ecological and heritage constraints to be avoided (refer to EIS for greater detail on the site selection process).

The Project site has had extensive environmental investigation and assessment which has informed the current concept layout. The layout has been reassessed and reduced to minimise its impact on the environment. Careful consideration of the existing environmental constraints has seen the total development footprint reduced from 1,097 ha (including adjacent Lots to the west and east of the Project Boundary identified during the Preliminary Environmental Assessment) to 149.24 ha.

In terms of biodiversity values, GAIA has undertaken significant steps to avoid, minimise and mitigate impacts, as per the process outlined below:

- Identification of biodiversity values through comprehensive, rigorous and thorough biodiversity surveys;
- Communication of identified values to the project team;
- Consultation between the design team and project ecology leader to consider direct and indirect impacts and work through the design process to achieve a feasible project with the least biodiversity impact; and
- Consultation with BCD, to seek input and discuss measures proposed to avoid and minimise impacts (see Table 1.4).

Through continued detailed design the Project will avoid the following areas of high biodiversity value:

- Avoid the large areas of intact vegetation communities within the eastern and south eastern portion of the Project Boundary;
- Avoid the majority of areas identified as a TEC, with the exception of <1 ha of low condition vegetation representing a TEC. All areas of moderate condition vegetation representing a TEC have been avoided;
- The second and third order watercourses will be avoided through detailed design and survey, with riparian buffers to be applied either side of the streams, measured from the edge of the top of bank. The buffers applied to this BDAR are 20m either side of the second order stream and 30m to either side of the third order streams; and
- Locating ancillary facilities in areas where there are minimal biodiversity values.

Regardless of the above, the proposed development will result in unavoidable impacts to some areas containing native vegetation and habitat values to accommodate the necessary infrastructure associated with the proposal. These impacts are described in the following sections.

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. Prescribed Biodiversity impacts relevant to the proposal are:

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

Prescribed impacts requiring assessment are identified in Section 8.2.1.2 of the BAM (OEH 2017a). How these prescribed impacts have been avoided and minimised by the proposal is detailed in Table 6.1.

Table 6.1 Avoidance and Minimisation of Impacts

Impact	Avoidance/Minimisation Measures	Outcome
Prescribed Impact		
(a) Impacts of development on the habitat of threatened species or ecological communities associated with: ■ (i) karst, caves, crevices, cliffs and other geological features of significance, or ■ (ii) rocks, or ■ (iii) human made structures, or ■ (iv) non-native vegetation	A total of eleven rocky areas were recorded within the Subject Land. Five of these have been avoided by the proposal. Only two outcrops occur in the middle of the cleared paddocks and cannot be avoided by the development footprint. The remaining four may also be avoided during the detailed design and survey of the required riparian buffers and perimeter road. Vegetation within the Development Site comprises 108.03 ha of Cleared Land, Disturbed Grasslands and Dams. These areas were selected to be removed as they represent areas with reduced biodiversity value.	Avoidance of five rocky areas within the Project Boundary. Loss of only two rocky areas located in the centre of the Development Site. Four additional rocky areas likely to be avoided during detailed design.
(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.	The predominantly cleared landscape provides low quality connectivity across the Development Site itself. Isolated trees scattered across the Development Site represent limited connectivity features for highly mobile species to travel across the landscape. The second and third order creeks within the Development Site have some, albeit limited, potential to provide aquatic connectivity to Dumaresq River and have been avoided.	Retention of the second and third order streams which are the landscape features with highest potential as linking corridor.

Impact	Avoidance/Minimisation Measures	Outcome
(c) Impacts of development on movement of threatened species that maintains their life cycle	The predominantly cleared landscape provides low quality connectivity across the Development Site and the movement of the Grey-crowned Babbler largely confined to the woodland habitats and riparian corridors as this species has limited flying capacity. The riparian corridors (with a 20-30m buffer) have been avoided. Regarding the Cicadabird and microchiropteran bats, it is not considered the project will restrict the movement of these highly mobile aerial species and they will continue to utilise retained habitats surrounding the solar farm.	Retention of the second and third order creek lines along which movement of threatened species will continue to occur.
(d) 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)	The second and third order watercourses will be avoided through detailed design (including 20-30m riparian buffer zones measured from the top of bank of the streams). Any waterway crossings required as a result of the Project will be designed in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management and the Policy and Guidelines for Fish Friendly Waterway Crossings. Six farm dams are present within the development site. These farm dams could not be avoided due to the size constraints of the solar panels. These farm dams would be filled in during construction of the solar farm. The impacts proposed to these dams are not anticipated to have any broader impacts for environments that sustain and interact with rivers, streams or wetlands either on or offsite. Appropriate drainage features would be constructed along internal access roads to minimise the risk of polluted water leaving the site or entering water bodies. Ground cover would be maintained beneath the solar arrays and there would be a low risk of contamination in the event of a chemical spill (fuels, lubricants, herbicides etc.) as storage and emergency handling protocols will be implemented.	Avoidance of second and third order creek lines. Loss of six first order creeks and six farm dams.
(e) Impacts of wind turbine strikes on protected animals	Not applicable	Not applicable

Impact	Avoidance/Minimisation Measures	Outcome
(f) Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.	The proposal would not directly increase impacts of vehicle strikes on threatened species. Threatened species would not be funnelled into transport corridors. An increase in vehicle traffic may indirectly increase vehicle strikes on native fauna. Site design would be unlikely to reduce impacts associated with vehicle strikes. Site management to enforce and reduce site speed limits would minimise the likelihood of vehicle strikes.	Increased traffic may indirectly increase vehicle strikes with fauna, including threatened species such as Grey-crowned Babbler.
Impacts to Other Biodiversity Values		
Loss of Species Credit Species Habitat or Individuals	Habitat for the Bristle-faced Free-tailed Bat will be retained within riparian buffers of 2nd and 3rd creek lines. The bat was also detected in one of the first order creeks to be retained. To further avoid impact, vegetation clearance shall only be undertaken outside breeding period for the species to prevent miscarriage in gravid females. Hollow bearing trees within the development footprint will be inspected prior to removal. If this species is confirmed utilising any of the hollow bearing trees, the trees will be left undisturbed until further advice is sought from BCD and a suitably recognised bat expert.	The species polygon for the Bristle-faced Free-tailed Bat occupies the entire Development Site. Offsets will be required to compensate for unavoidable impacts.
Loss of habitat for the Grey-crowned Babbler, Brown Treecreeper and Speckled Warbler	A total of 21 Grey-crowned Babbler nests were recorded across the assessment area, with 13 of these to be avoided. The predominantly cleared landscape provides low quality connectivity across the development site and the movement of the Grey-crowned Babbler is largely confined to woodland areas and riparian corridors. Riparian corridors (including 20-30m buffer) have been avoided. However, there will be some loss of suitable (albeit degraded) woodland habitat for this species and potentially for the Brown Treecreeper and Speckled Warbler (recorded adjacent to Subject Land during investigation of potential offset areas). To further minimise impacts, enhancement of linking corridors along 2nd and 3rd order riparian zones will be provided. This is expected to improve the current fragmented condition of riparian corridors and assist movement and dispersal of these and other fauna species.	Offsets will be required to compensate for unavoidable impacts.

Impact	Avoidance/Minimisation Measures	Outcome
Loss of Hollow Bearing Trees (HBT)	A total of 60 hollow bearing trees were recorded across the assessment area, including 34 HBT within the development footprint. Trees will be planted at a rate of 2:1 with two new trees planted for each HBT removed. A minimum of 68 trees shall be planted within the riparian corridor with commitment to 100% recruitment rate. As naturally formed tree hollows take many decades to develop, nest-boxes suitable for relevant hollow dependent species will be installed prior to HBT removal. Nest boxes shall be installed within suitable retained habitat (e.g. riparian corridors) and will be monitored and maintained during the construction and operational phases of the development.	The impacts of the loss of HBT will be minimised via revegetation and the provision of nest boxes .
Impacts of Development on the Habitat of Threatened Species or Ecological Communities	One TEC was recorded on and adjacent to the Subject Land – White Box Yellow Box Blakely's Red Gum Woodland. Impacts on this TEC have been largely avoided by retaining riparian and buffer areas. Threatened species recorded within the Development Site included the Grey-crowned Babbler and a number of microbats. In addition, Brown Treecreeper and Speckled Warbler were recorded adjacent to the Subject Land during investigation of potential offset areas. Large areas of intact vegetation representing better quality habitat for the above species have been avoided during the design phase of the project. Avoided areas include forest, woodland and riparian habitats. However, there will be some loss of suitable (albeit degraded) habitat for these species.	Implementation of mitigation measures will result in negligible impact on retained habitat of threatened species on and adjacent to the Development Site.
Impacts of Development on the Habitat of EPBC Listed Migratory Species	The project will not result in impacts on habitat of EPBC listed migratory species. One individual of the Cicadabird was recorded within the Development Site. The species occupies several types of vegetation across its range and forages on fruits and insects. No species-specific avoidance measures have been proposed for the Cicadabird. However, measures proposed for other threatened species will enhance roosting habitat and foraging resource availability for this migratory bird.	Implementation of mitigation measures will result in negligible impacts on migratory species.

6.3 Impact that Cannot be Avoided

6.3.1 Direct Impacts

Direct impacts associated with the construction and operational phases of the proposed development are outlined in Table 6.2.

Table 6.2 Direct Impacts to Biodiversity during the Construction and Operational Phases

Nature of Impact	Area of impact	Frequency/Timing	Description of the Impact	Threatened species and habitats likely to be affected
Loss of habitat	Up to approx. 150ha	Construction	Direct removal of native vegetation representing flora and fauna habitat. Direct removal of fallen timber and bush rock representing fauna habitat.	Grey-crowned Babbler and other threatened woodland birds. Microchiropteran bats, such as Bristle-faced Free-tailed Bat.
Displacement of resident fauna	Unknown	Construction and Operation	Direct loss of native fauna from the Subject Land.	Grey-crowned Babbler and other threatened woodland birds. Microchiropteran bats, such as Bristle-faced Free-tailed Bat.
Potential injury or death of fauna	Unknown	Construction and Operation	Injury and/or mortality of fauna during removal of vegetation and other fauna habitat components. Potential decline in local fauna populations.	Resident and dispersing fauna
Removal of important habitat features e.g. Hollow bearing trees	34 trees with hollows to be removed	Construction	Direct loss of native fauna habitat. Injury and mortality of fauna during clearing of fauna habitat and habitat trees.	Hollow dependent fauna, including arboreal mammals (e.g. Possum), microbats and birds
Bush Rock removal and disturbance	Up to six outcrops may be disturbed	Construction	Direct loss of native fauna habitat. Injury and mortality of fauna during clearing of fauna habitat	Reptiles Ground-dwelling mammals
Shading by solar infrastructure	Up to approx. 150ha	Operation	Modification of ecosystem grassland composition.	Flora species

The likely changes in vegetation integrity scores as a result of clearing for the solar array, laydown areas and access roads are documented for each vegetation zone in Table 6.3.

Table 6.3 Current and Future Vegetation Integrity Scores for each Vegetation Zone

Vegetation Zone		PCT	Area of Impact [A]	Vegetation integrity scores	
No	Name			Current	Future
1	594_Moderate	594	4.10	61.3	0
2	594_Low	594	9.54	33.3	0
3	596_Moderate	596	11.15	62.6	0
4	596_Low	596	0.25	38.2	0
5	596_Very Low	596	0.30	23.6	0
6	596_Derived_Low	596	9.04	8	0
7	516_Very Low	516	3.00	20.7	0
8	516_Derived_Moderate	516	2.76	24.7	0
9	544_Low	544	0.83	35	0
10	516_Disturbed Grassland	NA	7.39	15.8	0
11	594_Distrubed Grassland	NA	49.81	11.8	0
12	596_Disturbed Grassland	NA	50.59	5.6	0
13	Cleared Land / Dams	NA	0.48	-	-

6.3.2 Indirect Impacts

Identified indirect impacts that could occur as a result of the project include:

- Increased noise, vibration and dust levels;
- Increased sedimentation and erosion;
- Increased mortality and/or injury of fauna;
- Artificial lighting impacting nocturnal species behaviour; and
- Increase in invasive species, weeds and pathogens.

Table 6.4 Potential Indirect Impacts Associated with the Proposed Development

Nature of Impact	Area of impact	Frequency/ Timing	Description of the Impact and Consequence for Bioregional Persistence	Threatened species and habitats likely to be affected
Increased noise, vibration and dust levels	Development Site	Working hours during the Construction and Operational phases	Construction activities may result in increased levels of noise and vibration. No significant impacts are anticipated as the fauna abundance is low across the development site and largely limited to highly mobile species. A number of Grey-crowned Babblers and one confirmed nest were observed within the Development Site, family groups of the species stay together within their home range (generally 10 ha and up to 50 ha). It is expected that individuals of the local family group would move to roosting nests outside of the Development Footprint. No other threatened species are anticipated to rely on any of the habitats currently present and no sensitive receptors have been identified.	All fauna species, including the Grey-crowned Babblers
Increase sedimentation and erosion	Development Site & Project Boundary	During and following the Construction and Operational Phases	Mobilisation of soils/sediments may occur during inclement weather over disturbed soils and sediments in areas where vegetation has been cleared and/or areas where soil and construction material has been stockpiled. Reduction in watercourse bank stability following any nearby construction and any clearing of riparian vegetation could also result in bank erosion and input of sediments into watercourses.	Aquatic fauna and habitat within the Dumaresq riparian system
Artificial lighting impacting	Development Site & Project Boundary	Night time during the Construction and Operational Phase	The project will require limited permanent night lighting, most likely for the operations and maintenance buildings and substations. Temporary, localised night lighting may be required during general maintenance activities conducted during the operational stage of the project. Lighting has the potential to impact species behaviour. Any impacts are anticipated to be highly localised and are not anticipated to be significant given the low diversity and abundance of fauna recorded within the Development Site.	All fauna, including the Grey-crowned Babbler and microbats
Increase in invasive species	Development Site & Project Boundary	During and following the Construction and Operational Phases	Increased movement of vehicles has the potential to transport weeds and pathogens into the development site and adjacent vegetation. Given the high levels of disturbance within the development site, there is also the risk that weeds may be transported off-site. Infection of native plants by *Phytophthora cinnamomi* is listed as a key threatening process under the BC Act and EPBC Act. *P. cinnamomi* can lead to death of trees and shrubs, resulting in devastation of native ecosystems (DECC 2008). As described by DoE (2014), infection of susceptible communities with *P. cinnamomi* can lead to:	Predation of fauna species, including threatened birds (e.g. Grey-crowned Babbler) and microbats (e.g. Bristle-faced Free-tailed Bat)

Nature of Impact	Area of impact	Frequency/ Timing	Description of the Impact and Consequence for Bioregional Persistence	Threatened species and habitats likely to be affected
			■ changes in the structure and composition of native plant communities; ■ a significant reduction in primary productivity and functionality; and ■ habitat loss and degradation for dependent flora and fauna. Clearing of vegetation and construction of roads provides increased potential for the introduction/spread of invasive pest species. Invasive species can also be unintentionally transported in vehicles and machinery. Monitoring and management of invasive species, such as cats, foxes and cane toads should be completed.	
Impacts to Riparian Habitats	Development Site & Project Boundary	During and following the Construction and Operational Phases	Second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of these streams, measured from the edge of the high bank. This includes a 20m buffer either side of second order streams and 30m either side of third order streams. Furthermore, watercourses within the Development Site are highly disturbed being heavily grazed and eroded. The project is unlikely to result in any increased impact to the aquatic habitat, and the change in land use may improve habitats by reducing stocking rate and revegetating disturbed riparian areas.	Movement of fauna species, including the Grey-crowned Babbler and microbats.
Increased Fragmentation	Development Site	Permanent after clearing	The removal of native vegetation has the potential to result in fragmentation of fauna habitat, with resultant effects on fauna species movement, reproduction and gene flow. The impact of this vegetation clearance in an already highly modified landscape is anticipated to be negligible given that no significant fauna movement corridors currently exist within the development site (excluding riparian corridors).	All fauna species, including the Grey-crowned Babbler and microbats

6.3.3 Prescribed Impacts

Prescribed impacts requiring assessment are identified in Section 8.2.1.2 of the BAM (OEH 2017a). Avoidance of prescribed impacts is discussed in Section 6.2. These are discussed in Table 6.5 below.

Table 6.5 Identification of Prescribed Impacts associated with the Proposed Development

Prescribed Impact	Likely to occur as result of the proposed Solar Farm
(a) Impacts of development on the habitat of threatened species or ecological communities associated with: ■ karst, caves, crevices, cliffs and other geological features of significance, or ■ rocks, or ■ human made structures, or ■ non-native vegetation	A total of eleven rocky areas were recorded within the Development Site. Up to six of these may be impacted by the proposed development. No threatened species were observed, or likely to be dependent on these six outcrops. No threatened species are likely to be dependent on any human made structures or areas of non-native vegetation.
(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.	Isolated paddock trees scattered across the Development Site represent limited connectivity features for highly mobile species to travel across the landscape. A number of these trees would be removed as a result of the proposed development. The Subject Land does not represent a known connectivity link for threatened species and the proposal is therefore unlikely to significantly disrupt the movement of a threatened species across its range. However, the removal of some degraded woodland habitat is likely to represent a minor reduction in the availability of dispersal habitat for the Grey-crowned Babbler and potentially Brown Treecreeper and Speckled Warbler (recorded adjacent to Subject Land during investigation of potential offset areas).
(c) Impacts of development on movement of threatened species that maintains their life cycle	A breeding population of Grey-crowned Babbler have been recorded on the Subject Land. The movement of this species is largely confined to the woodland habitats and riparian corridors as this species has limited flying capacity. Although riparian corridors (with a 20-30m buffer) have been avoided, there will be some impacts to degraded woodland habitat that may facilitate the movement of this species across the Subject Land. Regarding the Cicadabird and microchiropteran bats, it is not considered the project will restrict the movement of these highly mobile aerial species and they will continue to utilise retained habitats adjacent to the solar farm. The Subject Land does not represent a known migratory path for any threatened species. Due to the highly cleared and fragmented landscape the proposal is not likely to disrupt the movement of a threatened species that maintains their lifecycle.

Prescribed Impact	Likely to occur as result of the proposed Solar Farm
(d) 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)	Six farm dams are present within the development site. These farm dams would be filled in during construction of the solar farm. The filling of these dams is not anticipated to have any broader impacts for environments that sustain and interact with the rivers, streams and wetlands either onsite or offsite. These dams are not considered to represent important habitat for any threatened species or ecological community. The proposed development will affect six first order streams which are located within the proposed Development Site. These six first order creeks will be lost permanently. The proposal has the potential to affect surface water quality and quantity due to sediment runoff and/or contaminant runoff into adjacent watercourses. Pollutants to water courses may be associated with vehicle movement, spill of chemicals used for solar panel maintenance/cleaning and maintenance of associated infrastructure.
(e) Impacts of wind turbine strikes on protected animals	Not applicable
(f) Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.	Vehicle strikes may occur during the construction and operational phases of the proposed development given the likelihood of increased vehicle movements.

6.4 Impacts to Matters of National Environmental Significance

An assessment of the impacts of the project on MNES within the Development Site was prepared to determine whether referral of the project to the Commonwealth Minister for the Environment is required. Matters of MNES relevant to the development site are summarised in Table 6.6 below.

A likelihood of occurrence assessment considering each entity individually is provided in Appendix D. Based on the results of the likelihood of occurrence and risk assessment, all TECs and threatened species as identified in the PMST were concluded to have a low residual risk. Given that one individual of the Cicadabird was recorded on the Subject Land, an assessment of significance for the species was undertaken as a precautionary measure (see Appendix E). No additional assessments of significance are considered to be required for other MNES (Appendix D).

Referral of the project to the Commonwealth Minister for the Environment for assessment is not required.

Table 6.6 Assessment of the Project in relation to EPBC Act

MNES	Predicted MNES	Result
Wetlands of International Importance	Three wetlands of national importance were identified as being between 1,100 and 1,300 km form the Development Site: ■ Banrock Station Wetland Complex ■ Riverland ■ The Coorong, and lakes Alexandrina and Albert wetland.	No direct or indirect effects on these wetlands of international importance will result from the proposal.
Threatened Ecological Communities (TECs)	Four TECs were identified as likely to occur within the project area: Natural Grasslands on basalt and fine-textured alluvial plains of northern New South Wales and Southern Queensland (CEEC) New England Peppermint (Eucalyptus nova-anglica) Weeping Myall Woodland (CEEC) Weeping Myall Woodlands (EEC) White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (CEEC)	A likelihood of occurrence analysis was undertaken for these TECs (see Table D.3 in Appendix D). This analysis concluded that the proposed development is unlikely to affect EPBC listed TECs. Although the NSW listing of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland is considered to be represented on the Subject Land by PCT 544, this vegetation does not satisfy the minimum condition criteria for the Commonwealth listing of this TEC. This determination has been made on the basis of very small patch sizes occurring on the Subject Land, low diversity of native understorey species and absence of "important species" as described in the Threatened Species Scientific Committee listing advice and National Recovery Plan (DECCW 2011).
Threatened Species	A total of 36 threatened species were predicted to occur within the project area, including: ■ Eight mammals ■ Seven birds ■ Four reptiles ■ One fish ■ 16 flora	Seven species were identified as likely to occur within the Development Site and were taken into account during survey design. No EPBC listed threatened species have been recorded within the Development Site.
Migratory Species	A total of 11 migratory species were predicted to occur within the project area.	One migratory bird, Cicadabird (*Coracina tenuirostris*), was recorded during the surveys. A Significant Impact Assessment for this migratory species was undertaken (see Appendix E) and it was concluded that the species is unlikely to be significantly impacted as result of the proposed development. No further assessment for the Cicadabird is required.

7. MANAGEMENT AND MITIGATION MEASURES

The key measures required to mitigate the impacts of the proposal is provided below in Table 7.1.

Table 7.1 Recommended Mitigation Measures for Residual Impacts

Impact	Mitigation Measure	Responsibility	Timing	Reporting
Loss of Species Credit Species Habitat or Individuals	Vegetation clearance: ■ Preparation and implementation of a vegetation clearing protocol. ■ Clearing to be supervised by an experienced fauna catcher / ecologist. ■ Time works to avoid critical life cycle events such as breeding. ■ Monitoring of tree hollows prior to removal to avoid impacting any breeding females or juveniles. If Bristle-cased Freetail Bat is confirmed utilising any of the hollow bearing trees, the trees will be left undisturbed and managed in accordance with the Biodiversity Management Plan. ■ Replacement of trees at a rate of 2:1 (i.e. two trees will be planted to replace each hollow bearing tree removed). A minimum of 68 trees will be planted within the riparian corridor with commitment to a 100% recruitment rate. ■ Nest-boxes suitable for hollow dependent microbats will be installed prior to HBT removal. Nest boxes shall be installed within suitable retained habitat (e.g. riparian corridors) and will be monitored and maintained during the construction and operational phases of the development.	■ Principal contractor to ensure implementation of vegetation clearing protocol. ■ Experienced fauna catcher / Ecologist to supervise clearing and relocate native fauna.	■ Vegetation clearing protocol to be prepared by an Ecologist prior to vegetation clearing. ■ Clearing supervision to occur during the entire clearing process. ■ Letter with results of clearing to be prepared by the fauna catcher/Ecologist supervising the clearance. Letter to be available for review by delegated authority (if requested).	Vegetation Clearing Protocol as part of the Biodiversity Management Plan

Impact	Mitigation Measure	Responsibility	Timing	Reporting
	■ No stockpiling or storage within dripline of any mature trees. ■ Approved clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing.			
Grey-crowned Babbler habitat	Nest removal: ■ Approved clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing. ■ Removal of trees with nests will be included in the vegetation clearing protocol including any seasonal constraints to avoid impacting any juveniles or unfledged chicks. ■ Removal of trees with nests will be supervised by an experienced fauna catcher or ecologist. ■ A portion of felled trees will be salvaged as habitat for fauna and translocated in suitable areas in the remainder of the Project Boundary.	■ Principal contractor to ensure implementation of vegetation clearing protocol. ■ Experienced fauna catcher / Ecologist to supervise clearing and relocate native fauna	■ Clearing supervision to occur during the entire clearing process. ■ Letter with results of clearing to be prepared by the fauna catcher/Ecologist supervising the clearance. Letter to be available for review by delegated authority (if requested).	Vegetation Clearing Protocol as part of the Biodiversity Management Plan

Impact	Mitigation Measure	Responsibility	Timing	Reporting
Loss of Hollow Bearing Trees	■ Replacement of trees at a rate of 2:1 (i.e. two trees will be planted to replace each hollow bearing tree removed). A minimum of 68 trees will be planted within the riparian corridor with commitment to a 100% recruitment rate. ■ Nest-boxes suitable for hollow dependent microbats will be installed prior to HBT removal. Nest boxes shall be installed within suitable retained habitat (e.g. riparian corridors) and will be monitored and maintained during the construction and operational phases of the development.	■ GAIA to appoint a qualified ecologist for preparation of the monitoring plan. ■ GAIA to liaise with relevant authority regarding outcomes. ■ Appointed Ecologist to undertake monitoring as required.	■ Monitoring Plan to be prepared and approved prior to commencement of clearing. ■ Monitoring to be implemented as required.	Tree Replacement and Nest Box Monitoring Plan as part of the Biodiversity Management Plan
Impacts of Development on the Habitat of Threatened Species or Ecological Communities	■ A tree replacement and nest box monitoring plan will be prepared for the Project. The plan will provide details of monitoring and Key Performance Indicators (KPIs) to ensure objectives of tree replacement and nest box monitoring is achieved. ■ Monitoring and reporting to be undertaken by a qualified ecologist. Avoidance of use of chemicals, such as pesticides and herbicides, within the solar farm during the construction and operational phases to prevent contributing to the global decline in insect population and diversity. ■ Facilitation of natural regeneration of native ground cover within viable solar farm footprint (e.g. under solar panel arrays) and in retained areas. This will include management of weeds.	■ GAIA to appoint a qualified ecologist for preparation of the monitoring plan. ■ GAIA to liaise with relevant authority regarding outcomes. ■ Appointed Ecologist to undertake monitoring as required.	■ Monitoring Plan to be prepared and approved prior to commencement of clearing. ■ Monitoring to be implemented as required.	Tree Replacement and Nest Box Monitoring Plan as part of the Biodiversity Management Plan

Impact	Mitigation Measure	Responsibility	Timing	Reporting
Impacts of Development on the Habitat of EPBC Listed Migratory Species	None required	NA	NA	NA
Impacts of Development on Water Quality, Water Bodies and Hydrological Processes that sustain Threatened Species and TECs	■ An erosion and sediment control plan (ESCP) would be prepared in conjunction with the final design and implemented. ■ Design of creek crossings to meet best practice industry standards. ■ ESCP to include requirements for water quality monitoring, chemical use and control.	■ GAIA has overall responsibility to ensure meeting that they are meeting environmental commitments.	■ ESCP to be prepared and approved prior to commencement of works. ■ Reporting, evaluation and auditing as per the ESCP.	CEMP ESCP
Impacts of Vehicle Strikes on Threatened Species of animals or on animals that are part of a TEC	Actions to minimise mortality of wildlife involved in vehicle strikes: ■ Appropriate vehicle speeds and signage to be installed within the solar farm. ■ Protocol detailing actions to be undertaken in the event of a vehicle strike. ■ Identification of a wildlife veterinary and/or wildlife carer group and agreement for injured wildlife to be taken care of or being humanely euthanised.	■ GAIA has overall responsibility to ensure meeting that they are meeting environmental commitments.	■ CEMP to be prepared and approved prior to commencement of works. ■ Reporting, evaluation and auditing as per the CEMP.	CEMP
	■ Avoid night works. ■ Direct lights away from retained native vegetation.	■ GAIA has overall responsibility to ensure meeting that they are meeting environmental commitments.	■ CEMP to be prepared and approved prior to commencement of works. ■ Reporting, evaluation and auditing as per the CEMP.	CEMP

Impact	Mitigation Measure	Responsibility	Timing	Reporting
Invasive Species	■ CEMP will include a Management protocol for declared priority weeds under the *Biosecurity Act 2015* during and after construction. ■ Hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas. ■ Monitoring and management protocol for invasive feral/pest species, including cats, foxes and cane tods.	■ GAIA has overall responsibility to ensure meeting that they are meeting environmental commitments.	■ CEMP to be prepared and approved prior to commencement of works. ■ Reporting, evaluation and auditing as per the CEMP.	CEMP

8. SERIOUS AND IRREVERSIBLE IMPACTS (SAII)

A Serious and Irreversible Impact (SAII) is listed under the BC Act as an impact that is likely to contribute significantly to the risk of extinction of a threatened entity.

In accordance with the BAM, species and ecological communities with a 'very high' biodiversity risk weighting will be a potential serious and irreversible impact (SAII). Whenever potential SAII are identified for a Development Site, those SAII need to be address as per Section 10.2 of the BAM (OEH 2017a).

The following guidelines were consulted to identify potential SAII:

- OEH (2017b) *Guidance to assist a decision-maker to determine a serious and irreversible impact*.
- OEH (2018b) '*Species Credit' threatened bats and their habitats guide*.

8.1 Potential Serious and Irreversible Impact Entities

Based on candidate ecosystem credit species, species credit species and results of field surveys, the potential SAII for the Development Site are listed in Table 8.1 below.

Table 8.1 Potential SAII within the Development Site

Scientific Name Common Name	Justification as potential SAII	Corresponding habitat constraint	Is SAII present?
Miniopterus orianae oceanensis Large Bent-winged Bat	The species is dependent on non-responding attribute (breeding habitat only) (OEH 2017b)	Caves are the primary breeding habitat for the Eastern Bentwing Bat. Breeding habitat does not occur on the Subject Land.	No
Vespadelus troughtoni Eastern Cave Bat	Breeding habitat is classified as SAII (OEH 2018b)	Breeding habitat for the species is caves, overhangs, crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within the potential habitat. Breeding habitat is not considered to occur on the Subject Land.	No
White Box Yellow Box Blakely's Red Gum Woodland	Threatened Ecological Community with very high sensitivity to loss due to small population size (extent)	Fertile lower footslopes and flats. This TEC is represented onsite by PCT 544 which is associated with stream banks, beds and channels. Riparian areas associated with this TEC have largely been avoided.	No

8.1.1 Threatened Ecological Communities

One threatened ecological community, that is a candidate for serious and irreversible impacts, was identified on the Subject Land – White Box Yellow Box Blakely's Red Gum Woodland. This TEC is represented on the Subject Land by disturbed areas of PCT 544 – Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion of New England Tableland Bioregion. The majority of this TEC has been avoided by retaining riparian corridors and associated buffers. The proposed development is not considered to represent a SAII on this TEC as impacts on 0.83 ha of highly disturbed vegetation representing PCT 544 are unlikely to contribute to the risk of extinction of the TEC. This TEC will be allowed to naturally regenerate within retained riparian areas and buffers. Infill plantings will also be provided that will expand the extent of this TEC on the Subject Land and improve its current condition.

8.1.2 Threatened Species

Two potential SAII entities were identified, the Eastern Bentwing Bat and the Eastern Cave Bat. The echolocation calls of these species were recorded within the assessment area. However, breeding habitat for these microbat species, i.e. caves, overhangs crevices, cliffs or escarpments, are not present on the Subject Land. It is concluded that due to the lack of suitable breeding habitat, the Subject Land represents foraging habitat only. Therefore, the proposed development does not represent a SAII on these species.

8.1.3 Additional Potential Entities

No other threatened species or communities, were identified as potential candidates for serious and irreversible impacts.

8.2 Assessment of SAII

The proposed development is not considered to represent a serious and irreversible impact on any identified SAII entities.

9. REQUIREMENT TO OFFSET

This chapter provides an assessment of the impacts requiring offsetting in accordance with Section 10 of the BAM (OEH 2017a).

9.1 Impacts Requiring an Offset

9.1.1 Impacts on Native Vegetation – Ecosystem Credits

Impacts to native vegetation requiring offsets include:

- Direct impacts on PCT 516 – Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion;
- Direct impacts on PCT 544 – Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion;
- Direct impacts on PCT 594 – Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion; and
- Direct impacts on PCT 596 – Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion

A total of 598 ecosystem credits are required to offset impacts of the proposed development. The impacts on the vegetation zones within each of the four PCTs is shown in Table 9.1.

Table 9.1 Summary of Ecosystem Credits

Vegetation Zone Number	Vegetation Zone Name	Area (ha)	Vegetation Integrity Score	Future Vegetation Integrity Score	Change in Vegetation Integrity Score	Credits Required
PCT 594 – Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion						
1	594_Moderate	4.1	61.3	0	-61.3	110
2	594_Low	9.54	33.3	0	-33.3	139
					Total Ecosystem Credits required to offset impacts on PCT 594	249
PCT 596 – Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion						
3	596_Moderate	11.15	62.6	0	-62.6	262
4	596_Low	0.25	38.2	0	-38.2	4
5	596_Very Low	0.30	23.6	0	-23.6	3
					Total Ecosystem Credits required to offset impacts on PCT 596	269

Vegetation Zone Number	Vegetation Zone Name	Area (ha)	Vegetation Integrity Score	Future Vegetation Integrity Score	Change in Vegetation Integrity Score	Credits Required
PCT 516 – Grey Box grassy woodland or open forest of the Nandewar Bioregion of New England Tableland Bioregion						
7	516_Very Low	3.00	20.7	0	-20.7	31
8	516_Derived_Moderate	2.76	24.7	0	-24.7	34
					Total Ecosystem Credits required to offset impacts on PCT 516	65
PCT 544 – Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion of New England Tableland Bioregion						
9	544_Low	0.83	35	0	-35	15
					Total Ecosystem Credits required to offset impacts on PCT 544	15

9.1.2 Impacts on Threatened Species – Species Credits

Impacts to habitat of Threatened Species requiring offsets include:

- Habitat for the Bristle-faced Free-tailed Bat in PCTs 516, 544, 594 and 596, requiring 1,180 species credits;
- Foraging habitat for Eastern Cave Bat in PCTs 516, 544, 594 and 596, requiring 1,030 species credits; and
- Potential (assumed) breeding habitat for Masked Owl and Barking Owl in PCTs 516, 544, 594 and 596, where suitably sized hollows occur, requiring 680 species credits for each of these species.

A total of 3,570 species credits are required to offset loss of fauna habitat within the Development Site.

9.1.3 Offsets Required Under the EPBC Act

No offsets requirements under the EPBC Act have been identified for the proposed development.

9.2 Impacts Not Requiring an Offset

In accordance with the BAM, an offset is not required for impacts on native vegetation where the vegetation integrity score is below those set out in Paragraph 10.3.1.1. These thresholds are as follows:

a) A vegetation zone that has a vegetation integrity score <15 where the PCT is representative of an endangered or critically endangered ecological community, or

b) A vegetation zone that has a vegetation integrity score <17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community, or

c) A vegetation zone that has a vegetation integrity score <20 where the PCT is not representative of a TEC or associated with threatened species habitat.

Areas of the Subject Land that are not required to be offset in accordance with the thresholds described above are provided in Table 9.2. These vegetation zones represent highly disturbed areas, including cleared areas, heavily grazed grasslands and low integrity derived grasslands.

Table 9.2 Summary of Impacts on Vegetation Not Requiring Offsets

Vegetation Zone Number	Vegetation Zone Name	Area (ha)	Vegetation Integrity Score	Future Vegetation Integrity Score	Change in Vegetation Integrity Score	Credits Required
PCT 596 – Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion						
6	596_Derived_Low	9.04	8	0	-8	0
12	596_Disturbed Grasslands	50.59	5.6	0	-5.6	0
PCT 594 – Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion						
11	594_Disturbed Grasslands	49.81	11.8	0	-11.8	0
PCT 516 – Grey Box grassy woodland or open forest of the Nandewar Bioregion of New England Tableland Bioregion						
10	516_Disturbed Grassland	7.39	15.8	0	-15.8	0

9.3 Summary of Offset Credits Required

The proposed development will incur loss of native vegetation and threatened fauna habitat requiring offsets for a total of 598 ecosystem credits and 3,570 species credits.

9.4 Biodiversity Offset Framework

This section outlines several options that are available to proponents to offset project related impacts on biodiversity in accordance with the Biodiversity Offset Scheme (BOS). The final offset strategy for the project is yet to be developed. However, GAIA is committed to satisfying all offset requirements prior to the commencement of works (including bulk earthworks and vegetation removal).

In accordance with the BOS, proponents may use one or more of the following methods to satisfy an offset requirement:

- Purchasing credits: Identify and purchase the required ‘like for like’ credits in the market and then retire those credits via Biodiversity Offsets and Agreement Management System (BOAMS).
- Generating credits: Identify potential offset land containing the biodiversity values required to be offset. Generate credits by applying the BAM and placing a Biodiversity Stewardship Agreement (BSA) on proposed offset land.

- Offsets Payment Calculator: Determine the cost of the credit obligation and transfer this amount to the Biodiversity Conservation Fund via the BOAMS. The Biodiversity Conservation Trust is then responsible for identifying and securing the credit obligation.
- Submit approval to the consent authority to apply variation rules. This excludes impacts on threatened species and TECs.

Given that impacts on threatened species habitat are associated with the proposed development, variation rules are not applicable to the Bonshaw Solar Farm development. GAIA will use one, or a combination, of the first three options above to meet the offset obligation.

The BAM Biodiversity Credit Report (like-for-like) detailing requirements for offsetting impacts on PCTs (i.e. 516, 544, 594 and 596) and threatened fauna habitat (i.e. Bristle-faced Free-tailed Bat, Eastern Cave Bat, Barking Owl and Masked Owl) is provided in Appendix K.

10. CONCLUSIONS

GAIA is proposing to develop a solar farm in disturbed land located in Lot 2 DP 1039185 (Project Boundary), Bonshaw within the Inverell LGA. The Development Site is located in the western portion of the Project Boundary and will occupy approximately 149.24 ha. The purpose of this BDAR was to address the requirements of the BAM and to address the biodiversity matters raised in the SEARs.

Based on the results of extensive field surveys, a total of 12 vegetation zones were identified on the Subject Land pertaining to the following four plant community types (PCTs):

- PCT 516 – Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion;
- PCT 544 - Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest/woodland of the Nandewar Bioregion and New England Tableland Bioregion;
- PCT 594 – Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion; and
- PCT 596 – Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion.

PCT 544 is considered to represent the following Threatened Ecological Community, which is listed as Endangered under the NSW *Biodiversity Conservation Act 2016:*

- White Box Yellow Box Blakely's Red Gum Woodland

The occurrence of this TEC on the Subject Land is not considered to satisfy the minimum condition criteria for the Commonwealth listing of this TEC. This determination has been made on the basis of very small patch sizes occurring on the Subject Land, low diversity of native understorey species and absence of “important species” as described in the Threatened Species Scientific Committee listing advice and National Recovery Plan for the TEC.

An assessment of the potential impacts on the biodiversity values of the Subject Land has identified the following direct impacts to native vegetation requiring offset:

- Impacts on PCT 516 – Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion, requiring 65 ecosystem credits;
- Impacts on PCT 544 - Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest/woodland of the Nandewar Bioregion and New England Tableland Bioregion, requiring 15 ecosystem credits;
- Impacts on PCT 594 – Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion ad Nandewar Bioregion, requiring 249 ecosystems credits; and
- Impacts on PCT 596 – Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion, requiring 269 ecosystem credits

A total of 598 ecosystem credits are required to offset the impacts of the project.

A total of thirteen threatened fauna species were recorded within the Project Boundary. Threatened species included eight vulnerable microchiropteran bats (Little Pied Bat, Eastern Bent-wing Bat, Corben’s Long-eared Bat, Yellow-bellied Sheath-tailed Bat, Eastern Cave Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat and Hoary Wattled Bat), one endangered microchiropteran bat (Bristle-faced Free-tailed bat), three vulnerable birds (Grey-crowned Babbler, Brown treecreeper and Speckled Warbler) and one migratory bird (Cicadabird). Out of the eight Vulnerable microchiropteran bats, six were recorded as “definite” calls and two (Greater Broad-nosed Bat and Hoary Wattled Bat) were recorded as “possible” calls by a microbat call identification expert. Brown Treecreeper and Speckled Warbler were recorded within the Project Boundary but not directly on the Subject Land.

Impacts on threatened fauna habitat generated the following species credits:

- Bristle-faced Free-tailed Bat, requiring a total of 1,180 species credits;
- Eastern Cave Bat, requiring a total of 1,030 species credits;
- Masked Owl, requiring a total of 680 species credits; and
- Barking Owl, requiring a total of 680 species credits.

The proposed Bonshaw Solar Farm development in its current footprint requires a total offset of 598 ecosystem credits and 3,570 species credits. Retirement of these credits will be carried out in accordance with the *Biodiversity Conservation Regulation 2017* and the NSW Biodiversity Offsets Scheme.

11. REFERENCES

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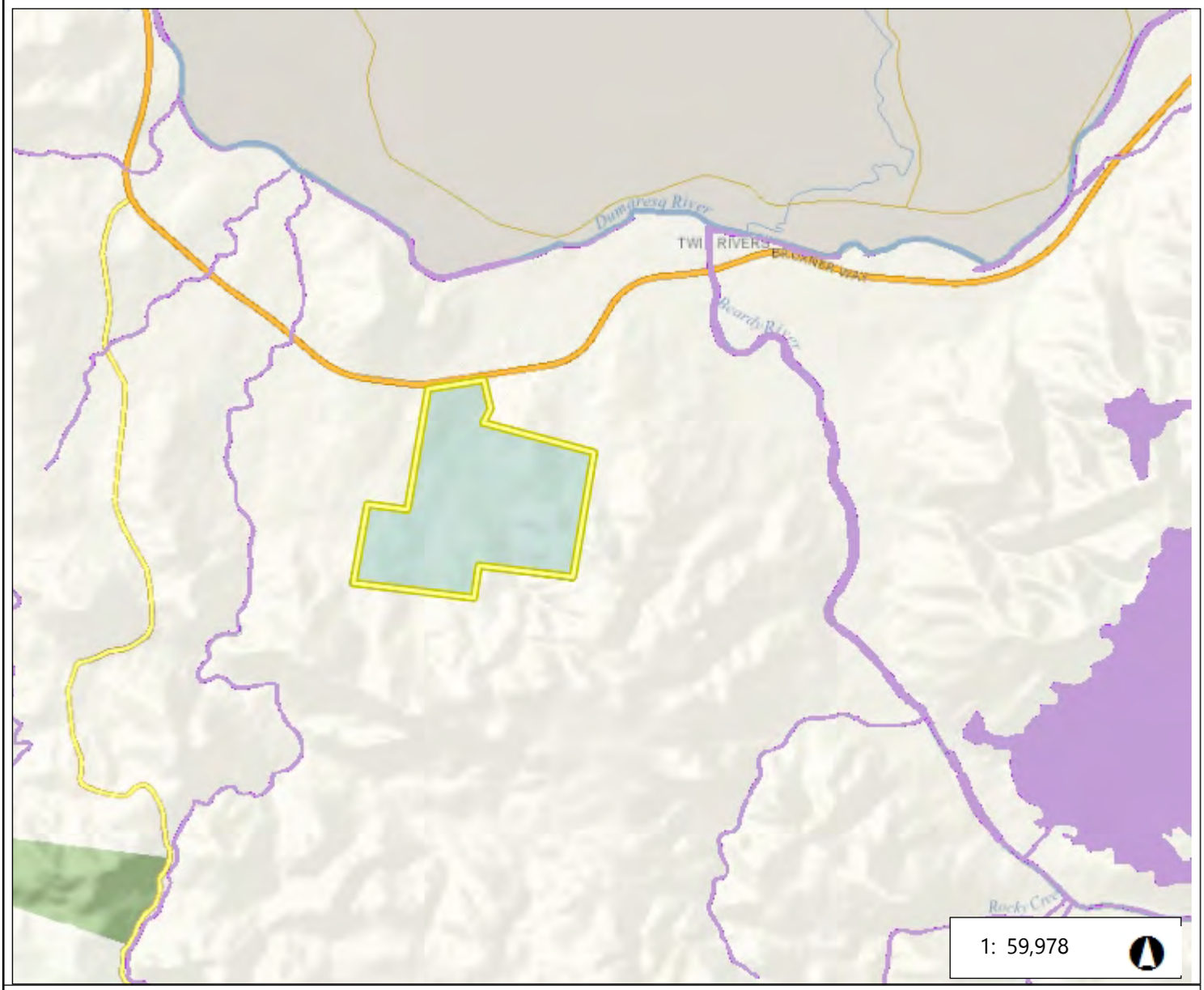
APPENDIX A BOSET REPORT

Biodiversity Offset Scheme (BOS) Entry Threshold Map



3.0 0 1.52 3.0 Kilometers

GCS_GDA_1994

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Legend

- Biodiversity Values that have been mapped for more than 90 days
- Biodiversity Values added within last 90 days

Notes

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Biodiversity Values Map and Threshold Report

Results Summary

Date of Calculation	08/01/2019 10:12 AM	**BDAR Required***
Total Digitised Area	356.35 ha	
Minimum Lot Size Method	Lot size	
Minimum Lot Size	199.02 ha	
Area Clearing Threshold	1 ha	
Area clearing trigger Area of native vegetation cleared	Unknown #	Unknown #
Biodiversity values map trigger Impact on biodiversity values map(not including values added within the last 90 days)?	no	no

*If BDAR required has:

- at least one 'Yes': you have exceeded the BOS threshold. You are now required to submit a Biodiversity Development Assessment Report with your development application. Go to https://customer.lmbc.nsw.gov.au/assessment/AccreditedAssessor to access a list of assessors who are accredited to apply the Biodiversity Assessment Method and write a Biodiversity Development Assessment Report
- 'No': you have not exceeded the BOS threshold. You may still require a permit from local council. Review the development control plan and consult with council. You may still be required to assess whether the development is '"likely to significantly affect threatened species' as determined under the test in s. 7.3 of the Biodiversity Conservation Act 2016. You may still be required to review the area where no vegetation mapping is available.

Where the area of impact occurs on land with no vegetation mapping available, the tool cannot determine the area of native vegetation cleared and if this exceeds the Area Threshold. You will need to work out the area of native vegetation cleared - refer to the BOSET user guide for how to do this.

Disclaimer

This results summary and map can be used as guidance material only. This results summary and map is not guaranteed to be free from error or omission. The State of NSW and Office of Environment and Heritage and its employees disclaim liability for any act done on the information in the results summary or map and any consequences of such acts or omissions. It remains the responsibility of the proponent to ensure that their development application complies will all aspects of the *Biodiversity Conservation Act 2016.*

The mapping provided in this tool has been done with the best available mapping and knowledge of species habitat requirements. This map is valid for a period of 30 days from the date of calculation (above).

Acknowledgement

I as the applicant for this development, submit that I have correctly depicted the area that will be impacted or likely to be impacted as a result of the proposed development.

Signature_____ Date:08/01/2019 10:12 AM

APPENDIX B NSW BIONET ATLAS RECORDS

Results of search of existing records of threatened species and Threatened Ecological Communities (TECs) in the NSW BioNet Atlas is summarised in Table B.1 below.

Table B.1 BioNet Atlas results

Family	Scientific Name	Common Name	NSW status	Comm. status	Records within 10km radius
Reptilia					
Gekkonidae	*Uvidicolus sphyrurus*	Border Thick-tailed Gecko	V	V	1
Aves					
Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	V		1
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	V		2
Psittacidae	*Neophema pulchella*	Turquoise Parrot	V		6
Climacteridae	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subspecies)	V		2
Acanthizidae	*Chthonicola sagittata*	Speckled Warbler	V		2
Pomatostomidae	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V		3
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	V		1
Artamidae	*Artamus cyanopterus cyanopterus*	Dusky Woodswallow	V		1
Petroicidae	*Petroica boodang*	Scarlet Robin	V		1
Estrildidae	*Stagonopleura guttata*	Diamond Firetail	V		2
Mammalia					
Phascolarctidae	*Phascolarctos cinereus*	Koala	V	V	9
Petauridae	*Petaurus norfolcensis*	Squirrel Glider	V		1
Macropodidae	*Petrogale penicillata*	Brush-tailed Rock-wallaby	E	V	1
Vespertilionidae	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V		1

Family	Scientific Name	Common Name	NSW status	Comm. status	Records within 10km radius
Vespertilionidae	*Miniopterus orianae oceanensis*	Eastern Bentwing-bat	V		1
Vespertilionidae	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V		2
Flora					
Araliaceae	*Astrotricha roddii*	Rodd's Star Hair	E	E	12
Asteraceae	*Rutidosis heterogama*	Heath Wrinklewort	V	V	1
Fabaceae (Faboideae)	*Swainsona sericea*	Silky Swainson-pea	V		1
Myrtaceae	*Eucalyptus caleyi subsp. ovendenii*	Ovenden's Ironbark	V	V	1
Myrtaceae	*Eucalyptus nicholii*	Narrow-leaved Black Peppermint	V	V	1

Notes: V = Vulnerable; E = Endangered

APPENDIX C MATTERS OF NATIONAL SIGNIFICANCE ASSESSMENT – PMST REPORT

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

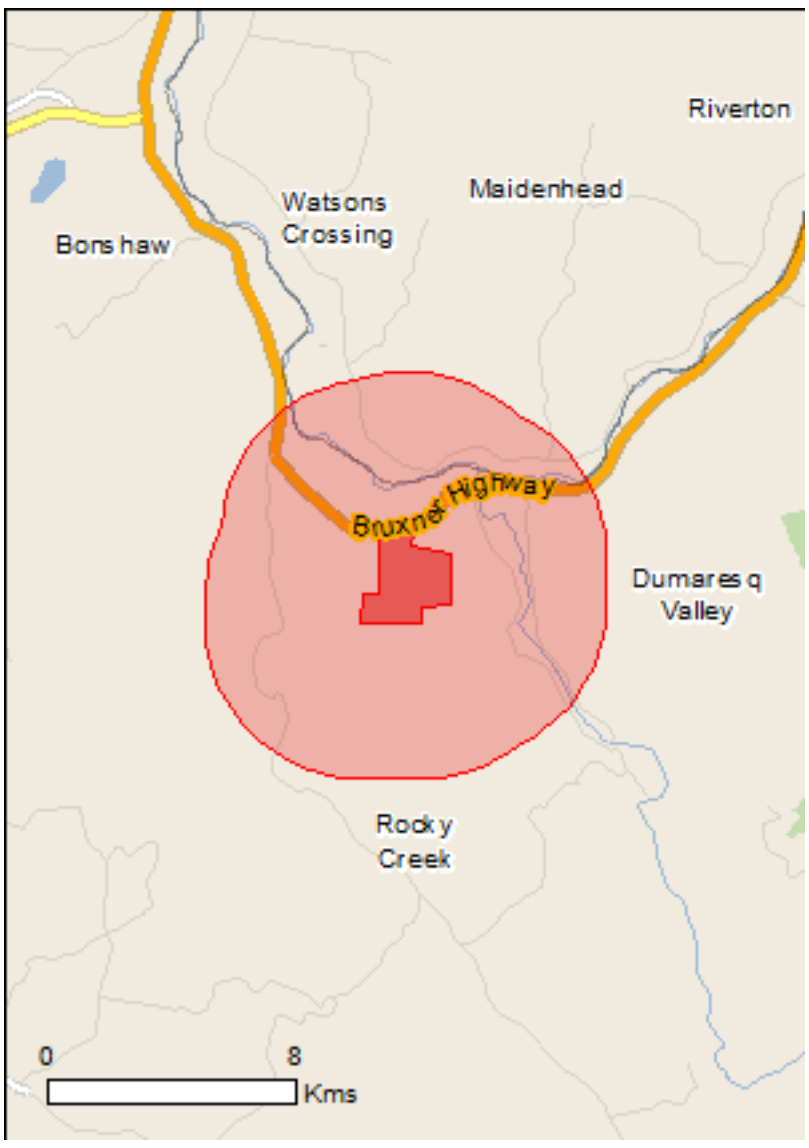
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 08/01/19 09:21:50

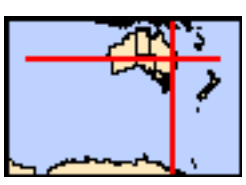
Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 5.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	36
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	1
Invasive Species:	19
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Banrock station wetland complex	1100 - 1200km
Riverland	1100 - 1200km
The coorong, and lakes alexandrina and albert wetland	1300 - 1400km

Listed Threatened Ecological Communities		[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community likely to occur within area
New England Peppermint (Eucalyptus nova-anglica) Grassy Woodlands	Critically Endangered	Community may occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Fish		
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat known to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat likely to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Plants		
Acacia pubifolia Velvet Wattle [19799]	Vulnerable	Species or species habitat may occur within area
Astrotricha roddii [56312]	Endangered	Species or species habitat known to occur within area
Boronia granitica Granite Boronia [18598]	Endangered	Species or species habitat may occur within area
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area
Callistemon pungens [55581]	Vulnerable	Species or species habitat likely to occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus caleyi subsp. ovendenii Ovenden's Ironbark [56193]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus mckieana McKie's Stringybark [20199]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus nicholii Narrow-leaved Peppermint, Narrow-leaved Black Peppermint [20992]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Homopholis belsonii Belson's Panic [2406]	Vulnerable	Species or species habitat may occur within area
Lepidium peregrinum Wandering Pepper-cress [14035]	Endangered	Species or species habitat may occur within area
Leucopogon confertus Torrington Beard-heath [14417]	Endangered	Species or species habitat may occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area
Rutidosis heterogama Heath Wrinklewort [13132]	Vulnerable	Species or species habitat known to occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
Tylophora linearis [55231]	Endangered	Species or species habitat may occur within area
Reptiles		
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area
Uvidicolus sphyrurus Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko [84578]	Vulnerable	Species or species habitat known to occur within area
Wollumbinia belli Bell's Turtle, Western Sawshelled Turtle, Namoi River Turtle, Bell's Saw-shelled Turtle [86071]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		

Name	Threatened	Type of Presence
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Crooked Creek	NSW

Regional Forest Agreements	[Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
North East NSW RFA	New South Wales

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat may occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle,		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-29.190623 151.336471,-29.190324 151.336299,-29.190324 151.336299,-29.188525 151.345569,-29.190474 151.34677,-29.193471 151.346255,-29.195269 151.357242,-29.208156 151.357242,-29.208605 151.348659,-29.212651 151.349345,-29.212651 151.331493,-29.205459 151.331664,-29.205459 151.336642,-29.190623 151.336471

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX D LIKELIHOOD OF OCCURRENCE AND RISK ANALYSIS

In order to complement identification of likely threatened species likely to occur within the Development Site, the NSW BioNet and the PMST were undertaken. A likelihood of occurrence and risk assessments were undertaken for all species. Where results identify additional species to those generated in the BCD Calculator as “Ecosystem Species Credits” or “Species Credit Species”, those species were added in the surveys design.

Likelihood of Occurrence

Species identified in the NSW BioNet atlas and the PMST were collated into a table where an assessment of the likelihood of occurrence of that threatened biodiversity was undertaken. In making this determination, the following factors were considered:

- habitat quality within and adjacent to the Development Site as determined through review of regional vegetation mapping and the results of the September survey;
- breeding habitat/resources present – assists with identification of the importance of habitat to the species;
- dispersal ability - based on known ecology - whether the species have an ability to disperse to new areas of habitat following disturbance; and
- local records in similar habitat/distance/connectivity to the Development Site.

This allows for assessment of cryptic or seasonal species that are unlikely to be readily identified during brief site inspections and/or due to seasonal constraints. The likelihood of each species occurring was categorised as known, potential or unlikely to occur based on the definitions provided in Table D-1. Results of likelihood of occurrence is presented in Table D.3 for TECs and Table D.4 for threatened species.

Table D.1 Definitions of Likelihood of Occurrence

Category	Description
Known	■ the ecological community/species/matter has been recorded in the Development Site during field surveys; or ■ database records demonstrate that the ecological community/species has been known to occur in the Development Site within the last 10 year period.
Potential	■ the ecological community/species’ known distribution includes the Development Site, and suitable habitat is present within it, or, ■ database records demonstrate that the ecological community/species has been known to occur in the Development Site, however has not been recorded within the last 10 years, or ■ the species is a wide ranging flying species which may ‘fly-over’ the Development Site, regardless of the habitat types present and has been recorded within the 10 km locality surrounding the Development Site.
Unlikely	■ the ecological community/species has not been recorded within 10 km locality of the Development Site and suitable habitat does not occur within the Development Site, or ■ the Development Site is not within the TEC/species’ known distribution, or ■ sufficient field surveys have been conducted to conclude that the species is likely to be absent.
The following considerations were made in assessing habitat suitability and distribution: *Habitat quality within and adjacent to the Site.* *Breeding habitat/resources present – assists with identification of the importance of habitat to the species.* *The species’ ability to disperse to new areas of habitat following disturbance.* *Local records in similar habitat/distance/connectivity to the Site.*	

Risk Assessment

A risk assessment was undertaken using the definitions of Species Sensitivity and Consequence to assign a relative risk ranking for each listed ecological value (Low, Medium, High or Very High, as shown in Table D.2). Impacts to ecological values with potential to occur that were assessed as having a Low risk was not further assessed. Results of risk assessment is presented in Table D.3 for TECs and Table D.4 for threatened species.

Impacts to ecological values with potential to occur that were assessed as having a Medium, High or Very High risk were further assessed in accordance with the requirements of the EPBC Act and BC Act, including the preparation of detailed Assessments of Significance (see Appendix E).

Species sensitivity rankings are based on the species conservation status under the EPBC Act, FM Act and BC Act. Where the conservation status differs between listings, the conservation status with higher sensitivity is used.

Table D.2 Risk Assessment Matrix

Sensitivity \ Consequence	Negligible	Minor	Moderate	Major
Ecological value not listed as threatened	Low	Low	Medium	High
Ecological value listed as Vulnerable or Migratory	Low	Medium	Medium	High
Ecological value listed as Endangered	Low	Medium	High	Very High
Ecological value listed as Critically Endangered	Medium	High	Very High	Very High

Consequence Definitions

Negligible: No impacts or removal of ecological community. Effect on species is within the likely normal range of variation. No removal of specific breeding habitat features.

Minor: Indirect impacts to listed ecological community which may affect a small proportion of the ecological community. Effects a small proportion of a population and Project-related mortality of a small number of individuals may occur, but does not substantially affect other species dependent on it, or the populations of the species itself. No removal of specific breeding habitat features.

Moderate: Direct removal of a portion of a listed ecological community. Effects a sufficient proportion of a species population that it may bring about a substantial change in abundance and/or reduction in distribution over one or more generations, but does not threaten the long term viability of that population or any population dependent on it.

Major: Direct removal of a listed ecological community. Effects an entire population or species at sufficient scale to cause a substantial decline in abundance and/or change in distribution beyond with natural recruitment (reproduction, immigration from unaffected areas) may not return that population or species, or any population or species dependent upon it, to its former level within several generations, or when there is no possibility of recovery.

Species sensitivity definitions

Species sensitivities refer to listed under either the EPBC Act or BC Act. Where listings differ, the higher sensitivity is used.

Table D.3 Threatened Ecological Communities: Likelihood of Occurrence and Risk Assessment

TEC name	EPBC Act	BC Act	Community Description	Likely of TEC Occurring in the Site	Potential Impacts	Mitigation Measures	Risk Rating
Natural Grasslands on Basalt and Fine-textured alluvial plains of northern New South Wales and southern Queensland Source: PMST	CE		The Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales (NSW) and southern Queensland are native grasslands typically composed of perennial native grasses. They are found on soils that are fine textured (often cracking clays) derived from either basalt or alluvium on flat to low slopes (< 1 degree). A tree canopy is usually absent, but when present, comprises ⩽10% projective foliage cover. The distribution of the ecological community is strongly reliant on soil type as it is associated with fine textured, often cracking clays derived from either basalt or quaternary alluvium. Temperate grasses and grassland forbs comprise the ground layer. Tussock grasses within this vegetation community can be dominated by species of the genera *Austrodanthonia*, *Austrostipa*, *Bothriochloa*, *Chloris*, *Enteropogon*, or *Themeda*. In the Darling Downs component of the community, Bluegrass (*Dichanthium sericeum*) tends to dominate, whereas the Plains Grass (*Austrostipa aristiglumis*) tend to dominate in the Liverpool Plains component. The herbaceous cover includes species within genera *Desmodium*, *Glycine*, *Lotus* and Rhynchosia. The shrub layer is generally a minimum component of the community, it can include Mimosa (*Acacia farnesiana*), *Pittosporum phylliraeoides*, *Pimelea* spp. and *Sclerolaena* spp. A tree canopy is typically absent. Where trees are present, they are of variable species composition and comprise less than 10% of projective crown cover. Tree species that may be present as scattered individuals include: *Acacia pendula* (Weeping Myall), *Eucalyptus albens* (White Box), *E. conica* (Fuzzy Box), *E. coolabah* (Coolabah), *E. melliodora* (Yellow Box), *E. populnea* (Poplar Box) or *E. tereticornis* (Forest Red Gum). This ecological community occurs from the Darling Downs in Queensland to Dubbo in NSW and incorporates the Liverpool and Moree Plains. This ecological community occurs within the Brigalow Belt South Bioregion and Border Rivers-Gwydir, Central West, Namoi, Condamine, Burnett Mary and Fitzroy Basin Natural Resource Management Regions. Patches of this vegetation community extend into the Nandewar, Sydney Basin and Darling Riverine Plains bioregions.	Unlikely The Development Site is located immediately south form the Darling Downs, Queensland. Cracking clays were observed in the southern portion of the Development Site, however, the site is highly disturbed and the characteristic species in the northern portion of the distribution of this TEC, i.e. Queensland Bluegrass (*Dichanthium sericeum*) were not recorded. Therefore, it is considered unlikely this CEEC occurs.	NA	NA	Low
New England Peppermint (*Eucalyptus nova-anglica*) Grassy Woodlands Source: PMST	CE	CE	The New England Peppermint (*Eucalyptus nova-anglica*) Grassy Woodlands ecological community occurs in northern NSW and southern Queensland, in the New England Tablelands, NSW North Coast and Nandewar IBRA Bioregions. The tree canopy is typically dominated (>50%) or co-dominated (>30%) by the tree species *Eucalyptus nova-anglica* (New England Peppermint). A range of other associated tree species may be present, and may be co-dominant in the ecological community, but do not dominate it by themselves, in particular *E. pauciflora* (Snow Gum) and *E. dalrympleana* subsp. *heptantha* (Mountain Gum). The understorey is usually made up of a dense, species-rich ground layer of grasses and herbs. Shrubs are typically sparse to absent. The main tree species in the community are New England Peppermint (*Eucalyptus nova-anglica*). Other tree species include Snow Gum (*E. pauciflora*), Black Sallee (*E. stellulata*), Mountain Gum (*E. dalrympleana subsp. heptantha*), Blakely's Red Gum (*E. blakelyi*) and Fuzzy Box (*E. conica*).	Unlikely No tree elements characteristic of the vegetation community were observed within the Development Site during surveys.	NA	NA	Low
Weeping Myall Woodlands	E		The Weeping Myall Woodlands ecological community occurs on the inland alluvial plains west of the Great Dividing Range in NSW and Queensland. It occurs in the Riverina, NSW South Western Slopes, Darling Riverine Plains, Brigalow Belt South, Brigalow Belt North, Murray-Darling Depression, Nandewar and Cobar	Unlikely No elements characteristic of the vegetation community were observed within the Development Site during surveys.	NA	NA	Low

TEC name	EPBC Act	BC Act	Community Description	Likely of TEC Occurring in the Site	Potential Impacts	Mitigation Measures	Risk Rating
Source: PMST			Peneplain IBRA Bioregions. The ecological community currently occurs in small pockets throughout this range. The Weeping Myall Woodlands occur in a range from open woodlands to woodlands, generally 4-12 m high, in which Weeping Myall (*Acacia pendula*) trees are the sole or dominant overstorey species. Weeping Myall trees often occur in monotypic stands, however other vegetation may also occur in the ecological community, though not as dominant species. These include: Western Rosewood (*Alectryon oleifolius subsp. elongatus*); Poplar Box (*Eucalyptus populnea*); or Black Box (*Eucalyptus largiflorens*). Grey Mistletoe (*Amyema quandang*) commonly occurs on the branches of Weeping Myall trees throughout the ecological community's range. Weeping Myall goes through regular cycles of senescence (aging and death) and regeneration. Weeping Myall trees are also susceptible to defoliation by Bag-shelter Moth (*Ochrogaster lunifer*) caterpillars and are often lopped for domestic stock fodder. Therefore, the ecological community can be dominated by Weeping Myall trees that are in a living, defoliated or dead state. The understorey of Weeping Myall Woodlands often includes an open layer of shrubs above an open ground layer of grasses and herbs, though the ecological community can exist naturally either as a shrubby or a grassy woodland.				
White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland Source: PMST	CE	E	Box – Gum Grassy Woodlands and Derived Grasslands are characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs, and the dominance, or prior dominance, of White Box, Yellow Box or Blakely's Red Gum trees. In the Nandewar Bioregion, Grey Box (*Eucalyptus microcarpa* or *E. moluccana*) may also be dominant or codominant. The tree-cover is generally discontinuous and consists of widely-spaced trees of medium height in which the canopies are clearly separated. Associated, and occasionally co-dominant, trees include, but are not restricted to: Grey Box (*Eucalyptus microcarpa*), Fuzzy Box (*E. conica*), Apple Box (*E. bridgesiana*), Red Box (*E. polyanthemos*), Red Stringybark (*E. macrorhyncha*), White Cypress Pine (*Callitris glaucophylla*), Black Cypress Pine (*C. enderlicheri*), Long-leaved Box (*E. goniocalyx*), New England Stringybark (*E. calignosa*), Brittle Gum (*E. mannifera*), Candlebark (*E. rubida*), Argyle Apple (*E. cinerea*), Kurrajong (*Brachychiton populneus*) and Drooping She-oak (*Allocasuarina verticillata*). This ecological community occurs in areas where rainfall is between 400 and 1200 mm per annum, on moderate to highly fertile soils at altitudes of 170 metres to 1200 metres. The White Box – Yellow Box – Blakely's Red Gum grassy woodlands that existed prior to European settlement now exists as remnants in three different states. The three states are: i) An overstorey of eucalypt trees exists, but there is no substantial native understorey. ii) A native understorey exists, but the trees have been cleared; and iii) Both a native understorey and an overstorey of eucalypts exist in conjunction. In order for an area to be included in the EPBC listed ecological community, a patch must have a predominantly native understorey. The size and life-form of understorey species are such that viable populations can exist in very small areas. Therefore, in order to be the listed ecological community, an understorey patch, in the absence of overstorey trees, must have a high level of native floral species diversity, but only needs to be 0.1 hectares or greater in size. A patch in which the perennial vegetation of the ground layer is dominated by native species, and which contains at least 12 native, non-grass understorey species (such as forbs, shrubs, ferns, grasses and sedges) is considered to have a sufficiently high level of native diversity to be the listed ecological community. At least one of the understorey species should be an important species (e.g. grazing-sensitive, regionally significant or uncommon species; such as Kangaroo Grass or orchids) in order to indicate a reasonable condition.	Potential An area likely to conform to the Box-Gum community was recorded in the southern portion of the Subject Land. An individual tree, potentially identified as Blakely's Red Gum (*Eucalyptus blakely*), was observed during the September 2018 survey. The tree was later confirmed as *Eucalyptus dealbata* by ecologists Joanne Woodhouse and Tom Cotter. No elements of this vegetation community were found across the Development Site although it is likely to occur within the broader Project Boundary.	Negligible	Avoidance	Low

Table D.4 Threatened Species: Likelihood of Occurrence and Risk Assessment

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
Fauna **Reptilia**							
Delma torquata Adorned Delma, Collared Delma Source: PMST		V	Adorned Delma is the smallest of the legless lizards. The Collared Delma normally inhabits eucalypt dominated woodland and open forest where it is associated with suitable micro-habitats (exposed rocky outcrops). The ground cover is predominantly native grasses, such as Kangaroo Grass (*Themeda triandra*), Barbed-wire Grass (*Cymbopogon refractus*), Wiregrass (*Aristida* sp.) and *Lomandra*. The Collared Delma is known from the western suburbs of Brisbane, Queensland, and the following sites: Bunya Mountains, Blackdown Tableland National Park (NP), Bullyard Conservation Park, D'Aguilar Range NP, Expedition NP, Naumgna and Lockyer Forest Reserves, Western Creek near Millmerran and the Toowoomba Range. It occurs within the South East Queensland, Condamine, Burnett Mary and Fitzroy (Queensland) Natural Resource Management regions.	Unlikely No records of the species are known within a 10km radius of the Site. The species was not recorded during target reptile surveys within the rocky outcrops in December 2018.	NA	NA	Low
Furina dunmalli Dunmall's Snake		V	Dunmall's Snake preferred habitat is Brigalow forest and woodland with fallen timber and ground litter, growing on cracking clay soils and clay loam soils. It also occurs in eucalypt and *Callitris* woodland with fallen timber and ground litter. The species is nocturnal. Dunmall's Snake occurs in south-east interior of Queensland, including the Darling Downs, and is thought to potentially extend into inland north-eastern NSW. Most locality records are between 200 and 500 m elevation	Unlikely No records of the species are known within a 10km radius of the Site. The species was not recorded during target reptile surveys in December 2018.	NA	NA	Low
Uvidicolus sphyrurus Border Thick-tailed Gecko Source: BioNet, PMST	V	V	The Border Thick-tailed Gecko is a small lizard up to 10 cm long (average 7 cm). It often occurs on steep rocky or scree slopes, especially granite. Recent records from basalt and metasediment slopes and flats indicate its habitat selection is broader than formerly thought and may have extended into areas that were cleared for agriculture. Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter. Occupied sites often have a dense tree canopy that helps create a sparse understorey. These Geckos are active at night and shelter by day under rock slabs, in or under logs, and under the bark of standing trees. It is found only on the tablelands and slopes of northern NSW and southern Queensland, reaching south to Tamworth and west to Moree. Most common in the granite country of the New England Tablelands. Occurs at sites ranging from 500 to 1100 m elevation. Populations are mostly fragmented, with over 50 discrete sites currently known that are separated by at least 2km.	Potential Habitat resources for the species are present within the Development Site. The only record within the 10km locality is at approximately 2.4km south from the site and was recorded over 10 years ago (in 1999) The species was not recorded during target reptile surveys within the rocky outcrops in December 2018.	Negligible A total of eleven rocky areas were recorded within the Subject Land. Five of the rocky outcrops have been avoided. Only two outcrops occur in the middle of the cleared paddocks and cannot be avoided by the development footprint. The remaining four may also be avoided during the detailed design and survey of the required riparian buffers and perimeter road.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation and habitat features to be retained within the adjacent habitat.	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
Wollumbinia belli Bell's Turtle	E	V	Bell's Turtle occurs in shallow to deep pools in upper reaches or small tributaries of major rivers in granite country. Occupied pools are most commonly less than 3 m deep with rocky or sandy bottoms and patches of vegetation. Most typically uses narrow stretches of rivers 30 - 40 m wide. Most surrounding habitat has been converted to grazing land. Nests are dug out in riverbanks of sand or loam during late September to January. Eggs take 80 days to hatch and are thus vulnerable to nest predation for an extended period. Primarily a vegetarian, eating both aquatic plants and terrestrial leaves that fall into the watercourse. Also takes invertebrates ranging from insects to crayfish, other small animals and carrion. In NSW, currently found in four disjunct populations in the upper reaches of the Namoi, Gwydir and Border Rivers systems, on the escarpment of the North West Slopes.	Unlikely No deep pools occur within any of the unnamed creeks or their tributaries.	Negligible	NA	Low
Aves							
Anthochaera phrygia Regent Honeyeater Source: PMST	CE	CE	The Regent Honeyeater mainly inhabits temperate woodlands and open forests, particularly Box – Ironbark woodland and riparian forests of River Sheoak. The species inhabits woodlands that support a significantly high abundance and species richness of birds. These type of woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. The species can also be found in drier coastal woodlands and forests in some years. Non-breeding flocks of the species can be seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests. Although the species is a generalist forager, it feeds mainly on the nectar from a small number of eucalypts that produce high volumes of nectar (e.g. Mugga Ironbark, Yellow Box, White Box and Swamp Mahogahy).	Potential Limited foraging habitat is present within the woodland and riparian **corridor**. This woodland bird species forages in woodlands with significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. No habitat is available within the disturbed grasslands. The Regent Honeyeater has not been recorded within the Site.	Negligible. The second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of the streams, measured from the edge of the high bank. The distances applied to this BDAR are 20m either side of the second order stream and 30m either side of the third order streams. This will significantly reduce the risk of the potential impacts.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation and habitat features to be retained within the adjacent habitat.	Low
Artamus cyanopterus cyanopterus Dusky Woodswallow	V		The Dusky Woodswallow primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland. The species forages on invertebrates, mainly insects, which are captured whilst hovering or sallying above the canopy or over water. It builds an open, cup-shape nest made of twigs, grass, fibrous rootlets and occasionally casuarina needles. Generally, nests are located on shrubs or low trees, living or dead, horizontal or upright forks in braches, spouts, hollow stumps or logs, behind loose bark or in a hollow in the top of a wooden fence post.	Potential. Potential foraging habitat is present in most woodland vegetation zones, excluding grasslands, cleared and disturbed land.. No records of the species exist for the Site and the nearest location is at approximately 4 km south-east where it was recorded in 1995.	Negligible The second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of the streams, measured from the edge of the high bank. The distances applied to this BDAR are 20m either side of the second order stream and 30m either side of the third order streams. This will significantly reduce the risk of the potential impacts.	NA	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
Calyptorhynchus lathami Glossy Black-Cockatoo Source: BioNet	V		The Glossy Black-cockatoo inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods. Inland populations feed on a wide range of sheoaks, including Drooping Sheoak, *Allocasuaraina diminuta*, and *A. gymnathera*. Belah is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (*Casuarina cristata*). Feeds almost exclusively on the seeds of several species of she-oak (*Casuarina* and *Allocasuarina* species), shredding the cones with the massive bill.	Unlikely. Limited breeding habitat for the species is present within the Development Site. However, no suitable feeding habitat is present as its preferred feed tree species have not been recorded within the Site. It is unlikely the sepcies would breed in hollow-bearing trees at the site as the cost to travel long distances to feed will be too high. The nearest location is at approximately 3.6 km to the east, where one record from 1999 exists.	Negligible	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
Climacteris picumnus victoriae Brown Treecreeper (eastern subspecies) Source: BioNet	V		The Brown Treecreeper (eastern subspecies) is found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (*Eucalyptus camaldulensis*) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. It is considered resident of areas where it occurs and is usually observed in pairs or small groups of 8 to 12 birds. It forages on trunks and branches of trees and among fallen timber. Hollows in standing dead or live trees and stumps are essential for nesting.	Potential This species was recorded adjacent to the Subject Land during potential offset site investigations. Suitable habitat for the species is considered to occur in the woodland PCTs. Grasslands and cleared land (disturbed grasslands) do not represent suitable habitat for the species..	Negligible The second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of the streams, measured from the edge of the high bank. The distances applied to this BDAR are 20m either side of the second order stream and 30m either side of the third order streams. This will significantly reduce the risk of the potential impacts.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
Chthonicola sagittata Speckled Warbler Source: BioNet	V		The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees. Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding. The rounded, domed, roughly built nest of dry grass and strips of bark is located in a slight hollow in the ground or at the base of a low dense plant, often among fallen branches and other litter. A side entrance allows the bird to walk directly inside.A clutch of 3-4 eggs is laid, between August and January, and both parents feed the nestlings. Speckled Warblers often join mixed species feeding flocks in winter, with other species such as Yellow-rumped, Buff-rumped, Brown and Striated Thornbills.	Potential This species was recorded adjacent to the Subject Land during potential offset site investigations. Suitable habitat for the species is considered to occur in the woodland PCTs. Grasslands and cleared land (disturbed grasslands) do not represent suitable habitat for the species.	Negligible The second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of the streams, measured from the edge of the high bank. The distances applied to this BDAR are 20m either side of the second order stream and 30m either side of the third order streams. This will significantly reduce the risk of the potential impacts.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
Daphoenositta chrysoptera Varied Sittella Source: BioNet	V		The Varied Sittella Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland. It feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy. It builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years. Generation length is estimated to be 5 years. The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west.	Potential Potential foraging habitat is present in most woodland vegetation zones. The nearest record of the species dates back in 1995 and was located at approximately 4 km south from the Site.	Negligible The second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of the streams, measured from the edge of the high bank. The distances applied to this BDAR are 20m either side of the second order stream and 30m either side of the third order streams. This will significantly reduce the risk of the potential impacts.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
Erythrotriorchis radiatus Red Goshawk Source: PMST	CE	V	Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers.	Unlikely Limited habitat for the species exists within the Development Site. Riparian corridor was dry at the time of surveys and highly fragmented. No existing records of the species within the 10 km locality exist. The species was not recorded during surveys.	Negligible	NA	Low
Geophaps scripta scripta Squatter Pigeon Source: PMST	CE	V	Squatter Pigeons are medium-sized ground-dwelling pigeons. They are found in grassy woodlands and plains, preferring sandy areas and usually close to water. Feed on the ground, on seeds of grasses, herbs and shrubs, as well as insects. Nest on the ground. The species is found from north Queensland to the North West Slopes of NSW and extending down to the Liverpool Plains and Dubbo. Today they are very rare in the southern parts of their range.	Potential Substandard foraging habitat is present within the Development Site. No existing records of the species within the 10 km locality exist. The species was not recorded during surveys.	Negligible	NA	Low
Glossopsitta pusilla Little Lorikeet Source: BioNet	V		The Little Lorikeet is a small parrot distributed widely across the coast and Great Divide regions. The species forages primarily in the canopy of open Eucalyptus forests and woodland. It also forages in Angophora, Melaeuca and other species including paddock, roadside remnants and urban trees. It feeds mainly on nectar and pollen, occasionally on native fruits.	Potential. Limited suitable foraging habitat for the species is present in Eucalypt trees within the remnant trees and vegetation. The nearest records of the species dates back in 1995 (two records) and were located at approximately 1 km east from the Site.	Negligible. Any clearing of Eucalypt trees has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat. Develop fauna clearance protocol that includes procedures to be followed should any injured fauna be encountere	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
Grantiella picta Painted Honeyeater Source: PMST	V	V	The Painted Honeyeater inhabits Boree/ Weeping Myall (*Acacia pendula*), Brigalow (*A. harpophylla*) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus *Amyema*. Insects and nectar from mistletoe or eucalypts are occasionally eaten. Nest from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.	Potential Limited foraging resources for the species are available in Box and Ironbark trees across the Subject Land. No existing records of the species within the 10 km locality exist. The species was not recorded during surveys.	Negligible. Any clearing of Eucalypt trees has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
Neophema pulchella Turquoise Parrot Source: BioNet	V		The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range (OEH 2019). The Turquoise Parrot lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Usually seen in pairs or small, possibly family, groups and have also been reported in flocks of up to thirty individuals. It prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Forages quietly and may be quite tolerant of disturbance. However, if flushed it will fly to a nearby tree and then return to the ground to browse as soon as the danger has passed. It nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust (OEH 2019).	Potential Suitable habitat for the species includes woodlands and native grasslands. Roosting and breeding habitat for this woodland bird are hollow-bearing trees in woodlands. It forages in woodlands and native grasslands. The nearest record of the species dates back in 1995 and was located at approximately 1 km south-east from the Site.	Negligible The second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of the streams, measured from the edge of the high bank. The distances applied to this BDAR are 20m either side of the second order stream and 30m either side of the third order streams. This will significantly reduce the risk of the potential impacts.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
Ninox connivens *Barking Owl*	V	-	The Barking Owl is found throughout continental Australia except for the central arid regions. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile riparian soils. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance. Requires very large permanent territories in most habitats due to sparse prey densities. Monogamous pairs hunt over as much as 6000 hectares, with 2000 hectares being more typical in NSW habitats (OEH 2019).	Potential Hollow bearing trees occur within woodland habitats and also as isolated trees within highly disturbed vegetation zones on the Subject Land.	Negligible. Any clearing of Eucalypt trees has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
Petroica boodang Scarlet Robin Source: BioNet	V		The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps.o Its habitat usually contains abundant logs and fallen timber: these are important components of its habitat. It breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude. It breeds between July and January. In autumn and winter many Scarlet Robins live in open grassy woodlands, and grasslands or grazed paddocks with scattered trees. It builds nests in the fork of branches, usually more than 2 metres above the ground.	Potential Limited suitable habitat for the species occurs in woodlands with fallen logs and timber in the Subject Land. The nearest record of the species dates back in 1995 and was located at approximately 4 km south-east from the Site.	Negligible The second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of the streams, measured from the edge of the high bank. The distances applied to this BDAR are 20m either side of the second order stream and 30m either side of the third order streams. This will significantly reduce the risk of the potential impacts.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
Pomatostomus temporalis temporalis Grey-crowned Babbler (eastern subspecies) Source: BioNet	V		The Grey-crowned Babbler inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions. Flight is laborious so birds prefer to hop to the top of a tree and glide down to the next one. Birds are generally unable to cross large open areas. It lives in family groups that consist of a breeding pair and young from previous breeding seasons. A group may consist of up to fifteen birds. All members of the family group remain close to each other when foraging. It is insectivorous and it forages on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses. It builds nests that are used as dormitory and roosting and uses them all year round. It breeds between July and February. Territory ranges from one to 50 hectares (usually ten hectares) and are defended all year. Grey-crowned Babblers are communal breeders that form a family group, in which offspring from the previous season and other unrelated birds help to raise the current's year's brood. In some populations, breeding success is related to the number of helpers. Young birds staty with the family group for at least one year after fledging and may remain for two or more years acting as non-breeding helpers. As breeding spaces become available in the population, some helpers may disperse to establish their own breeding group. Population viability studies in Victoria suggests that a viable population is likely to contain more than ten family groups, while populations with less than ten family groups are likely to have high rate of extinction.	Known A breeding population of Grey-crowned have been recorded on site. The nearest BioNet record of the species dates back in 2010 and was located at approximately 500 m east from the Development Site.	Moderate A breeding population of Grey-crowned have been recorded on site. The movement of this species is largely confined to the riparian corridors as this species has limited flying capacity. These corridors (with a 20-30m buffer) have been avoided although nests will be removed within the development footprint..	Approved clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing. Removal of trees with nests will be included in the vegetation clearing protocol including any seasonal constraints to avoid impacting any juveniles or unfledged chicks. Removal of trees with nests will be supervised by an experienced fauna catcher or ecologist. A portion of felled trees will be salvaged as habitat for fauna and translocated in suitable areas in the remainder of the Project Boundary.	Medium

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Rostratula australis Australian Painted-snipe Source: PMST	E	E	The Australian Painted Snipe is small freshwater wader. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. The nest consists of a scrape in the ground, lined with grasses and leaves. Breeding is often in response to local conditions; generally occurs from September to December. Incubation and care of young is all undertaken by the male only. Forages nocturnally on mud-flats and in shallow water. Feeds on worms, molluscs, insects and some plant-matter.	Unlikely No preferred habitat is available. No existing records of the species within the 10 km locality exist. The species was not recorded during surveys.	NA	NA	Low
Stagonopleura guttata Diamond Firetail Source: BioNet	V		Diamond Firetails are found in open grassy woodland, heath and farmland or grassland with scattered trees. Diamond Firetails feed on the ground and generally eat ripe or partially ripe seeds and can be seen hopping around on the ground. They occasionally eat insects and their larvae. The Diamond Firetail builds a nest with green grass blades and stems and lines it with fine grasses and feathers. The nest can be found in trees and shrubs with dense foliage and has sometimes been known to build in the base of a hawk's nest.	Potential Potential roosting and breeding habitat for the species occurs in woodlands, foraging habitat for the species occurs across the entire Subject Land.. The nearest BioNet record of the species dates back in 1995 and was located at approximately 3 km south-east from the Site.	Negligible The second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of the streams, measured from the edge of the high bank. The distances applied to this BDAR are 20m either side of the second order stream and 30m either side of the third order streams. This will significantly reduce the risk of the potential impacts.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
Tyto novaehollandiae Masked Owl	V	-	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. It lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting(OEH 2019).	Potential Hollow bearing trees occur within woodland habitats and also as isolated trees within highly disturbed vegetation zones on the Subject Land.	Negligible. Any clearing of Eucalypt trees has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
Calidris ferruginea Curlew Sandpiper Source: PMST	E	CE, Mi	The Curlew Sandpiper is a migratory bird inhabiting coastal habitats and sometimes freshwater wetlands. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland.	Unlikely No preferred habitat is available. No existing records of the species within the 10 km locality exist. The species was not recorded during surveys.	NA	NA	Low

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Mammals							
Dasyurus maculatus Spotted-tailed Quoll Source: PMST	V	E	The Spotted-tailed Quoll is recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Females occupy home ranges up to about 750 hectares and males up to 3500 hectares. Are known to traverse their home ranges along densely vegetated creeklines	Unlikely The high level of disturbance at the Development Site suggests no suitable habitat for the species is present. No known records of the species exists within the 10 km locality. The species was not recorded during surveys in September and December 2018.	NA	NA	Low
Petaurus norfolcensis Squirrel Glider Source: BioNet	V		The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or *Acacia* midstorey. Live in family groups of a single adult male one or more adult females and offspring. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.	Unlikely. No suitable habitat for the species occurs within the Site. Only one record of the species exist within the 10km locality. It is located at approximately 3.5 km to the south from the Site and was recorded in 1997.	Negligible	NA	Low
Petauroides volans Greater Glider Source: PMST		V	The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. The greater glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. During the day it shelters in tree hollows, with a particular selection for large hollows in large, old trees. The greater glider is considered to be particularly sensitive to forest clearance.	Unlikely Limited substandard foraging habitat for the species occurs in remnant vegetation within the Development Site. No rsheltering habitat is present and the species has not been recorded within the 10km locality.	Negligible	NA	Low
Petrogale penicillata Brush-tailed Rock-wallaby Source: BioNet PMST	V		In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night.	Unlikely. Limited habitat for the species occurs within the Site. Only one record of the species exist within the 10km locality. It is located at approximately 2.2 km to the south-west from the Site and was recorded in 1997.	Negligible	NA	Low

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Phascolarctos cinereus Koala Source: BioNet, PMST	V	V	The Koala is an arboreal marsupial that inhabits eucalypt woodlands and forests. The species feed on the foliage of more than 70 species of eucalypt and 30 non-eucalypt species.	Potential Suitable feeding trees (e.g. E. albens) are present within the Subject Land. . No known records exists within the site. The nearest record is located at approximately 3 km south-east and is dated 1995.	Negligible. Any clearing of koala feed tree species has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
Pseudomys novaehollandiae New Holland Mouse, Pookila Source: PMST		V	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes It is a social animal, living predominantly in burrows shared with other individuals Distribution is patchy in time and space, with peaks in abundance during early to mid stages of vegetation succession typically induced by fire.	Unlikely. Limited substandard woodland habitat for the species is present within the Development Site. No records of the species are known within the 10km locality.	Negligible	NA	Low
Pteropus poliocephalus Grey-headed Flying-fox Source: PMST	V	V	Grey-headed Flying-foxes are generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. Also forage in cultivated gardens and fruit crops.	Potential Potential foraging habitat is present in canopy of Eucalypt trees. Grasslands and cleared land excluded as potential foraging habitat.. No records of the species exist within the 10km locality. The species was not recorded during surveys.	Negligible. Any clearing of Eucalypt trees has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
Microchiropteran Bats							
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat Source: PMST	V	V	The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. The species is found in well-timbered areas containing gullies. The species roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years.	Potential. Potential foraging/hunting habitat for cave dependant microchiropteran bats is present in the remnant trees and vegetation. No suitable roosting habitat is available and the microchiropteran bats	Negligible. Any clearing of native vegetation has the potential to add to the incremental decline of potential foraging habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat. Breeding habitat for these species is not present within the Development Site and avoidance measures for breeding habitat is not required.	Low

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Falsistrellus tasmaniensis Eastern False Pipistrelle Source: BioNet	V		The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania (OEH 2019). The species prefers moist habitats, with trees taller than 20 m. It generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. It hunts beetles, moths, weevils and other flying insects above or just below the tree canopy. Hibernates in winter. Females are pregnant in late spring to early summer (OEH 2019). Only one record of the species exist within the 10km locality. It is located at approximately 3.2 km to the south-west from the Site and was recorded in 1997.	Known. Potential foraging/hunting and roosting habitat for hollow dependant microchiropteran bats is present in the remnant trees and vegetation.	Minor Any clearing of native vegetation has the potential to add to the incremental decline of potential foraging habitat available within the region. Removal of important habitat features e.g. 37 hollow bearing trees are to be removed	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat. Trees will be planted at a rate of 2:1 with two new trees planted for each HBT removed. This results in planting of 74 new trees within the riparian corridor. As naturally formed tree hollows will take many decades to develop, nest-boxes suitable for hollow dependent microbats will be installed prior to HBT clearance and will be monitored during the lifespan of the solar farm	Medium
Miniopterus schreibersii (orinae) oceanensis Eastern Bentwing-bat (Large Bentwinged-bat) Source: BioNet	V		Eastern Bentwing-bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Hunt in forested areas, catching moths and other flying insects above the tree tops. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. At other times of the year, populations disperse within about 300 km range of maternity caves. The nearest known record is located at approximately 150m north-west from the site and was recorded in 2006.	Known. Potential foraging/hunting habitat for cave dependant microchiropteran bats is present in the remnant trees and vegetation. No suitable roosting habitat is available and the microchiropteran bats assessed are unlikely to be dependent on any of the resources available.	Minor Any clearing of native vegetation has the potential to add to the incremental decline of potential foraging habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat. Breeding habitat for these species is not present within the Development Site and avoidance measures for breeding habitat is not required.	Low
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat Source: PMST	V	V	Corben's Long-eared Bat inhabits a variety of vegetation types, including mallee, bulloke *Allocasuarina leuhmanni* and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. It roosts in tree hollows, crevices, and under loose bark. Slow flying agile bat, utilising the understorey to hunt non-flying prey - especially caterpillars and beetles - and will even hunt on the ground. Mating takes place in autumn with one or two young born in late spring to early summer. Corben's Long-eared Bat has not been recorded within the 10 km locality.	Known. Potential foraging/hunting and roosting habitat for hollow dependant microchiropteran bats is present in the remnant trees and vegetation.	Minor Any clearing of native vegetation has the potential to add to the incremental decline of potential foraging habitat available within the region. Removal of important habitat features e.g. 37 hollow bearing trees are to be removed	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat. Trees will be planted at a rate of 2:1 with two new trees planted for each HBT removed. This results in planting of 74 new trees within the riparian corridor. As naturally formed tree hollows will take many decades to develop, nest-boxes suitable for hollow dependent microbats will be installed prior to HBT clearance and will be monitored during the lifespan of the solar farm	Medium

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Scoteanax rueppellii Greater Broad-nosed Bat Source: BioNet	V		The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m. Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species. Although this species usually roosts in tree hollows, it has also been found in buildings. Only two records of the species exist within the 10km locality. The nearest record is located at approximately 3.2 km to the south from the Site and was recorded in 1997.	Known. Potential foraging/hunting and roosting habitat for hollow dependant microchiropteran bats is present in the remnant trees and vegetation.	Minor Any clearing of native vegetation has the potential to add to the incremental decline of potential foraging habitat available within the region. Removal of important habitat features e.g. 37 hollow bearing trees are to be removed	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat. Trees will be planted at a rate of 2:1 with two new trees planted for each HBT removed. This results in planting of 74 new trees within the riparian corridor. As naturally formed tree hollows will take many decades to develop, nest-boxes suitable for hollow dependent microbats will be installed prior to HBT clearance and will be monitored during the lifespan of the solar farm	Medium
Mormopterus eleryi *Bristle-faced Free-tailed Bat*	V		Distributed from the southern half of the Northern Territory to central Queensland and north-western NSW. In NSW, the species has been recently recorded from only three disjunct locations: thirteen individuals from Gundabooka National Park, south of Bourke; one individual from Dhinnia Dthinawan Nature Reserve (formerly Bebo State Forest), north of Warialda two individuals near Bonshaw. Knowledge of the ecology of the Hairy-nosed Freetail Bat is limited, however evidence suggests that the species depends on hollows and tree fissures for roosting sites. All other Australian species from the same family generally roost in tree hollows and fissures. Appears to be extremely rare throughout its range. Nationally, it has been recorded from only 15 locations.	Known. Potential foraging/hunting and roosting habitat for hollow dependant microchiropteran bats is present in the remnant trees and vegetation.	Minor Any clearing of native vegetation has the potential to add to the incremental decline of potential foraging habitat available within the region. Removal of important habitat features e.g. 37 hollow bearing trees are to be removed	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat. Trees will be planted at a rate of 2:1 with two new trees planted for each HBT removed. This results in planting of 74 new trees within the riparian corridor. As naturally formed tree hollows will take many decades to develop, nest-boxes suitable for hollow dependent microbats will be installed prior to HBT clearance and will be monitored during the lifespan of the solar farm	Medium
Fish							
Maccullochella peelii Murray Cod Source: PMST		V	The Murray Cod is a large freshwater fish endemic to the Murray-Darling Basin, from south east Queensland, through NSW, into Vitoria and South Australia. The species can grow to 100 kg in the wild. The species requires permanent streams and is highly dependent on instream woody structures for habitat, is highly territorial and very aggressive.	Unlikely No suitable habitat for the species is present within the Development Site.	Negligible	NA	Low
Flora							
Acacia pubifolia Velvet Wattle Source: PMST	E	V	Velvet Wattle is a shrub or small tree 3 - 8 m tall with golden yellow flowers and dark-grey bark. It occurs in NSW and Qld. In NSW it is known from two main populations, one north of Emmaville and the other near Warrabah National Park. The species generally grows in dry shrubby woodland on granite and metasediment soils.	Unlikely No suitable habitat for the species occurs within the Development Site. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible	NA	Low

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Astrotricha roddii Rodd's Star Hair Source: BioNet, PMST	E	E	Rodd's Star Hair is an upright, sparsely-branched shrub 1 - 3 m tall. Rodd's Star Hair usually grows in low dry woodland and shrublands on granite and acid volcanic outcrops, often in rock crevices. The species occurs in NSW in the Ashford area north of Inverell, including Kwiambal and Kings Plains National Parks, Severn River Nature Reserve and Severn River State Forest, and has also been recorded at one site in southern Queensland.	Potential Limited potential habitat for the species occurs within the Subject Land. A total of 12 records of the species exist within the 10 km locality. No records exist within the Development Site and the species was not recorded within the development footprint. The nearest record is located at approximately 4.3 km to the south and was recorded in 1999.	Negligible A total of eleven rocky areas were recorded within the Subject Land. Five of the rocky outcrops have been avoided. Only two outcrops occur in the middle of the cleared paddocks and cannot be avoided by the development footprint. The remaining four may also be avoided during the detailed design and survey of the required riparian buffers and perimeter road.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation and habitat features to be retained within the adjacent habitat.	Low
Boronia granitica Granite Boronia Source: PMST	V	E	Granite Boronia is a medium-sized shrub 0.6 - 2 m tall. It flowers from July to October. It grows on granitic soils amongst rock outcrops, often in rock crevices, and in forests and woodlands on granite scree and shallow soils. Important site characteristics include low precipitation and high levels of solar radiation. This semi-arid soil environment will have selected the more xerophytic species from the available regional assemblage of rainforest species. The largely barren substrate (e.g. granite) may help to control too frequent fire, thus allowing maturity and seed set. Granite Boronia occurs in scattered localities on the New England Tablelands and North West Slopes north from the Armidale area to the Stanthorpe district in southern Queensland. It can be locally common in appropriate habitat (e.g. Torrington).	Potential Suitable substrate for the species is present within the Subject Land. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible A total of eleven rocky areas were recorded within the Subject Land. Five of the rocky outcrops have been avoided. Only two outcrops occur in the middle of the cleared paddocks and cannot be avoided by the development footprint. The remaining four may also be avoided during the detailed design and survey of the required riparian buffers and perimeter road.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation and habitat features to be retained within the adjacent habitat.	Low
Cadellia pentastylis Ooline Source: PMST	V	V	Ooline is a medium-sized spreading tree usually about 10 m tall, and rarely to 25 m. Appears to flower spasmodically, during a general flowering period of October to January. Dispersal of fruit and seed is probably by "passive fall" or by birds. Seeds showed a high rate of infertility at all sites, although they have been successfully germinated and established after heat application. Forms a closed or open canopy mixing with eucalypt and cypress pine species. There appears to be a strong correlation between the presence of Ooline and low- to medium-nutrient soils of sandy clay or clayey consistencies, with a typical soil profile having a sandy loam surface layer, grading from a light clay to a medium clay with depth. Has the capacity to resprout from rootstock and coppice vigorously from stumps, a feature which may be critical for the species survival in a fire-prone environment. Populations display a variety of age classes including large mature trees, suckering regrowth and seedlings. The total area occupied by Ooline is only about 1200 hectares, with remaining populations in NSW still threatened to various degrees by clearing for agriculture and grazing pressures.	Potential The development Site is located within known distribution of the species although it was not recorded on site during seasonal surveys. surveys. Noo known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible. Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low

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Callistemon pungens Source: PMST		V	*Callistemon pungens* is a distinct shrub or small tree ranging from 2-5 m tall. The species inhabits a range from riparian areas dominated by *Casuarina cunninghamiana subsp. cunninghamiana* to woodland and rocky shrubland. Often in rocky watercourses, usually with sandy granite (occasionally basalt) creek beds. Flowers over spring and summer, mostly in November.	Unlikely No suitable habitat is present within the Development Site. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible	NA	Low
Dichanthium setosum Bluegrass Source: PMST	V	V	Bluegrass is an upright grass less than 1 m tall. Flowering time is mostly in summer. Associated with heavy basaltic black soils and red-brown loams with clay subsoil. Often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. (Often collected from disturbed open grassy woodlands on the northern tablelands, where the habitat has been variously grazed, nutrient-enriched and water-enriched). It is open to question whether the species tolerates or is promoted by a certain amount of disturbance, or whether this is indicative of the threatening processes behind its depleted habitat. Associated species include *Eucalyptus albens*, *Eucalyptus melanophloia*, *Eucalyptus melliodora*, *Eucalyptus viminalis*, *Myoporum debile*, *Aristida ramosa*, *Themeda triandra*, *Poa sieberiana*, *Bothriochloa ambigua*, *Medicago minima*, *Leptorhynchos squamatus*, *Lomandra aff. longifolia*, *Ajuga australis*, *Calotis hispidula* and *Austrodanthonia*, *Dichopogon*, *Brachyscome*, *Vittadinia, Wahlenbergia* and *Psoralea* species. Bluegrass occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, extending to northern Queensland. It occurs widely on private property, including in the Inverell, Guyra, Armidale and Glen Innes areas.	Potential. Suitable habitat elements for the species occur within the Development Site. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible. Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
Eucalyptus caleyi subsp. ovendenii Ovenden's Ironbark Source: BioNet, PMST	V	V	Ovenden's Ironbark grows in grassy woodland on dry, shallow soils of moderate fertility. Its preferred altitudes are 610 to 820 m, on granitic substrates. Ovenden's Ironbark occupies a higher geographical range than that of subspecies caleyi, occurring on the crests of broad high ridges and replacing subspecies caleyi inhabiting the lower slopes in the same general area. Associated species include *Eucalyptus melliodora*, *Eucalyptus dealbata*, *Eucalyptus albens*, *Eucalyptus melanophloia* and *Geijera parviflora*. Flowering occurs from July to September, with fruits having a distinctly square cross-section. Can be locally abundant within its grassy woodland habitat. Juveniles were present in about half the sampled sites within Torrington State Conservation Area, indicating good recruitment	Potential The species was not recorded within the Development Site during surveys in September and December 2018. Several species with which Ovenden's Ironbark is associated were recorded within the Development Site, including *Eucalyptus dealbata*, *Eucalyptus albens* and *Geijera parviflora*. Only one record of the species exist within the 10 km locality and at approximately 5.3 km to the south-west from the Development Site. The species was recorded in 1999.	Negligible. Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
Eucalyptus mckieana MicKie's Stringybark Source: PMST	V	V	MicKie's Stringybark is a medium sized tree about 25 m tall. The species flowers are white, with a flowering period of March to May. The species is remarkable for its very narrow and numerous sucker leaves, the narrowest of all the stringybarks and which persist to a height of 2 to 4 metres. *Eucalyptus mckieana* is found in grassy open forest or woodland on poor sandy loams, most commonly on gently sloping or flat sites. Associated species at Northern Tablelands sites include *Angophora floribunda*, *Eucalyptus amplifolia*, *Eucalyptus andrewsii*, *Eucalyptus bridgesiana*, *Eucalyptus youmanii*, *Eucalyptus nicholii*, *Eucalyptus blakelyi* and *Eucalyptus conica*, and at North Western Slopes sites *Eucalyptus andrewsii*, *Eucalyptus stannicola*, *Eucalyptus prava* and *Angophora floribunda*. Confined to the drier western side of the New England Tablelands of NSW, from Torrington to Bendemeer. Most populations occur on private property, but it does occur in Kings Plain National Park, Torrington State Conservation Area and Severn River Nature Reserve.	Unlikely. Very limited potential habitat is present. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible	NA	Low
Eucalyptus nicholii Narrow-leaved Black Peppermint Source: BioNet, PMST	V	V	The Narrow-leaved Black Peppermint typically grows in dry grassy woodland, on shallow soils of slopes and ridges. Found primarily on infertile soils derived from granite or metasedimentary rock. Seedling recruitment is common, even in disturbed soils, if protected from grazing and fire. It tends to grow on lower slopes in the landscape. This species is sparsely distributed but widespread on the New England Tablelands from Nundle to north of Tenterfield, being most common in central portions of its range. Found largely on private property and roadsides, and occasionally in conservation reserves. Planted as urban trees, windbreaks and corridors.	Potential The species was not recorded during surveys in September and December 2018. Only one record of the species exist within the 10 km locality and at approximately 5.5 km to the south-west from the Development Site. The species was recorded in 2000.	Negligible. Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
Homopholis belsonii Belson's Panic Source: PMST		V	Belson's Panic is a perennial grass growing to 0.5m high. It is known to occur in dry woodland habitats on poor soils, such as those derived from basalt. It occurs on rocky hills supporting White Box (*Eucalyptus albens*) and in Wilga (*Geijera parviflora*) woodland; flat to gently undulating alluvial areas supporting Belah (*Casuarina cristata*) forest; and soils and plant communities of Poplar Box (*Eucalyptus populnea*) woodlands. It may also be associated with shadier areas of Brigalow (*Acacia harpophylla*), Myall (*A. melvillei*), and Weeping Myall (*A. pendula*) communities; in Mountain Coolibah (*Eucalyptus orgadophila*) communities; and on roadsides. It is generally found among fallen timber at the base of trees or shrubs, among branches and leaves of trees hanging to ground level or along the bottom of netting fences. It is known to occur within the southern Brigalow belt, Queensland and on the north-western slopes and plains of NSW. In NSW, this species occurs between Wee Waa, Goondiwindi and Glen Innes.	Potential Limited suitable habitat for the species occurs within the Development Site. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible. Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
Lepidium peregrinum Wandering Pepper-cress Source: PMST		E	The Wandering Pepper-cress is a spreading soft-stemmed perennial herb to sub-shrub 10 - 80 cm tall but sometimes ascending to 2 m in surrounding vegetation. Flowers from January to April. The largest population of Wandering Pepper Cress occurs in an open riparian forest on the banks of the Tenterfield creek at Clifton. Sandy alluvium is the main soil type at the site. Associated species at the Clifton site are dominated by *Eucalyptus camaldulensis* and *Casuarina cunninghamiana*, with a variably dense shrubby understorey of *Hymenanthera dentata*, *Bursaria spinosa*, Acacia fimbriata, Acacia floribunda, Callistemon viminalis and *Leptospermum brachyandrum*. *Lepidium peregrinum* was most abundant in the tussock grassland fringe of the riparian open forest, comprising *Poa* species, *Lomandra longifolia* and *Paspalum dilatatum*. After 2001, the species was found near Tenterfield and south-eastern Queensland.	Unlikely No suitable habitat for the species is present. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible	NA	Low
Leucopogon confertus Torrington Beard-heath Source: PMST		E	*Leucopogon confertus* is known from only one collection along Silent Grove Road, near Torrington, in the NSW Northern Tablelands. It is possible that the species is extinct. Little is known of the habitat of *L. confertus*, but it may occur in open forest or woodland in rocky granite areas. This species occurs within the Border Rivers–Gwydir (NSW) Natural Resource Management Region. The distribution of this species overlaps with the “White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland and Derived Native Grassland”.	Potential Limited potential habitat is present within the Subject Land. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible	NA	Low
Polygala linariifolia Native Milkwort	E	-	Native Milkwort is an annual or perennial herb recorded to occur north from Copeton Dam and the Warialda area to southern Queensland; also found on the NSW north coast near Casino and Kyogle, and there is an isolated population in far western NSW near Weebah Gate, west of Hungerford. It occurs in sandy soils in dry eucalypt forest and woodland with a sparse understorey. The species has been recorded from the Inverell and Torrington districts growing in dark sandy loam on granite in shrubby forest of Eucalyptus caleyi, Eucalyptus dealbata and Callitris, and in yellow podsolic soil on granite in layered open forest. Flowers from spring to summer (OEH 2019).	Potential Limited potential habitat is present within the Subject Land. No known records of the species exist within the 10 km locality. The species was not recorded during surveys.	Negligible	NA	Low
Prasophyllum sp. Wybong (C.Phelps ORG 5269) A leek Orchid Source: PMST		CE	*Prasophyllum* sp. Wybong (C. Phelps ORG 5269) is a terrestrial orchid that grows to approximately 30 cm high. A perennial orchid, appearing as a single leaf over winter and spring. Flowers in spring and dies back to a dormant tuber over summer and autumn. Known to occur in open eucalypt woodland and grassland. Endemic to NSW, it is known from near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area. Most populations are small, although the Wybong population contains by far the largest number of individuals.	Potential Suitable habitat for the species is present within the Development Site. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible	NA	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
Rutidosis heterogama Heath Wrinklewort Source: BioNet, PMST	V	V	The Heath Wrinklewort is a small perennial herb to 30 cm tall. It grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides. It flowers mainly in Autumn. The species has been recorded from near Cessnock to Kurri Kurri with an outlying occurence at Howes Valley. On the Central Coast it is located north from Wyong to Newcastle. There are north coast populations between Wooli and Evans Head in Yuraygir and Bundjalung National Parks. It also occurs on the New England Tablelands from Torrington and Ashford south to Wandsworth south-west of Glen Innes.	Potential Limited potential habitat for the species might occur within the Subject Land. Surveys were undertaken outside the flowering period for the species. Only one record of the species exist within the 10 km locality and at approximately 5.4 km to the south from the Development Site. The species was recorded in 1999.	Negligible. Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
Swainsona sericea Silky Swainson-pea Source: BioNet	V		The Silky Swainson-pea is a prostrate or erect perennial, growing to 10 cm tall. The species flowers in spring and produces hairy pods. It is found in Natural Temperate Grassland and Snow Gum *Eucalyptus pauciflora* Woodland on the Monaro. It is also found in Box-Gum Woodland in the Southern Tablelands and South West Slopes. It is sometimes found in association with cypress-pines *Callitris* spp. Habitat on plains unknown. Regenerates from seed after fire.	Potential. Cypress pines, Whtie Cypress Pine (*Callitris glaucophylla*), was recorded within the Development Site. The Development Site is highly disturbed due to historical land use and current land use for grazing. Therefore, it is considered the species has a very low potential to occur within the Development Site. The species was not recorded during surveys in Spring and Summer. Only one record of the species exist within the 10 km locality and at approximately 3.5 km to the south-west from the Development Site. The species was recorded in 2003.	Negligible. Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
Thesium australe Austral Toadflax, Toadflax Source: PMST	V	V	The Austral Toadflax is a small, straggling herb to 40 cm tall. It is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Although originally described from material collected in the SW Sydney area, populations have not been seen in a long time. It may persist in some areas in the broader region. It occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. It is often found in association with Kangaroo Grass (*Themeda australis*). The species is a root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.	Potential Limited suitable habitat for the species is present within the Development Site. No records of the species exist within the 10 km locality and the species was not recorded during the September and December 2018 surveys.	Negligible	NA	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
Tylophora linearis Source: PMST	V	E	*Tylophora linearis* is a slender, almost hairless twiner with a clear sap. It grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa*, *Eucalyptus sideroxylon*, *Eucalyptus albens*, *Callitris endlicheri*, *Callitris glaucophylla* and *Allocasuarina luehmannii*. Also grows in association with *Acacia hakeoides*, *Acacia lineata*, *Melaleuca uncinata*, *Myoporum* species and *Casuarina* species. It flowers in spring, with flowers recorded in November or May with fruiting probably 2 to 3 months later.	Potential Limited suitable habitat for the species is present within the Development Site. No records of the species exist within the 10 km locality and the species was not recorded during the September and December 2018 surveys.	Negligible	NA	Low

APPENDIX E TEST OF SIGNIFICANCE AND SIGNIFICANT IMPACT ASSESSMENT

Test of Significance

The following Test of Significance (ToS) have been prepared in accordance with Section 7.3 of the BC Act and OEH (2018) *Threatened Species Test of Significance Guidelines*.

Grey-crowned Babbler (Pomatostomus temporalis) – Vulnerable

Species Overview

The Grey-crowned Babbler is a bird listed as vulnerable under the BC Act.

The Grey-crowned Babbler inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions. Its flight is laborious so birds prefer to hop to the top of a tree and glide down to the next one. Birds are generally unable to cross large open areas. It lives in family groups that consist of a breeding pair and young from previous breeding seasons. A group may consist of up to fifteen birds. All members of the family group remain close to each other when foraging. It is insectivorous and it forages on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses. It builds nests that are used as dormitory and roosting and uses them all year round. It breeds between July and February. Territory ranges from one to 50 hectares (usually ten hectares) and are defended all year.

Grey-crowned Babblers are obligate communal breeders that form a family group, in which offspring from the previous season and other unrelated birds help to raise the current's year's brood. Young birds stay with the family group for at least one year after fledging and may remain for two or more years acting as non-breeding helpers. As breeding spaces become available in the population, some helpers may disperse to establish their own breeding group. In some populations, breeding success is related to the number of helpers. Population viability studies in Victoria suggests that a viable population is likely to contain more than ten family groups, while populations with less than ten family groups are likely to have high rate of extinction. In NSW, the species breeds between July and February (OEH 2019).

It has been suggested that cooperative breeder species, such as the Grey-crowned Babbler, are more sensitive to habitat fragmentation and loss (including loss due to fire) as availability of resources for breeding decreases (Fischer 2011). Habitat fragmentation and predation by introduced species being the major threats to the species. The species is capable to survive in disturbed landscapes, such as urban areas, where proportion of ground cover and leaf litter provides sufficient food (Lambert and Ford 2016, Stevens *et. al*. 2015).

Results of the NSW BioNet atlas indicated that a total of three records of the Grey-crowned Babbler exists within the 10 km locality. None of those known (i.e. BioNet) records are within the Development Site. The nearest BioNet record of the species dates back to 2010 and was located approximately 500 m east of the Development Site.

The Grey-crowned Babbler was observed during surveys in September and December 2018, heard during the March 2019 survey and observed more recently during surveys in November 2019 and January 2020. In December 2018, the Grey-crowned Babbler was recorded at 20 locations on the Subject Land and a total of 21 bird nests likely to belong to the species were observed (see Figure 5.2). The records included six individuals observed, 21 calls heard with an additional two potential calls heard at distance. A pair was also observed adding twigs to a nest located on the lower branches of a Silver-leaved Ironbark (*Eucalyptus melanophloia*). At least 12 individuals were observed on and adjacent to the Subject Land during more recent surveys in November 2019 and January 2020.

The Grey-crowned Babbler was observed in the following vegetation types:

- 594_Moderate (Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion). This vegetation zone covers a total of 4.10 ha on the Subject Land;
- 596_Moderate (Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion). This vegetation zone covers a total of 11.15 ha are on the Subject Land;
- 544_Low (Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion). This vegetation zone covers a total of 0.83 ha on the Subject Land
- 516_Very Low (Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion). This vegetation zone covers a total of 3.00 ha on the Subject Land; and
- 516_Disturbed Grasslands (Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion). This vegetation zone covers a total of 7.39 ha on the Subject Land.

Test of Significance	
(a)	*in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*
	The Grey-crowned Babbler individuals observed within the Development Site are likely to be part of a single family group utilising the grassy woodlands and derived grasslands. Based on published information, the home range of a local population can range from one to 50ha (usually 10 ha). It is likely the family group range extends beyond the development footprint, as two potential Grey-crowned Babbler nests were recorded to the north-east from the Development Site. The movement of this species is expected to be largely confined to the woodland habitats as this species has limited flying capacity. The riparian corridors (with a 20-30m buffer) have been avoided although nests will be removed within the development footprint and any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region. The removal of 8 nests (38 % of the 21 nests recorded on site) will reduce the availability of roosting dormitories for the species, and will likely reduce available nesting sites for current breeding adults and for young individuals sexually mature seeking to establish breeding nests. Removal of trees with nests will be included in the vegetation clearing protocol including any seasonal constraints to avoid impacting any juveniles or unfledged chicks. The vegetation clearance protocol should also consider that nests are salvaged and translocated to a suitable location within the riparian corridor where possible. A portion of felled trees will be salvaged as foraging habitat for fauna and translocated to suitable areas in the remainder of the Project Boundary. Tree replacement is also proposed as a mitigation measure for loss of hollow bearing trees. Replacement of trees at a rate of 2:1 (i.e. two trees will be planted to replace each hollow bearing tree removed). This results in planting of 68 new trees within the riparian corridor. In the event that a newly-planted tree dies during the lifespan of the solar farm, the client has the responsibility to replace it in order to achieve a 100% recruitment of 68 trees. This is expected to improve the current fragmented condition of the riparian corridor and assist movement of the Grey-crowned Babbler along creek-lines outside of the Development Site and beyond the solar panel fields. Monitoring of the revegetation works would also include monitoring of the local Babbler population including population numbers and evidence on ongoing breeding (active nests). Based on the application of these mitigation measures the proposed solar farm is unlikely to result in an adverse effect on the life cycle of the species such that the local population might be placed at risk of extinction.
(b)	*in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:* *'(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
	Not applicable
	'(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
	Not applicable

Test of Significance	
(c)	*in relation to the habitat of a threatened species or ecological community:*
	(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
	The movement of this species is largely confined to the woodland habitats and riparian corridors as this species has limited flying capacity. Habitat to be removed includes 29.17 ha of woodland zones and 11.80 ha of Derived Native Grasslands. This constitutes 27.5 % of the Development Site. The riparian corridors (with a 20-30m buffer) have been avoided although 8 nests (38% of the 21 nests recorded on site) will be removed within the development footprint and any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region. No vegetation removal will occur outside of the Development Site and the remainder of the Property Boundary will not be modified as result of the current proposal.
	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
	The removal of native vegetation has the potential to result in fragmentation of fauna habitat, with resultant effects on fauna species movement, reproduction and gene flow. The impact of this vegetation clearance in an already highly modified landscape is anticipated to be negligible for species such as the Grey-crowned Babbler given that no significant fauna movement corridors currently exist within the development site (excluding the riparian corridor). The movement of this species is largely confined to the woodland habitats and riparian corridors as this species has limited flying capacity. The riparian corridors (with a 20-30m buffer) have been avoided and the proposed replacement tree planting is expected to improve the current fragmented condition of the riparian corridor and assist movement of the Grey-crowned Babbler along creek-lines outside of the Development Site and beyond the solar panel fields. Monitoring of the plantings would also include monitoring of the local Babbler population including population numbers and evidence on ongoing breeding (active nests). It is considered that the development of this site will not further isolate or fragment any known habitat linkages for the local population of Grey-crowned Babbler.
	(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
	The Development Site has been selected as being a suitable site for a solar plant based on its mostly cleared landscape with minimal vegetation removal required. Habitat to be removed includes 29.17 ha of woodland zones and 11.80 ha of Derived Native Grasslands (27.5 % of the Development Site). Although localised and short term impacts may be observed, the local population of Babbler would not be dependent on this habitat for their long term survival, particularly given the retention (and enhancement) of the riparian corridors which will assist movement of the Grey-crowned Babbler along creek-lines outside of the Development Site and beyond the solar panel fields.
(d)	*whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)*
	The proposed development is not located within areas listed as Critical Habitat Declarations in the Register of Declared Areas of Outstanding Biodiversity Value in NSW.

Test of Significance	
(e)	*whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key of a key threatening process.*

The proposed development of this site is likely to include the following key threatening processes (KTP):

- Infestation of habitat by invasive weed exotic perennial grasses.
- Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners.
- Nest predation by species such as ravens and butcherbirds in the fragmented landscape.

Mitigation measures such as weed management, monitoring and control of invasive and nuisance species will be required during the construction and operational phase of the proposed solar farm development..

Conclusion

Although localised and short term impacts may be observed, the local population of the Grey-crowned Babbler would not be dependent on development site for their long term survival, particularly given the retention (and enhancement) of the riparian corridors which will assist movement of the Grey-crowned Babbler along creek-lines outside of the Development Site and beyond the solar panel fields.

Loss of habitat for the Grey-crowned Babbler within the Development Site will require offsetting as per the BC Act. The possibility to offset the direct impact on habitat of the Grey-crowned Babbler by active management and/or enhancement of retained areas of habitat may be considered a viable option in consultation with BCD.

It is considered that with the implementation of mitigation measures, the proposed solar farm development will not result in any long term significant effect on the population.

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Bristle-faced Free-tailed Bat (Mormopterus eleryi) – Endangered

Species Overview

The Bristle-faced Free-tailed Bat or Hairy-nosed Freetail Bat (*Mormopterus eleryi* Reardon and McKenzie, 2008) (Reardon et. al. 2008) or *Mormopterus (Setirostris) eleryi* (Reardon et. al. 2014) is a microchiropteran bat species listed as endangered under the BC Act. The species was collected and referred to as *Mormopterus* 'Species 6' (e.g. Churchill 1988, Adams *et. al*. 1988) in publications prior to its formal description. The species is identified as data deficient in the action plan for Australian Bats (Duncan *et. al.* 1999).

The Bristle-faced Free-tailed Bat is distributed from the southern half of the Northern Territory to central Queensland and north-western NSW. The species appears to be extremely rare throughout its range. Nationally, it has been recorded from only 15 locations. In NSW, the species has been recently recorded from only three disjunct locations (NSW SC 2004, Pennay *et. al*. 2011, OEH 2019): thirteen individuals were recorded on 21 November 1998 at Yanda Creek in Gundabooka National Park, south of Bourke (Ellis 2001, Pennay 2006 in Scotts 2012); one individual was recorded in 2001 from Dhinnia Dthinawan Nature Reserve (formerly Bebo State Forest) (Pennay 2002); two individuals at and near Maroomba State Conservation Area (near Bonshaw) (Arden 2004 in Scotts 2012) and one individual captured on 25th March 2010 at the McIntyre River in Kwiambal National Park (Scotts 2012), Kwiambal National park and Maroomba State Conservation Area are located at approximately 37km south-west and 27km north-west from the proposed Bonshaw solar farm.

Knowledge of the ecology of the Bristle-faced Free-tailed Bat is limited, however evidence suggests that the species depends on hollows and tree fissures for roosting sites (NSW SC 2004, OEH 2019). All other Australian species from the family Molossidae, which includes the genus *Mormopterus*, generally roost in tree hollows and fissures (NSW SC 2004, OEH 2019) and Ellis (2001) recorded the species along with other six species known to roost in three hollows. Ellis and Wilson (1992) indicate that species within genus *Mormopterus* are aerial insectivorous with very high flight speed and limited manoeuvrability. They forage typically well-above the canopy and only coming low in relatively open areas. Three species within the genus *Mormopterus*, *M. nofolkensis*, *M. planiceps* and *Mormopterus* sp 1 were classified as an assemblage of vegetation dependent bats that generally fly over the canopy of any vegetation type when feeding; and which are dependent on hollows, usually in larger trees, for roosting and breeding (Ellis 2006).

At Yanda Creek (Gundabooka National Park), three individuals of the species were captured in a harp trap set under a *Eucalypt* tree on the margins of a dry creek (Ellis 2001), a similar habitat where the species' calls were recorded in the Bonshaw Solar Farm's assessment area. The habitat where the species was recorded by Ellis (2001) was a River Red Gum (*Eucalyptus camadulensis*) and Poplar Box (*E. populnea*) lined watercourse set in Poplar Box woodlands with areas of Mulga (*Acacia aneura*) shrublands in the vicinity. The species has also being regarded as using tree hollows for roosting with a "significant bias" for foraging and roost at locations along riparian habitats (Pennay 2006 in Scotts 2012). At Kwiamba National Park (Scotts 2012), the species was captured on a forested terrace adjacent to the McIntyre River where vegetation comprised a mixed over storey of Blakely's Red Gum (*Eucalyptus blakelyi*), Silver-leaved Ironbark (*E. melanophloia*) and Rough-barked Apple (*Angophora floribunda*). The mid-storey was generally sparse but with patch thickets of tea tree (*Leptospermum brevipes*) and White Cypress Pine (*Callitris glaucophylla*). A grassy understorey dominated the more open areas.

Lactating females had been recorded in November (Ellis 2001).

The calls of the Bristle-faced Free-tailed Bat were recorded in five of the eight SongMeters located within the assessment area. The records were analysed by Mr. Greg Ford (Balance!, see call report in Appendix I). Mr Ford is one of the most experience bat call analysis experts in Australia. Following consultation with BCD, Mr Greg Ford was requested to re-analyze the bat calls to ensure the records of the Bristle-faced Free-tailed Bat were confident. Regarding the Bristle-faced Free-tailed Bat, he noted that the calls of the species are similar to the non-listed Inland Broad-nosed Bat (*Scotorepens greyii*) but that the species can be differentiated based on their feeding buzzes (Ford 2018). A total of 53 definite calls of the species were recorded from S4 (11 definite calls) S2 (5 definite calls), S5 (25 definite calls), S6 (one definite call) and S7 (12 definite calls) (see Figure 5.2). The locations with the highest number of calls were S5 (25 calls), S7 (12 calls) and S4 (11 calls). These locations were near creek lines (S5 adjacent to a second order creek line with water, whereas S4 and S7 are located at/near a dry first order creek line).

Species Overview

Based record of the Bristle-faced Free-tailed Bat in the assessment area is considered to be a genuine record of this rare microbat species.

The Bristle-faced Free-tail Bat was recorded in the following vegetation types:

- 594_Moderate (Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion). A total of 18.78 ha of this vegetation zone is present within the Development Site.
- 594_Low (Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion). A total of 7.02 ha of this vegetation zone is present within the Development Site.
- 594_Disturbed Grassland is cleared land allocated as PCT 594 (Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion) for assessment purposes. A total of 45.95 ha of this vegetation zone is present within the Development Site.

Test of Significance

(a)	*in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*
	Little is known about the species and it has been assumed that similar to other species within the genus *Mormopterus*, it relies on tree hollows for roosting and maternity sites. It appears that the species is rare in NSW and no information is currently available regarding its habitat range, reproduction period and social activities although many of the existing records are along riparian habitats. This is also consistent with the results of the surveys within the Project Boundary, within a higher number of calls recorded near creek lines and water bodies. Within the Project Boundary, the riparian corridors (with a 20-30m buffer) have been avoided. A total of 60 hollow bearing trees were recorded across the assessment area, including 34 HBT within the development footprint. Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region and the removal of trees will be included in the vegetation clearing protocol including any seasonal constraints and monitoring of the hollows prior to removal to avoid impacting any breeding females or juveniles. If this species is confirmed utisiling any of the hollow bearing trees, the trees will be left undisturbed until further advice is sought from BCD and a suitably recognised bat expert. Tree replacement is also proposed as a mitigation measure for loss of hollow bearing trees. Replacement of trees at a rate of 2:1 (i.e. two trees will be planted to replace each hollow bearing tree removed). This results in planting of 68 new trees within the riparian corridor. In the event that a newly-planted tree dies during the lifespan of the solar farm, the client has the responsibility to replace it in order to achieve a 100% recruitment of 68 trees. This is expected to improve the current fragmented condition of the riparian corridor. As naturally formed tree hollows will take many decades to develop, nest-boxes suitable for hollow dependent microbats will be installed prior to HBT clearance and will be monitored during the lifespan of the solar farm Based on the recommended avoidance and mitigation measures outlined above, including the monitoring of the hollows prior to removal and consultation with BCD in the event that the species is confirmed utilising any of the hollows, it is unlikely that activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Species Overview	
(b)	*in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:*
	'(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
	Not applicable
	'(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
	Not applicable
(c)	*in relation to the habitat of a threatened species or ecological community:* *(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and*
	The Development Site is located in a highly disturbed environment that has undergone extensive clearing. Approximately 34 hollow-bearing trees (HBTs) will be removed across the Development Site, including at least three HBTs along first order streams. No trees will be removed along the second and third order creeklines, where echolocation calls of the Bristle-faced Free-tailed Bat is more frequently recorded. Also, it is estimated that a larger number of trees, particularly rough bark *Eucalyptus* and *Callitris* are available in vegetation to be retained within the Project Boundary and wider locality. Therefore the removal of approximately 34 trees will represent a small portion of trees available as breeding and roosting habitat for the Bristle-faced Free-tailed Bat. Loss of approximately 34 HBTs represent net-loss of suitable habitat for the Bristle-faced Free-tailed Bat and other hollow dependent fauna. However, on a landscape scale, loss of approximately 34 HBTs within a mostly cleared area is not considered significant when considering currently available tree resources elsewhere in the Project Boundary and broader locality.
	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
	The removal of native vegetation has the potential to result in fragmentation of fauna habitat, with resultant effects on fauna species movement, reproduction and gene flow. The impact of this vegetation clearance in an already highly modified landscape is anticipated to be negligible given that no significant fauna movement corridors currently exist within the development site (excluding the riparian corridor which will be avoided). As part of mitigation measures to compensate for loss of trees and vegetation, replacement of trees will be planted along the second and third order streams within the Project Boundary. This will increase the vegetation density along the creek-lines and enhance its value as a linking corridor with remnant vegetation fragments and paddock trees beyond the Development Site. This will also enhance corridors for mobile fauna such as the Bristle-faced Free-tailed Bat and other microbats recorded within the Project Boundary. Therefore, it is considered that the development of this site will not further isolate or fragment the existing landscape.

Species Overview	
	(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
	The Development Site has been selected as being a suitable site for a solar plant based on its mostly cleared landscape with minimal vegetation removal required. It appears that the species is rare in NSW and no information is currently available regarding its habitat range, reproduction period and social activities although many of the existing records are along riparian habitats. This is also consistent with the results of the surveys within the Project Boundary, within a higher number of calls recorded near creek lines and water bodies. Within the Project Boundary, the riparian corridors (with a 20-30m buffer) have been avoided. The importance of hollow bearing for this species within NSW is also not known however for the purposes of this assessment they have been assumed to be used for roosting and breeding. A total of 60 hollow bearing trees were recorded across the assessment area, including 34 HBT within the development footprint. Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region and the removal of trees will be included in the vegetation clearing protocol including any seasonal constraints and monitoring of the hollows prior to removal to avoid impacting any breeding females or juveniles. If this species is confirmed utisiling any of the hollow bearing trees, the trees will be left undisturbed until further advice is sought from BCD and a suitably recognised bat expert. Based on the recommended avoidance and mitigation measures outlined within this assessment, including the monitoring of the hollows prior to removal and consultation with BCD in the event that the species is confirmed utilising any of the hollows, the proposal is unlikely to remove any key habitats that will impact on the long-term survival of the local population.
(d)	*whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)*
	The proposed development is not located within areas listed as Critical Habitat Declarations in the Register of Declared Areas of Outstanding Biodiversity Value in NSW.
(e)	*whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key of a key threatening process.*
	Future development of this site is likely to include the following KTP: ■ Clearing and removal of hollow bearing trees as a consequence of firewood collection and agricultural and forestry practices. The proposal will remove HBT to give way to installation of solar panels. ■ Loss of habitat is exacerbated by its apparent low population numbers. ■ Lack of understanding about the species' ecology, distribution and habitat preferences. ■ Loss and degradation of foraging and roosting habitat, including changes in vegetation structure due to weed invasion. ■ Pesticides and herbicides may reduce the availability of insects, or result in the accumulation of toxic residues in individual's fat stores. The following mitigation measures will be implemented to minimise the potential of the above listed threats having negative effects on the species: ■ A weed management plan will be required to be implemented during the construction and operation phases of the solar farm. ■ Chemical use, such as pesticides and herbicides, will be controlled (or avoided) to prevent reduction of insect populations, a feeding resource for the species. This will also eliminate the possibility of trophic induced toxicity due to bioaccumulation in the bat species.

Species Overview

- Loss of hollow-bearing trees will be mitigated by replacement of nest boxes (short term mitigation measure) and replacement of trees suitable to develop hollows at their mature stage. It is noted that mature trees (i.e. with more than 80cm DBH) were rare at the site. It has been proposed that periods of time in the range of 180 to 238 years (e.g. soft bark Eucalypt spp.) or up to 324 years (e.g. ironbarks) are required for hollows suitable for fauna (e.g. bats) to form naturally on trees (e.g. Parnaby *et. al.* 2011). The development footprint area contains mature trees, but not old growth (i.e. trees with DBH greater than 100cm (DEC 2004)). Therefore, replanting trees suitable to naturally develop hollows, e.g. *Eucalypt* spp., has the potential to replace tree hollows in the long-term and provide natural habitat for hollow-dependent species, such as the Bristle-faced Free-tailed Bat. Evidence suggest that lineal planting and remnants are suitable habitat for bats in disturbed landscapes (Lentini *et. al.* 2012).

Conclusion

The conservation value of locations where the Bristle-faced Free-tailed Bat had been recorded is unknown due to the lack of knowledge on the biology and ecological requirements for the species. It is known that the species is rare and, based on the ecology of other species within the same genus, it has been assumed the Bristle-faced Free-tailed Bat to be tree hollow dependent. The pattern of the species being more frequently recorded along creek-lines than in other habitats in the landscape has emerged and the riparian corridors (with a 20-30m buffer) have been avoided.

Based on the recommended avoidance and mitigation measures outlined above, including the monitoring of the hollows prior to removal and consultation with BCD in the event that the species is confirmed utilising any of the hollows, it is unlikely that activity is likely to have an adverse effect on the life cycle of the species such that the local population of the species is likely to be placed at risk of extinction although it is noted that any clearing of native vegetation, including paddock trees has the potential to add to the incremental decline of potential habitat available within the region and will require offsetting in accordance with the offset scheme under the BC Act. The possibility to offset the impact on site by active management and/or enhancing retained areas of habitat might be considered as a viable option in consultation with BCD.

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Eastern Cave Bat (Vespadelus troughtoni) – Vulnerable

Species Overview

The Eastern Cave Bat (*Vespadelus troughtoni*) is a microchiropteran bat species listed as vulnerable under the BC Act.

The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tableland and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT (OEH 2019).

The profile for the species (OEH 2019) indicates the following with regards to the habitat and ecology of the species:

- Very little is known about the biology of this uncommon species.
- A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.
- Occasionally found along cliff-lines in wet eucalypt forest and rainforest.
- Little is understood of its feeding or breeding requirements or behaviour.

The Eastern Cave Bat was recorded in the following vegetation types:

- 594_Moderate (Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion). A total of 4.10 ha of this vegetation zone is present within the Development Site.
- 594_Low (Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion). A total of 9.54 ha of this vegetation zone is present within the Development Site.
- 594_Disturbed Grassland is cleared land allocated as PCT 594 (Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion) for assessment purposes. A total of 49.81 ha of this vegetation zone is present within the Development Site.

In accordance with the TBDC, the Eastern Cave Bat is also found in the other three PCTs recorded at the Development Site, i.e. PCT 516, 544 and 596.

Test of Significance

(a)	*in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*
	There is not suitable roosting or breeding habitat for the Eastern Cave Bat within the Development Site. The species is known to occur in the four PCTs recorded at the Development Site (i.e. PCT 594, 596, 544 and 516) and is likely that foraging resources for the species are present therein. Clearing within the Development Site will likely reduce potential foraging resources for the species. However, it is considered this is unlikely that activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Species Overview	
(b)	*in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:*
	'(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
	Not applicable
	'(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
	Not applicable
(c)	*in relation to the habitat of a threatened species or ecological community:* *(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and*
	The Development Site is located in a highly disturbed environment that has undergone extensive clearing. Approximately 29.17 ha of woodland and 11.80 ha of derived grasslands will be cleared within this disturbed environment. None of the vegetation to be cleared or the land where this will occur includes suitable roosting or breeding habitat for the Eastern Cave Bat. Therefore, the project will result in loss of a total of 40.97 ha of potential foraging habitat. However, on a landscape scale, loss of 40.97 ha within a mostly cleared area is not considered significant when considering currently available vegetated resources elsewhere in the Project Boundary and broader locality.
	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
	The removal of native vegetation has the potential to result in fragmentation of fauna habitat, with resultant effects on fauna species movement, reproduction and gene flow. The impact of this vegetation clearance in an already highly modified landscape is anticipated to be negligible given that no significant fauna movement corridors currently exist within the development site (excluding the riparian corridor which will be avoided). As part of mitigation measures to compensate for loss of trees and vegetation, replacement of trees will be planted along the second and third order streams within the Project Boundary. This will increase the vegetation density along the creek-lines and enhance its value as a linking corridor with remnant vegetation fragments and paddock trees beyond the Development Site. This will also enhance corridors for mobile fauna such as the Eastern Cave Bat and other microbats recorded within the Project Boundary. Therefore, it is considered that the development of this site will not further isolate or fragment the existing landscape.

Species Overview	
	(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
	The Development Site has been selected as being a suitable site for a solar plant based on its mostly cleared landscape with minimal vegetation removal required. The Development Site does not contain suitable roosting or breeding habitat for the Eastern Cave Bat, only potential foraging habitat is present therein. When considered at a larger spatial scale, loss of 40.97 ha of potential foraging ground in a disturbed land is not significant as more foraging habitat and at better condition is present in the broader locality. Therefore, the proposal is unlikely to remove any key habitats that will impact on the long-term survival of the local population.
(d)	*whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)*
	The proposed development is not located within areas listed as Critical Habitat Declarations in the Register of Declared Areas of Outstanding Biodiversity Value in NSW.
(e)	*whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key of a key threatening process.*
	Future development of this site is likely to trigger the following KTP: ■ Pesticides and herbicides may reduce the availability of insects, or result in the accumulation of toxic residues in individual's fat stores. ■ Probable predation by cats and foxes The following mitigation measures will be implemented to minimise the potential of the above listed threats having negative effects on the species: ■ Chemical use, such as pesticides and herbicides, will be controlled (or avoided) to prevent reduction of insect populations, a feeding resource for the species. This will also eliminate the possibility of trophic induced toxicity due to bioaccumulation in the bat species. ■ Monitoring and management of invasive pest species. This will minimize the possibility of predation on native species, such as microbats.
Conclusion	
	There is no suitable roosting and breeding habitat for the Eastern Cave Bat within the Development Site. The Development Site contains vegetation with potential foraging resources for the species. Given that little is known about the feeding behaviour of the Eastern Cave Bat, the conservation value of locations where the species had been recorded is unknown. Given that microchiropteran bats are considered to be insectivorous, use of pesticides and herbicides at the site will be avoided to prevent indirect impacts on insect populations and bioaccumulation on predators, such as the Eastern Cave Bat.

Species Overview	
	Based on the recommended avoidance and mitigation measures outlined above, including the monitoring of the invasive pest species and avoidance in use of herbicides and pesticides, it is unlikely that activity is likely to have an adverse effect on the life cycle of the species such that the local population of the species is likely to be placed at risk of extinction. Although it is noted that any clearing of native vegetation, including paddock trees has the potential to add to the incremental decline of potential habitat available within the region and will require offsetting in accordance with the offset scheme under the BC Act. The possibility to offset the impact on site by active management and/or enhancing retained areas of habitat might be considered as a viable option in consultation with BCD.
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Significant Impact Assessment

The following Significant Impact Assessment (SIA) have been prepared in accordance with DoE (2013) *Matters of National Environmental Significance. Significant Impact Guidelines 1.1 under the Environment Protection and Biodiversity Conservation Act 1999*.

Cicadabird (Coracina tenuirostris) – EPBC Act status: Marine

Species Overview

The Cicadabird (*Coracina tenuirostris*) is listed as Marine under the EPBC Act (DoEE 2019), whereas the subspecies Melville Cicadabird (*Coracina tenuirostris melvillensis*) is listed as Migratory. Given that Significant Impact Criteria for marine species is not provided in DoE (2013), the SIA for Cicadabird has been based on criteria for migratory species. The Cicadabird is listed as least concern (ALA 2019, BirdLife International 2017).

The Common Cicadabird (*Edolisoma tenuirostre* synonym *Coracina tenuirostris*) is a full migrant bird species found in Australia, Indonesia, New Guinea and the Solomon Islands (BirdLife International 2017, Wikipedia 2019). In Australia, the Cicadabird inhabits the northernmost part of the NT and WA. It also inhabits the eastern coast of Queensland, New South Wales and Victoria (see Screen Shot below). The species is considered native to the Northern Territory (ALA 2019).

Screen shot 1 Distribution of Cicadabird (source BirLife International 2017)

The natural habitat of the Cicadabird are temperate forests and subtropical or tropical moist lowland forests (Wikipedia 2019). The species is found in several habitats, including forest, artificial/terrestrial, savannah and shrubland. Of those habitats, temperate forests and subtropical/tropical moist lowland forests are habitats of major importance (BirdLife International 2017).

The Cicadabird's generation length is 4.6 years (BirdLife International 2017). The Cicadabrid is considered part of the frugivorous and insectivorous group of birds which has been observed breeding in February and December (Lavery 1985).

One individual of the Cicadabird was recorded in PCT 594 – Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion moderate condition adjacent to Disturbed Land.

Significant Impact Assessment – Significant Impact Criteria for Migratory Species	
(a)	*An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.*

Species Overview	
	The sole individual of the Cicadabird was recorded in a moderate condition forest within the Development Site. The Cicadabird has a wide distribution along the eastern coast of Australia and it is of least concern. Regarding the habitat where the species was recorded, the Development Site has undergone a long history of disturbance due to clearing, agriculture and grazing practices, including the vegetation where the species was recorded. The disturbed nature of the site along with the fact that only one individual of the Cicadabird was observed suggests that the species would not be a frequent visitor, or be dependant on any of the resources available. Therefore, it is not considered that the proposed development will substantially modify, destroy or isolate an area of important habitat for the Cicadabird.
(b)	*An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or*
	Information regarding invasive species harmful to the Cicadabird are not readily available (DoEE 2019). It has been assumed that predatory species feeding on birds (e.g. European Red Fox, Cats and Dogs) or species with aggressive behaviour (e.g. Noisy Miner) have potential to have negative effects on individuals and/or population of birds, such as the Cicadabird. It is not considered that the proposal will result in the establishment of invasive species. Therefore, it is not expected that significant negative effects on the Cicadabird due to interactions with invasive species will result from the proposed solar farm.
(c)	*An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.*
	Very little is known about the breeding, feeding, migratory and resting behaviour of the Cicadabird. Given its widespread distribution in eastern Australia, it is considered sufficient feeding and breeding resources for the species occur. Due to the Development Site being in a disturbed condition, it is not considered that critical feeding or breeding resources for the species are found. Therefore, it is not considered that the proposed solar farm will result in a significant impact on feeding or breeding resources for the species, nor will it result in disrupting its lifecycle or migratory behaviour.
Conclusion	
	The Cicadabird is widespread in eastern Australia and is a species of least concern. In spite of little knowledge about the species' feeding, breeding, roosting and migratory behaviour being available, the species continues to persist along the eastern coast of Australia, suggesting sufficient resources are present. The Development Site is a disturbed environment with cleared and disturbed vegetation. Remnant vegetation patches are disturbed (moderate to very low condition) and are not considered to represent critical habitat for the species. Therefore, it is considered that the proposed solar farm will not result in significant impacts on the species and that a referral to the Commonwealth is not deemed necessary as significant impacts to migratory/marine Matters of National Significance will not occur.

Species Overview	
References	

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Assessment of Significance

The following Assessment of Significance (AoS) have been prepared in accordance with DPI (2008) *Threatened Species Assessment Guidelines*. The DPI (2008) guideline, provide a series of criteria to assess whether a proposed development is likely to have significant effects on aquatic threatened species listed under the FM Act. An AoS has been prepared for three aquatic threatened species whose indicative distributional maps suggest they were likely to occur in creeks within the Development Site. The species are:

- Southern Purple Spotted Gudgeon (Endangered Species)
- Eel Tailed Catfish (Endangered Population)
- Olive Perchlet (Endangered Population)

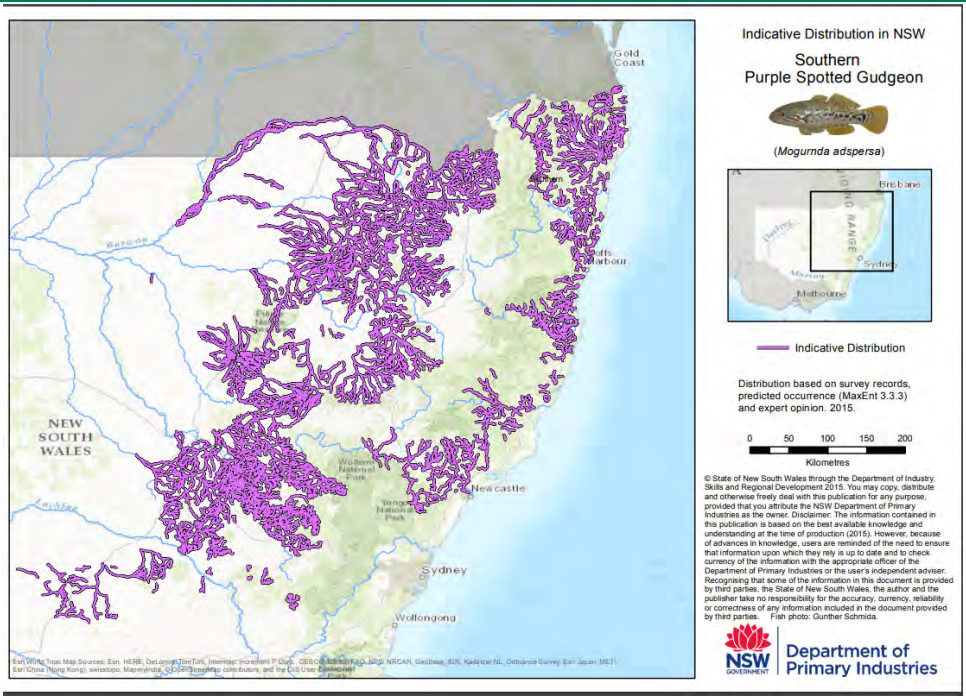
Southern Purple Spotted Gudgeon, Eel Tailed Catfish & Olive Perchlet

Species Overview
Southern Purple Spotted Gudgeon (*Mogunda adspersa*) – Endangered Species

The Southern Purple Spotted Gudgeon occur in inland drainages of the Murray-Darling basin as well as coastal drainages of northern NSW and Queensland. The western population of the Southern Purple Spotted Gudgeon was previously widespread in the Murray, Murrumbidgee and Lachlan River systems and tributaries of the Darling, but has experienced a significant decline in recent times. Southern Purple Spotted Gudgeons are now extremely rare in inland NSW, having been recorded from this area only once since 1983 (DPI 2019).

The Southern Purple Spotted Gudgeon generally grow to 15 cm in length. The species is found in slow moving or still waters of rivers, creeks and billabongs, often amongst weeds, rocks and snags. They feed mainly on insect larvae, but also consume worms, tadpoles, small fish and some plant matter. Female *Mogurnda adspersa* may lay several batches of eggs per season (30-1,300 per batch). The eggs are deposited in clusters on solid objects such as rocks, wood or broad-leafed plants. The male guards and fans the eggs until hatching (3-8 days). The species is part of the Endangered Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment, the Endangered Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River and the Endangered Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River (FSC 2008a).

Species Overview



DPI (2019) Indicative Distribution Map for the Southern Purple Spotted Gudgeon

A close review of DPI's indicative distribution map for the Southern Purple Spotted Gudgeon (see Figure 5.4) indicates that none of the creeks within the Project Boundary are mapped as habitat for the species.

Eel Tailed Catfish (*Tandanus tandanus*) – Endangered Population

The Murray-Darling Basin (MDB) population of Eel Tailed Catfish is listed as an Endangered population under the FM Act.

Eel Tailed Catfish is an Australian endemic fish species (DPI 2015). It is naturally distributed throughout the Murray-Darling Basin and in the Eastern drainages NSW north of Newcastle. Eel Tailed Catfish numbers in the Murray-Darling Basin have declined due to a range of impacts including invasive species, habitat degradation, cold water pollution and fishing pressures and are now virtually absent from the Murray, Murrumbidgee and Lachlan catchments (DPI 2019).

Eel Tailed Catfish is a medium-sized fish with a large head and a compressed rear portion of the body. It has a relatively long life span, living for at least 8 years (DPI 2015).It can grow up to 900mm in length and 7kg, however fish over 2kg are exceptional (DPI 2015, 2019). Colour ranges from grey to brown dorsally or laterally, usually mottled with dark brown to black blotchings with a whitish underbelly. Larger fish have less mottlings and can be greener in colour fading to white below (DPI 2019). Catfish are predominantly opportunistic carnivores, feeding mainly on small fish, freshwater prawns, yabbies, zooplankton and insects.

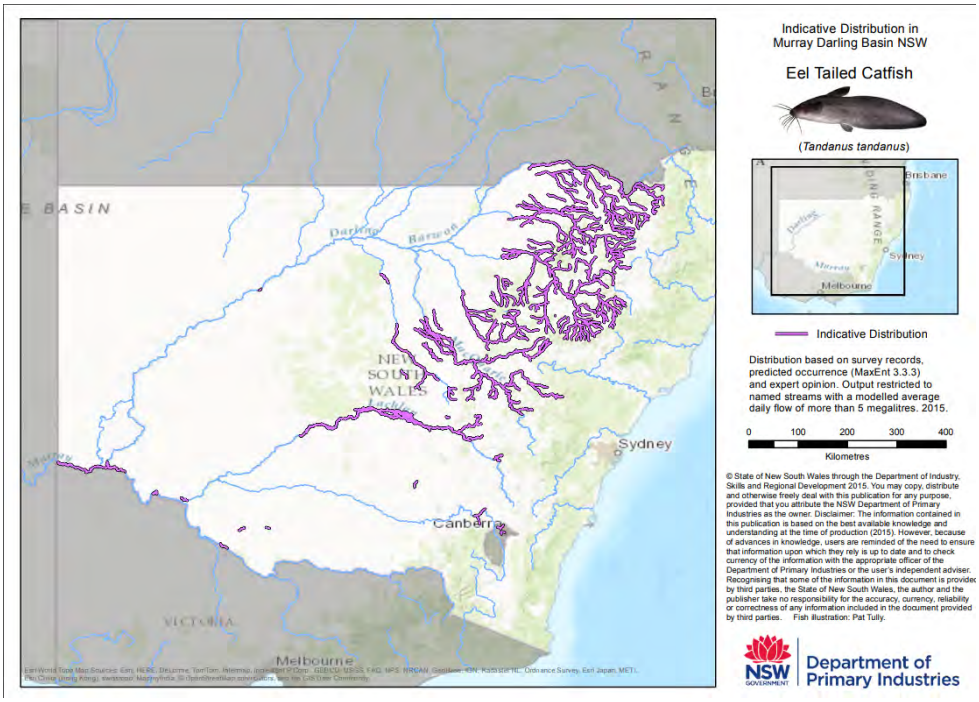
Individuals are sexually mature at 3-5 years of age and spawn in spring/summer when water temperatures are 20-24ºC (DPI 2015). Eel Tailed Catfish builds a nest in areas of still water to breed, and their reproduction is not temperature reliant. Males construct and defend a nest up to 2 metres in diameter, made from pebbles and gravel.

Eel Tailed Catfish is a non-migratory, benthic (bottom dwelling) species. It is relatively sedentary and adults typically only move within a 5 km range. Individuals are more active at night compared with during the day (DPI 2015, 2019). The species lives in a wide range of habitats including rivers, creeks, lakes, billabongs and lagoons, and although it inhabits flowing streams, prefers sluggish or still waters. It can be found in clear to turbid waters, and over substrates ranging from mud to gravel and rock. It is rare in natural riverine habitats but can be found in farm dams through-out inland NSW and southern Queensland (FSC 2008b). The species is relatively inactive and do not migrate for spawning, unlike other inland species such as Golden Perch or Murray Cod (DPI 2015, 2019).

Species Overview

Duncan et. al. (2017) indicated that Eel Tailed Catfish populations were most likely to be present in reaches of the MDB if there is a high cover of Cobble/Gravel, submerged macrophytes and low daily flow. Catfish are thought to prefer slow-moving or still waters and are found in greater abundance in lakes and backwaters. Breeding is more likely to occur at sites with a high abundance of Bedrock/Boulders, Riffle/Rapids, Emergent Macrophytes and low Daily Flow. They also note that in reaches of tributaries of the MDB where the species is currently extinct, it is unlikely that the species would naturally re-colonize and establish itself due to it being a not highly migratory species. Catfish have a relatively high minimum spawning temperature threshold relative to other native fishes in the MDB. Thermal pollution may partly explain their disappearance from some rivers in the MDB subject to cold-water releases from large impoundments.

The indicative distributional map for the species indicates the Project Boundary is within the portion of the Murray-Darling Basin where the species had been recorded (see DPI's image below). A zoom into the Project Boundary (see Figure 5.4) shows that the creeks within the Project Boundary are not mapped as habitat for the Eel Tailed Catfish. Duncan et. al. (2017) indicated that the species has disappeared from the Dumaresq River.



DPI (2019) Indicative Distribution Map for the Eel Tailed Catfish

Olive Perchlet (*Ambassis agassizii*) – Endangered Population

The Western Population of the Olive Perchlet in the Murray-Darling Basin (MDB) is listed as an Endangered population under the FM Act.

Olive Perchlets are a small native fish that occur in both eastern (coastal) and western (Murray-Darling) drainages, but these populations may be genetically distinct. The western population of the Olive Perchlet was once widespread throughout the Murray-Darling system of South Australia, Victoria, western New South Wales and southern Queensland. This population has suffered a serious decline and is now found only at a few sites in the Darling River drainage (DPI 2019).

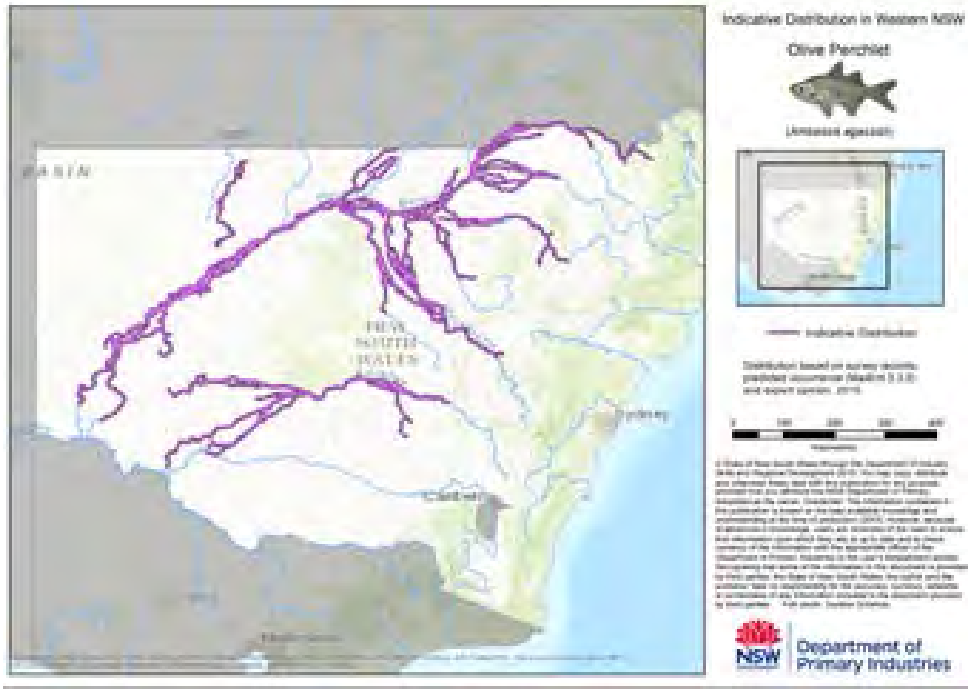
Olive Perchlets have an oval shaped body with a moderately large mouth, very large eyes and a forked tail. They are usually semi-transparent, with dark-edged scales forming a distinct pattern. The fins are generally clear, although there is often a broad, blackish band along the edges of the pelvic and anal fins. Olive Perchlet can grow to about 7080 mm but are more commonly less than 40 mm (DPI 2013, 2019).

Species Overview

Males and females reach sexual maturity at one year of age, and live for 2-4 years. Spawning occurs between October and December when the water temperature reaches 23°C. Females lay 200-700 eggs which attach to aquatic plants and rocks on the streambed. The eggs are scattered among vegetation. Both sexes reach maturity in one year, with some males surviving and breeding for two years and some females breeding in their third year (DPI 2009).

Olive Perchlet inhabit rivers, creeks, ponds and swamps. They are usually found in slow-flowing or still waters. They are usually found in sheltered areas such as overhanging vegetation, aquatic macrophyte beds, logs, dead branches and boulders during the day, and disperse to feed during the night. Olive Perchlet feed on a range of zooplankton and aquatic and terrestrial insects (DPI 2013, 2019).

The indicative distributional map for the species in the Murray-Darling Basin indicates the Project Boundary is within the portion of the Murray-Darling Basin where the species had been recorded (see DPI's image below (DPI 2019)). The current distribution of the species in the MDB has decreased (DPI 2013). A zoom into the Project Boundary (see Figure 5.4) shows that the creeks within the Project Boundary are not mapped as habitat for the Olive Perchlet.



DPI (2019) Indicative Distribution Map for the Olive Perchlet

Assessment of Significance

(a)	*In the case of threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*
	The six first order creeks to be lost as part of the proposed development are currently dry, as such, they do not represent suitable habitat for any of these aquatic fish species. The third, second and first order creeks within the Project Boundary to be retained were also dry at the time of surveys and are isolated from the broader riparian system due to the presence of Bruxner Way. During period of heavy rain and increase surface flow, the possibility exists for aquatic fauna, such as fish, to occasionally occupy these creeks in association with flooding events whereby they can be carried into the creeks by the flow and remained 'trapped' as waters recede. When such flood-induced occasional use of the creeks might occur, it is unlikely those individuals would establish a local population due to the lack of connectivity with the broader riparian system and ephemerality of the creeks.

Species Overview	
	The proposed development is unlikely to result in any impacts to any local population of these aquatic species nor it is predicted that the project or activities associated with it will put the species at risk of extinction.
(b)	*in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.*
	None of the creeks within the Subject Land provide habitat for any of the species assessed and the proposed development is unlikely to result in any impacts to any local population of these species or have any effect on the life cycle of any local population.
(c)	*in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:* *(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or* *(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*
	NA
(d)	*in relation to the habitat of a threatened species, population or ecological community:* *(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and* *(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and* *(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality*
	None of the creeks within the Subject Land provide habitat for any of the species assessed and the proposed development is unlikely to result in any impacts or remove any habitat critical to the survival of any local population of these species.
(e)	*whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)*
	No critical habitat for the three threatened fish species is present at the Development Site.
(f)	*whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan*
	Southern Purple Spotted Gudgeon No recovery plan or threat abatement plan is available for the Southern Purple Spotted Gudgeon. The final determination for the species indicates that threatening processes associated with the decline of the species are: ■ predation by introduced fish such as gambusia and redfin perch, ■ habitat loss, ■ rapid fluctuations in water levels (due to water regulation) that have deleterious effects on successful reproduction and recruitment. A Priorities Action Statement for the species is available in DPI (2019). The proposed development do not contravene any of the provided actions for recovery of the Southern Purple Spotted Gudgeon.

Species Overview

Eel Tailed Catfish:

No recovery plan or threat abatement plan is available for the Eel Tailed Catfish. The final determination for the species and its PrimaFace (DPI 2015) indicates that threatening processes associated with the decline of the species are uncertain, but that probably include:

- Historic commercial fishing;
- Loss of habitat (lakes, billabongs, lagoons) through river regulation;
- Interactions with introduced species, such as carp (*Cyprinus carpio*) and Redfin Perch (*Perca fluviatilis*);
- Loss of habitat and spawning sites through siltation;
- Reduced success of spawning and recruitment;
- Loss of habitat due to alterations to flow patterns and flooding regimes;
- Reduced habitat and loss of temperature spawning cues due to cold-water discharge from the base of large dams and high-level weirs;
- Loss of aquatic plants;
- Chemical pollution, including agricultural pesticides.

A Priorities Action Statement for the species is available in DPI (2019). The proposed development do not contravene any of the provided actions for recovery of the Eel Tailed Catfish.

Olive Perchlet:

No recovery plan or threat abatement plan is available for the Olive Perchlet. The final determination for the species and its PrimaFace (DPI 2013) indicates that threatening processes associated with the decline of the species may include:

- Predation by introduced fish such as Mosquitofish (*Gambusia holbrooki*) and Redfin perch (*Perca fluviatilis*).
- Habitat degradation and loss, including the removal of vegetation, logs and snags.
- Rapid fluctuations in water levels (due to river regulation) that have deleterious effects on successful reproduction and recruitment.
- Cold water pollution from impoundment water release restricting spawning.
- Loss of instream aquatic vegetation through the impacts of river regulation and carp (*Cyprinus carpio*).

A Priorities Action Statement for the species is available in DPI (2019). The proposed development do not contravene any of the provided actions for recovery of the Western Population of the Olive Perchlet.

Conclusion

None of the creeks within the Subject Land provide habitat for any of the species assessed and the proposed development is unlikely to result in any impacts or remove any habitat critical to the survival of any local population of these species.

Species Overview

References

DPI (2013) **PrimeFact: Olive Perchlet (western population) – *Ambassis agassizii*.** NSW Department of Primary Industries, Port Stephens.

DPI (2015) **PrimeFact: Eel-tailed Catfish population in the Murray-Darling Basin, *Tandanus tandanus***. NSW Department of Primary Industries, Port Stephens.

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FSC (2009) Recommendation Ambassis agassizii – (Olive Perchlet). Recommendation by the Fisheries Scientific Committee under the NSW Fisheries Management Act 1994 (Ref. No. RF17, File No. FSC 01/09).

Rourke M. and Gilligan D. (2010) **Population genetic structure of freshwater catfish (*Tandanus tandanus*) in the Murray-Darling Basin and coastal catchments of New South Wales: Implications for future re-stocking programs**. Industry & Investment NSW, Narrandera Fisheries Centre, Narrandera NSW.

APPENDIX F SURVEY METHODS AND EFFORT

Survey Method and Effort

Flora and fauna surveys were undertaken within the Development Site at locations shown in Figure 5.1. Environmental conditions are presented in Table F.1 below. Weather conditions are as per the Bureau of Meteorology's Applethorpe (Station 041175).

Fauna survey methods and effort are presented in Table F.1.

Targeted flora surveys methods and effort are presented in Table F.3.

Table F.1 Weather during Surveys

Date	Min Temp	Max Temp	Rainfall (mm)	Other
10/09/2018	3.1	22.6	0	
11/09/2018	6.0	20.3	0	
12/09/2018	5.1	21.7	0	
13/09/2018	5.1	24.2	0	
14/09/2018	5.2	25.4	0	
10/12/2018	14.0	30.7	0	
11/12/2018	16.0	27.4	0	
12/12/2018	14.2	30.3	0	
13/12/2018	14.2	29.2	0.2	
14/12/2018	17.0	27.7	26	
25/03/2019	19.6	29.9	0	
26/03/2019	19.1	24.1	0	
27/03/2019	14.6	17.8	1.2	
28/03/2019	14.0	21.7	1.2	
21/01/2020	24.4	37	0.2	
22/01/2020	20.5	38	0	

Table F.2 Summary of Fauna Survey Effort

Bird Surveys

Survey method: A 20 minute point survey was undertaken by one or two ecologists. Survey consisted of listening bird calling, observing birds activity using binoculars. Bird surveys are in general agreement with guidelines such as DEWHA (2010) *Survey guidelines for Australia's threatened birds*. *Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*.

Date	Survey ID	Start Time	Finish Time	Ecologists	Effort (man hours)	Notes
12/09/2018	B0	10:35	11.00	JW	0.40	Diurnal
10/12/2018	B1	19:22	19:42	TC, ACM	0.67	Dusk
11/12/2018	B2	19:25	17:45	TC, ACM	0.67	Dusk
12/12/2018	B3	18:27	18:27	TC, ACM	0.67	Dusk
13/12/2018	B4	10:48	11:08	TC, ACM	0.67	Diurnal
13/12/2018	B5	18:22	18:42	TC	0.33	Dusk
14/12/2018	B6	6:08	6:28	TC	0.33	Dawn
14/12/2018	B7	6:57	7:17	TC	0.33	Dawn
				Total Survey Effort	4.07	

Ecologists: ACM – Adriana Corona Mothe; JW – Joanne Woodhouse; TC – Thomas Cotter

Frog Surveys

Survey method: Frog surveys were undertaken using playback of the call of Tusked Frog (*Adelotus brevis*) using a mobile phone and a speaker. Two or three cycles of two minutes playing the call recording followed by two minutes listening for any response.

Date	Survey ID	Start Time	Finish Time	Ecologists	No Playback events	Playback Duration
12/12/2018	F1	22:15	22:23	TC, ACM	2	2 min call, 2 min listen
13/12/2018	F2	18:58	19:10	TC, ACM	3	2 min call, 2 min listen
14/12/2018	F3	7:30	7:38	TC, ACM	2	2 min call, 2 min listen
				Total effort (no call playback events)	7	Survey undertaken at suitable habitat for the targeted species.

Ecologists: ACM – Adriana Corona Mothe; TC – Thomas Cotter

Reptile Surveys

A total of seven reptile surveys were undertaken within rocky areas.

Reptile surveys were design to target the following:

- General reptile habitats
- Targeting habitat for the Zigzag Velvet Gecko (*Amalosia rhombifer*) in gum trees (e.g. *Eucalyptus blakelyi*) and Whyte Cypress Pine (*Callitris glaucophyla*).
- Targeting habitat for the Border Thick-tailed Gecko (*Uvidicolus sphyrurus*) in rocky habitats, coarse woody debris and leaf litter.
- Targeting habitat for the Pale Headed Snake (*Hoplocephalus bitorquatus*) treed areas, riparian areas and coarse woody debris.

Survey Method: Two ecologist undertook nocturnal spotlight surveys. Searches included turning rocks, searching underneath leaf litter piles and under logs. Spotlighting also targeted tree trunks. No recommended survey effort for the targeted species is readily available, therefore, survey effort was determined based on standard practice for reptiles, habitat availability at the Development site, species profiles and advice for similar species (e.g. geckos) as per DEWHA (2011) *Survey guidelines for Australia's threatened reptiles*.

Date	Survey ID	Start Time	Finish Time	Ecologists	Effort (Man hours)	Notes
10/12/2018	R1	20:21	20:41	TC, ACM	0.67	Rocky Area. Leaf litter, log, rock, granite. Eastern facing
10/12/2018	R2	19:57	10:17	TC, ACM	0.67	Rocky Area. Leaf litter (3cm depth), log and rock turn, granite, eastern slope
11/12/2018	R3	20:50	21:10	TC, ACM	0.67	Rocky Area. Leaf litter (2cm depth), east facing
11/12/2018	R4	21:26	21:46	TC, ACM	0.67	Rocky Area. Leaf litter (2cm depth), west facing
11/12/2018	R5	21:58	22:09	TC, ACM	0.33	Rocky Area
11/12/2018	R6	21:00	21:34	TC, ACM	1.13	Rocky Area
12/12/2018	R7	20:34	20:54	TC, ACM	0.67	Rocky Area
12/12/2018	R8	20:02	20:22	TC, ACM	0.67	Rocky Area
				Total Survey Effort	5.48	Survey effort for reptiles at the Development Site is considered sufficient given the extent of suitable habitat .

Ecologists: ACM – Adriana Corona Mothe; TC – Thomas Cotter

Camera Traps

A total of eight camera traps were installed across the Project Boundary. Camera traps used included:

- Four pocket camera SG565F-8M.
- Four UV565 cameras.

Survey method: Camera traps were set up targeting arboreal fauna, particularly that using tree hollows, such as Squirrel Glider (*Petaurus norfolcensis*). Camera traps were set up to record fauna during three or four nights. The cameras were timed to record fauna activity one hour before dusk to hour after dawn. Analysis of photographic records were undertaken by ERM's ecologists.

Unit ID	Date Set up	Date Removed	Recording Start Time	Recording Finish Time	Effort (Trap Nights)	Notes
C1	10/12/2018	14/12/2018	18:00 hrs	6:00 hrs	4	Camera set up on an ironbark. Directed at a hollow in adjacent *Angophora floribunda*. Lure used: honey water spray
C2	10/12/2018	14/12/2018	18:00 hrs	6:00 hrs	4	Camera set up on a *Eucalyptus albens* at 2m height. Directed at an adjacent *E. albens*.
C3	10/12/2018	14/12/2018	18:00 hrs	6:00 hrs	4	Camera set up on a *Callitris glaucophylla* and at 1,5m high. Directed towards a *Eucalyptus blakelyi* which had some arboreal mammal scratch marks.
C4	10/12/2018	14/12/2018	18:00 hrs	6:00 hrs	4	Camera set up on a *Hakea* sp. at 1.5m high. Directed towards a *Eucalyptus melanophloia* with hollow.
C5	11/12/2018	14/12/2018	18:00 hrs	6:00 hrs	3	Camera set up on a *Eucalyptus melanophloia* and at 2 m high. Directed towards adjacent *Eucalyptus melanophloia*'s trunk located at the edge of a drainage feature with water present.
C6	11/12/2018	14/12/2018	18:00 hrs	6:00 hrs	3	Camera set up on a *Dododanea* sp. and a 1.5 m high. Directed towards *Eucalyptus melanophloia* with hollows. Lure used: honey water spray.
C7	11/12/2018	14/12/2018	18:00 hrs	6:00 hrs	3	Camera set up on a *Callitris glaucophylla* and at 1.75m high. Directed towards adjacent a *Corymbia dolichocarpa* with hollow. Lure used: honey water spray.
C8	11/12/2018	14/12/2018	18:00 hrs	6:00 hrs	3	Camera set up on a stag at 1.5m high. Directed towards *Eucalyptus dealbata* trunk with hollows and scratch marks. Lure used: honey water spray.
				Total trap nights	28	Given that the Development Site has undergone intensive disturbance due to its historical and current land use, an intense level of survey (e.g. 14 night traps and using approximately 10 cameras per hectare (DSEWPC (2011) *Survey guidelines for Australia's threatened mammals*)) was not considered necessary. We targeted the most likely habitats were arboreal species might occur.

SongMeters

Eight SongMeter model SM2+ (Wildlife Acoustics Inc.) were used. A total of 28 trap nights were recorded using eight instruments during three to four nights.
The microchiropteran bat recordings were submitted for analyses by recognised bat call analysis expert, Mr Greg Ford (Balance! Environmental). The report is provided in Appendix I.

Unit ID	Date Set up	Date Removed	Recording Start Time	Recording Finish Time	Effort (Trap Nights)	Notes
S1	10/12/2018	14/12/2018	18:00 hrs	6:00 hrs	4	Unit set up on an *E. albens*' stag, adjacent dam with water.
S2	10/12/2018	14/12/2018	18:00 hrs	6:00 hrs	4	Unit set up on an *E albens* at 2 m high and directed to adjacent dam.
S3	10/12/2018	14/12/2018	18:00 hrs	6:00 hrs	4	Unit set up on an *Angophora floribunda*, at 1.5m high and along dry drainage feature.
S4	10/12/2018	14/12/2018	18:00 hrs	6:00 hrs	4	Unit set up on an *E. melanophloia*, at 1.5 m high and along dry drainage feature.
S5	11/12/2018	14/12/2018	18:00 hrs	6:00 hrs	3	Unit set up on an *A. floribunda*, at 2m high, facing drainage feature with water immediately adjacent. Lure used: honey water spray.
S6	11/12/2018	14/12/2018	18:00 hrs	6:00 hrs	3	Unit set up on an *E. melanophloia* with hollows, at 1.75m high and adjacent to a dry drainage feature.
S7	11/12/2018	14/12/2018	18:00 hrs	6:00 hrs	3	Unit set up on a *C. glaucophylla*, at 2m high, directed towards *C. glaucophylla* regrowth
S8	11/12/2018	14/12/2018	18:00 hrs	6:00 hrs	3	Unit set up on a stag, at 1.75m high, directed towards cleared land adjacent *Eucalyptus dealbata* with hollows.
				Total	28	A total of 28 trap nights were undertaken at the Assessment Area, including the Development Site (approx. 149.24 ha). In accordance with the OEH (2016*) 'Species credit' threatened bats and their habitats. NSW survey guide for the Biodiversity Assessment Method*. A minimum of 16 bat nights are required for a default 50ha site. For Subject Lands larger than 50 ha, survey effort is to be scaled up. Based on the highly disturbed and heavily modified nature of the Subject Land and the identification of 29.17 ha of Woodland Vegetation and 11.80 ha Derived Native Grasslands, this survey effort is considered appropriate. SongMeters were installed along riparian areas and areas most likely used by microchiropteran bats as potential flyways.

Ecologists: JW = Joanne Woodhouse; TC = Thomas Cotter; ACM = Adriana Corona Mothe.

Targeted flora survey method

Candidate flora species requiring survey were identified early on during Stage 1 of the project. Table F.3 shows the candidate species identified along with their flowering periods and habitats. Survey method consisted of the following:

- Random meander transects (RMT) were undertaken across the Development Site to undertake vegetation ground-truthing. Along RMT, where suitable habitat for a candidate flora species was identified, the corresponding species was searched for. This was undertaken during the spring and summer survey field trips.
- As part of vegetation mapping, habitat observations and vegetation community observation were undertaken at over 150 locations across the Development Site. At each of these locations, candidate species were searched for if suitable habitat was present.
- At BAM plot locations, candidate flora species were looked for within the BAM plot area. A total of 44 BAM plots were undertaken.

Table F.3 Candidate flora species identified during survey design

Common Name (Scientific Name)	BC Act	EPBC Act	Habitat Targeted	Stratum Targeted	Flowering Period	Survey period		
						Spring (September 2018)	Summer (December 2018)	Autumn (March 2019)
Native Milkwort (*Polygala linariifolia*)	V	-	Grassland, Woodlands with *Eucalyptus* spp. and *Callitris* spp.	Groundcover	Spring - Summer	x	x	
Scant Pomaderris (*Pomaderris queenslandica*)	E	-	Vegetated areas, particularly where gum trees (*Eucalyptus*) are present	Shrub	Spring - Summer	x	x	
Silky Swainson-pea (*Swainsona sericea)*	V	-	Grassland, Woodlands with *Eucalyptus* spp. and *Callitris* spp.	Groundcover	Spring	x		
Austral Toadflax (*Thesium australe)*	V	V	Grassland, Grassy Woodlands, areas with Kangaroo Grass (*Themeda australis*)	Groundcover	Spring	x		
Bluegrass *(Dichanthium setosum)*	V	V	Grassland, Grassy Woodlands	Groundcover	Summer		x	
Finger Panic Grass *(Digitaria porrecta)*	E	-	Grassland, Grassy Woodlands, areas with *Eucalyptus albens*	Groundcover	Summer		x	
Rodd's Star Hair (*Astrotricha roddii)*	E	E	Woodlands	Shrub	October to February	x	x	
Heath Wrinklewort (*Rutidosis heterogama)*	V	V	Open Forests, disturbed areas	Groundcover	Mainly Autumn			x

Common Name (Scientific Name)	BC Act	EPBC Act	Habitat Targeted	Stratum Targeted	Flowering Period	Survey period		
						Spring (September 2018)	Summer (December 2018)	Autumn (March 2019)
Ovenden's Ironbark (*Eucalyptus caleyi subsp. ovendenii)*	V	V	Grassy Woodlands, paddock trees	Canopy	July to September	x		
Narrow-leaved Black Peppermint (*Eucalyptus nicholii*)	V	V	Grassy Woodlands, paddock trees	Canopy	Autumn	x	x	x
*Notes: * Tree identification based on trunk and leave characteristics*								

APPENDIX G BAM PLOTS DATA AND PHOTOGRAPHS

BAM Plot field data sheets

A total of 44 BAM Plots were undertaken as part of this study. Field data sheets used included:

- Hard Copy: Field data sheet printed in paper were used to collect data in a total of 35 BAM plots (i.e. plot P1 to P5 and P15 to P44). This section presents scanned field data sheets of those BAM plots.
- Electronic: Electronic field data sheets was created in Survey 123 (ArcGIS). A tablet was used in the field to collect data for nine BAM plots (i.e. plots P6 to P14). Data for BAM plots collected with electronic data sheet are presented in tabular form in this Appendix.

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

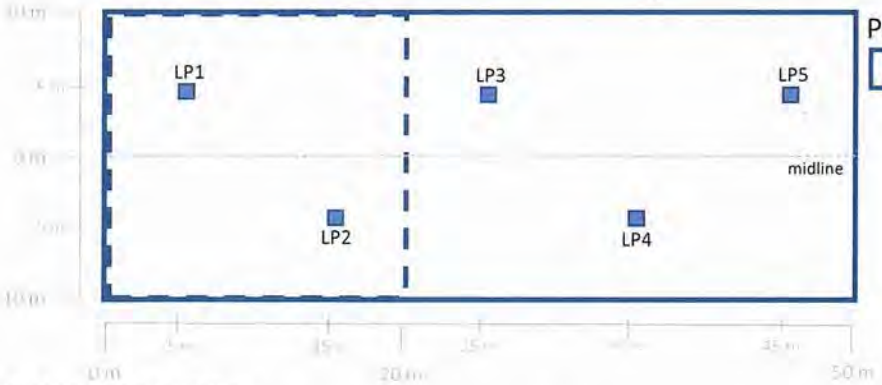
Date: 11 Sept 15 Recorders: JO + Adriana Plot ID: 1

Project No: _____ Project Name: Bonshaw Solar Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	56	IBRA region:	Nandewar		
Datum:		IBRA sub-region:	Nandewar Northern Complex		
Likely Vegetation Class:					Confidence H M L
Plant Community Type (PCT):	Silver Ironbark White Cypress		EEC:		Confidence H M L

BAM Nested Plots Requirement



Plots

20m x 50m

20m x 20m

1m x 1m

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	A75			86 E	✓	✓
50 m	A76					

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP / WP / Photo	1	2	3	4	5	Average
	WP	LP1	LP2	LP3	LP4		
Litter Cover (%)		5	35	70	80	20	
Bare Ground (%)		85	50	20	15	70	
Cryptogam Cover (%)		2	5	5			
Rock Cover (%)		8	5	5	5	10	

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)			
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 11/9/18 **Recorders:** Jo + Adriana **Plot ID:** 1

Project No: _____ **Project Name:** Bonshaw solar **Zone ID:** _____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm	1		1	
30 - 49 cm		1		
20 - 29 cm		IIII 1 = 6		1
10 - 19 cm		20 + 10 = 30		
5 - 9 cm		40		
<5 cm [b]		Callitris ✓	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		120 540 540 230 366 270 120 =2186		

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus,

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm
Callitris / stag	23	H1			1	-
silver ironbark	59	H2			10	-
stag	38	H3			6	

Field Data Sheet created by Dr Adriana Corona Mothe

O dry out

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400 m² plot: Sheet 1 of _	Survey Name	Plot Identifier	Recorders ACM / JW
Date 11 09 2018	Bonshaw	Plot 1	

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher	
	Callitris sp (Cipress) Callitris glaucophylla (White Cypress Pine)	N	30	2 + 28			+ (A)
	Iron bark (Eucalyptus melanophloia (Silver-leaved Ironbark)	N	15	1			
	S1 → Asteraceae sp. 1 10; • • • • 10, • • ; 30; 20; 30; 5; //	*	0.5	> 1000			
	S2 - (1) [Urtica urens (Small Nettle)] • 10; 20; 10; Sida corrugata (Native)	* N	0.1	155			
	Grass 1 Themeda triandra (Kangaroo Grass) • • 10, 10; • • ; 50	N	0.2	410			
	Clove 1 - Oxalis perennans // ; 10; 50	N	0.1	62			Y alow Stem
	W1 - Actinotus sp. 1 • • • • • • • • • • • • • ; 5; // ; 20; 30	N	0.2	2000			
	N2 - ~~Trifolium sp. Eucalyptus nutans~~ Trifolium sp. 1 ; 20; 4	* N	0.1	24			+ (B)
	Opuntia? Opuntia aurantiaca (Tiger Pear) //	*	0.1	17			
	W2 - Hypochaeris radicata (Flatweed) 10 • //	*	0.1	112			
	Grass 2 ~~Sporobolus sp~~ Tripogon longiformis • • ; 53; /	N	0.1	300			
	N2 Pimelea nova-anglica /	N	0.1	1			
	(B) Clove 2 → Trifolium sp. 2 • ; 20; //	*	0.1	122			
	W3 - Solanum sp. 1 10; //	*	0.1	12			
	Grass 3 Panicum sp. /	*	0.1	1			
	W4 Geranium molle (Cranesbill Geranium) /	*	0.1	1			
	(A) N3 Callitris glaucophyla (regeneration mostly eaten) //	N	0.1	2			
	W5 - Gamochaeta sp. 1 20	E	0.1	20			black dots unused
	N4 - Eucalyptus nutans /	N	0.1	1			
	(1) Urtica urens (Small Nettle)	*	0.1	145			
	Sclerolaena birchii	N	—	X			

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

• ≤ 100

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

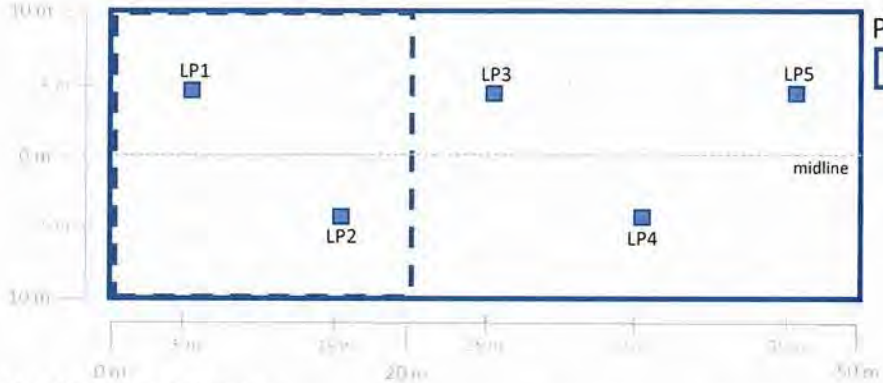
Date: 11/09/18 **Recorders:** Jo : Adriana **Plot ID:** 2

Project No: _____ **Project Name:** Bonshaw Salcal **Zone ID:** _____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar		
Datum:		**IBRA sub-region:**	Nandewar Northern Complex		
Likely Vegetation Class:					Confidence H M L
Plant Community Type (PCT):	Grey Box Grassy Woodland or open Box		**EEC:**		Confidence H M L

BAM Nested Plots Requirement



Plots
- 20m x 50m
- 20m x 20m
- 1m x 1m

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	787	151.33768°	29.20992	344°N	✓	✓
50 m	788	151.33763°	29.20946	–	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	LP1	LP2	WP 10	11	13	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		100.	80.	65.	70.	60.	
Bare Ground (%)							
Cryptogam Cover (%)							
Rock Cover (%)							

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type		**Landform Element**		**Landform Pattern**		**Microrelief**	
Lithology		**Soil Surface Texture**		**Soil Colour**		**Soil Depth**	
Slope		**Aspect**		**Site Drainage**		**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)			
Cultivation (incl. pasture) ✓			
Soil Erosion ✓			
Firewood | CWD removal			
Grazing (identify native/stock) ✓			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 11/09/18 **Recorders:** Jo + Adriana **Plot ID:** 2

Project No: _____ **Project Name:** Bonshaw Solar. **Zone ID:** _____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm	1		1	
50 - 79 cm	11		1	
30 - 49 cm				
20 - 29 cm	11	11		
10 - 19 cm		1		
5 - 9 cm		8		
<5 cm [b]		40	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		350 - 520 810 400 70 - 1080 140 - 990 610. =5670		

Total = 4970 = 49.7

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus,

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

1 m dbh >320cm
WP 15 Hollow

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm
Grey Box	140	16			IIII	1
Grey Box		17			IIII 1	

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	10 09 2018	0470861-Bonshaw	2	ACM, JW

GF Code	*Top 3 native species in each growth form group: Full species name mandatory* *All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
T	Grey Box Eucalyptus microcarpa	N	30	12		
T	Ironbark → Eucalyptus melanophila (Silver-leaved Ironbark)	N	20	1		
	Small Tree 1 Ficus sp. 1	N	0.3	7		
	Small Tree 2 Notelaea longifolia	N	30	47		
	Small Tree 3 Notelaea microcarpa	N	0.1	1		
	N1, small shrub up to 80cm high Pittosporum spinescens / ////	N	0.1	6		
	Grass 1 Tripogon longiformis • 10; 10; ///	N	0.1	123		
	Clove 1 Yellow flower Oxalis perennans •; 5; 10; ///	N	0.1	119		
	Grass 2 Sporobolus elongatus //	N	0.1	2		
	W1 Asteraceae sp. 1 • 10	*	0.1	110		
	W2 Asteraceae sp. 2 10; 20	*	0.1	30		
	N2 Euphorbia sp. 1 / //// ////	*	0.1	21		
	N3 Pimelea neo-anglica ///	N	0.1	4		
	N4 Melichrus sp. 1 /	N	0.1	1		
	Cypress 1 → Callitris glaucophylla (White Cypress Pine) ///	N	0.1	3		
	Grass 3 Schoenus sp. 1 60; //	N	0.1	62		
	Clove 2 Trifolium sp. 1 //	*	0.1	2		
	N5 white central vein Vine Parsonia sp. 1 •; 12; //; 10	N	0.1	124		
	Opuntia (same as plot 1) Opuntia aurantiaca /	E	0.1	1		
	V1 Hardenbergia violaceae /	N	0.1	1		
	V2 (*) <1cm Pandorea pandorana 10(T)+ /	N	0.1	11		
	N6 rhizome Dichondra sp. A ///	N	0.1	3		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

• = 100

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

Date: 11/9/18 **Recorders:** Jo, Adriana **Plot ID:** 3

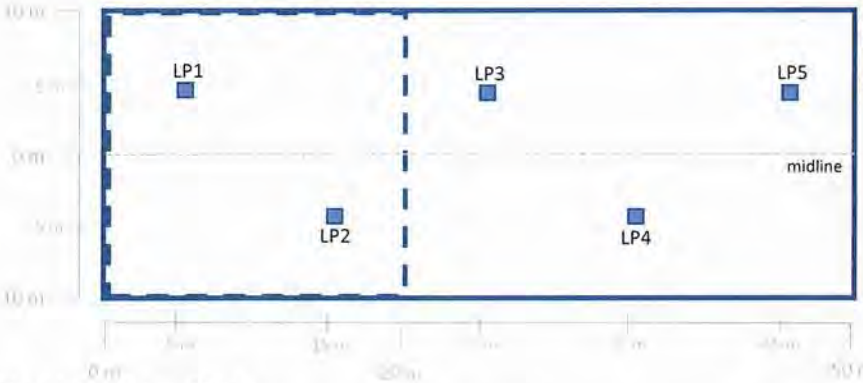
Project No: _____ **Project Name:** Bonshaw Solar **Zone ID:** _____

Desktop Information Requirements for BAM Plot survey

Zone:		**IBRA region:**	Nandewar		
Datum:		**IBRA sub-region:**	Nandewar Northern Complex		
Likely Vegetation Class:					Confidence H M L
Plant Community Type (PCT):	? Rough-barked Apple - White Cypress Pine - Blakely's Red Gum woodland		**EEC:**		Confidence H M L

BAM Nested Plots Requirement

4 monitors.



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	790	151.39035	29.21024°	24° NE	✓	✓
50 m						

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	19	20	21	22	23	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		65	30	20	10	90	
Bare Ground (%)		15	20	40	50	5	
Cryptogam Cover (%)							
Rock Cover (%)		20	~~40~~ 50	40	40	5	

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type		**Landform Element**		**Landform Pattern**		**Microrelief**	
Lithology		**Soil Surface Texture**		**Soil Colour**		**Soil Depth**	
Slope		**Aspect**		**Site Drainage**		**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)			
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: _____ **Recorders:** _____ **Plot ID:** 3

Project No: _____ **Project Name:** _____ **Zone ID:** _____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm	1		1	
30 - 49 cm	1			
20 - 29 cm		1		
10 - 19 cm		1		
5 - 9 cm		1		
<5 cm [b]	1	10	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)	530 150 400 910 520 330 160 610			= 3710

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus,

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm
Ironbark (Eleba?)	65	24			1	11

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 10 09 2018	0470861- Bonshaw	3	ACM / JW

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	Ironbark (E. crebra)	N	25	1	Canopy	
	Red Gum (E. blakely ?) → 5-03-2019 Tom Cotter confirmed the plant ID as E. dealbata	N	20	2	Canopy	1 <10cm ø
Ⓐ	Callistris glaucophylla (from < 20cm to Small trees)	N	0.2	1+ 13	Ground - < 50cm	
	[N2 - Pimelea neo-anglica] →		0.1	3	Small Shrub	
	Grass 1 → Poa sp. 1 10 ; >500	*	0.1	600	Ground	
	Fern 1		0.1	22	Ground	
	Opuntia (bare) Opuntia aurantiaca	*	0.1	2	Ground	
	[N1 Ozothamnus cassinioides] 50,		0.1	17,3	Ground - Shrub	
	Grass 2 Eragrostis sp. 1 10	*	0.1	10	ground	
	W1 Senecio sp. 1	*	0.1	6	ground	
	Clove 2 (as plot 2) Trifolium sp. 1 / ; 5	*	0.1	6	ground	
	Clove 1 (velvety one) Sclerohena birchii 8; 10;	N	0.1	28	ground	
	W2 Urtica urens 10;	*	0.1	32	ground	
	N3 = Ⓐ but grazed to ground	N	0.1	1	ground	
	Clove 3 (= Clove 1 Plot 1) Oxalis perennans ; 5	N	0.1	8	ground	
	W3 Plantago sp 1	*	0.1	1	ground	
	W4 Goodenia sp. 1	N	0.1	7	ground	
	W as in Plot 1 Asteraceae sp. 1	*	0.1	1	ground	

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, …, 1, 2, 3, …, 10, 15, 20, 25, …100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, …, 10, 20, 30, … 100, 200, …, 1000, …

Overall - bare ground
Soil + Silty-gravelly shale fragments
Ant? holes
rabbit
Most shrub-small trees chewed

741 @ 50m

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

Date: 12-09-2018 **Recorders:** ACM / JW **Plot ID:** 4

Project No: 0470961 **Project Name:** Bonshaw Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:		**IBRA region:**	Nandewar		
Datum:		**IBRA sub-region:**	Nundewar Northern Complex		
Likely Vegetation Class:					Confidence H M L
Plant Community Type (PCT):	Cleared - Non-native		**EEC:**		Confidence H M L

BAM Nested Plots Requirement

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
50 m	796	0338834	6768241	—	✓	✓
50 m	~~796~~ 797	0338827	6768189	1° N	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	798	799	800	801	802	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		15	2	0	85	80	
Bare Ground (%)		60	95	90	5	10	
Cryptogam Cover (%)		5	5	5	0	0	
Rock Cover (%)		0	2	0	0	0	

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type		**Landform Element**		**Landform Pattern**		**Microrelief**	flat
Lithology		**Soil Surface Texture**		**Soil Colour**	light orange	**Soil Depth**	
Slope	gentle <15° downslope to N	**Aspect**	N	**Site Drainage**		**Distance to nearest water and type**	Creek to East

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)			
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 12-09-2018 **Recorders:** ACM / JW **Plot ID:** 4

Project No: _____ **Project Name:** 0470861 **Zone ID:** _____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm	—			
50 - 79 cm	—			
30 - 49 cm	—			
20 - 29 cm	—			
10 - 19 cm	—			
5 - 9 cm	—			
<5 cm [b]	—		n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)	2;1;2,2;3 = 10			

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus,

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

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400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	12 09 2018	0470861- Bonshaw	4	ACM, JW

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	Kangaroo Grass Themeda triandra	N	0.1	200		
	Oxalic perennans	N	0.1	37		
	Kidney weed (4-1) Dichondra repens	N	0.1	20		
	Rock Fern Cheilantes sieberi	N	0.2	240		
	W1 (Mint Tile) Stingy-orp Urtica urens	*	0.1	27		
	Grass 1 * Dichanthium setosum (Bluegrass)	N	0.2	305		
	Trifolium sp 1	*	0.1	3		
	Opuntia aurantiana	*	0.1	4		
	N1 → Ericaceae (N?) Pimelea neo-anglica	N	0.1	17		
	W2 Goodenia sp. 1	N	0.1	2		
	Cactaceae Sclerolaena birchii	N	0.1	16		
	Cactus tree Opuntia tomentosa	*		X		
	W3 Wahlembergia graniticola	N	0.1	3		
	W4 Senecio sp. 1	*	0.1	1		
	Callitris sp 1 (< 7cm grazed)	N	0.1	1		
	Grass 2 Sporobolus elongatus (Slender Rat's Tail Grass)	N	0.1	5		
	W5 Euphorbia dallachyana	N	0.1	1		
	Pea flower Bossiaea scortechinii	N	0.1	3		
	Cyperaceae → Schoenus sp. 1	N	0.1	1		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

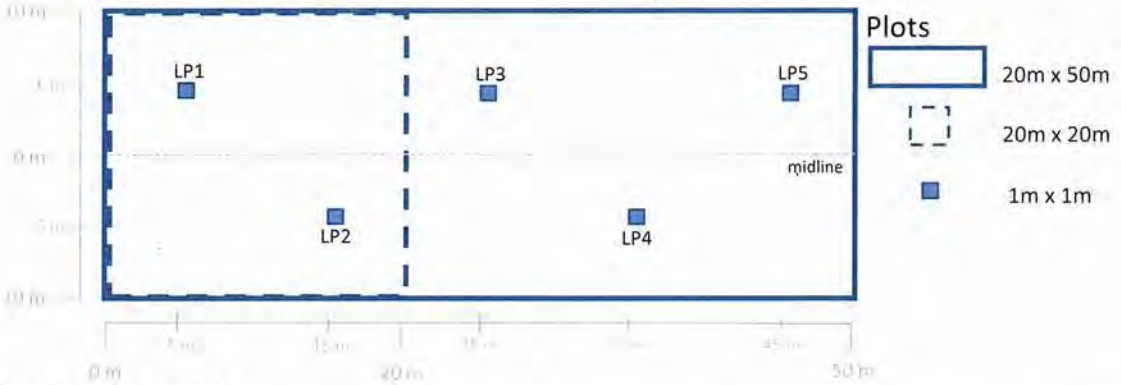
Date: 12-09-2018 **Recorders:** ACM / JW **Plot ID:** 5

Project No: 0470861 **Project Name:** Bonshaw Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:		**IBRA region:**	Nandewar		
Datum:		**IBRA sub-region:**	Nandewar Northern Complex		
Likely Vegetation Class:					Confidence H M L
Plant Community Type (PCT):			**EEC:**		Confidence H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	804	0339451	6768659	239° SW	✓	✓
50 m	803	0339402	6768675	201° S	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	29	30	31	32	33	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		82	90	85	20	98	
Bare Ground (%)		3	6	15	6	2	
Cryptogam Cover (%)							
Rock Cover (%)		15	4	-	74	-	

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type		**Landform Element**		**Landform Pattern**		**Microrelief**	
Lithology		**Soil Surface Texture**		**Soil Colour**		**Soil Depth**	
Slope		**Aspect**		**Site Drainage**		**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)			
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: _____ **Recorders:** _____ **Plot ID:** 5

Project No: _____ **Project Name:** _____ **Zone ID:** _____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm	I			
30 - 49 cm	IIII		I	
20 - 29 cm	IIII IIII IIII II		I	
10 - 19 cm	III			
5 - 9 cm	I	I		
<5 cm [b]	✓	✓	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)	810. 690 900 220 310 420 = 3,350 cm = 33.5m			

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus,

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm
red/Grey Gum?	38	34			II	
red/Grey Gum?	20.	35			I	
as above.?	23	36			I	
as above ?	54	37			II	I

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 12-09-2018	0470961- Bonstrain	S	ACM / JW

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	Gum 1 (Eucalyptus dealbata ? ~~sample~~) ① Juvenile < 30cm height → E. prima	N	20	12① + 6		
	Gum 2 [Corymbia sp.] E. dealbata	N	15	2		
	Callistris sp. 1 (Cypress grazed down to < 20cm) Callitris glaucophylla	N	0.2	166		
	N1 Pimelea neo-anglica //	N	0.1	2		
	Opuntia ~~aurantiaca~~ tomentosa ////	*	0.1	4		
	Grass 1 (perennial) Sporobolus elongatus ; 12	*N	0.1	12		
	Kidney weed ⊕ (vs Pb 4) Dichondra repens 200; 20; //	N	0.1	222		
	Rock Fern Cheilanthes sieberi • ;7 ;2; 10, ///; 3; 6	N	0.1	133		
	N2 Goodenia sp. ///	N	0.1	3		
	Oxalis perennans //	N	0.1	2		
	Grass 2 Trepogon longiformis > 1,000 tiny clumps ////	N	0.1	1000		
	W1 Bossiaea sp. ;4	N	0.1	4		
	W2 Undetermined 2	*	0.1	2		
	Vine 1 Pandorea pandorana /	N	0.1	1		
	Shrub 1 Dodonaea viscosa subsp. spatulata /	N	0.1	1		
	Rostellularia adscendens	N	X	X		
	Corymbya sp.		X			

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Rock section

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

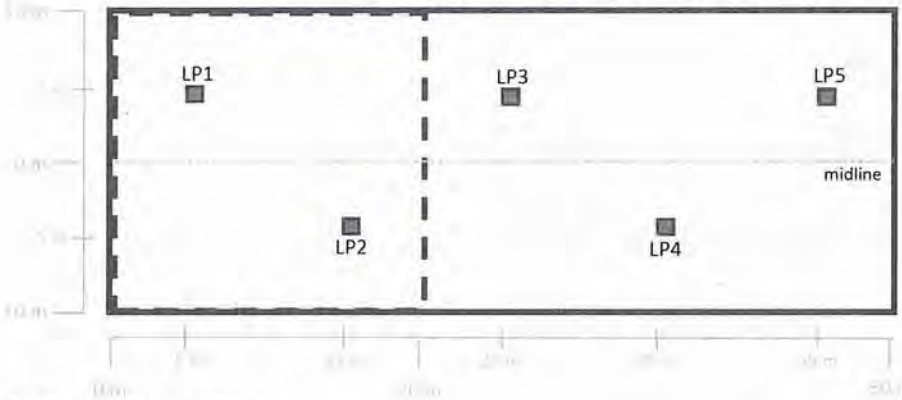
Date: 25 - March - 2019 **Recorders:** ACM, TZ **Plot ID:** 15

Project No: 0470861 **Project Name:** Bamshaw Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar		
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex		
Likely Vegetation Class:					**Confidence** H M L
Plant Community Type (PCT):			**EEC:**		**Confidence** H M L

BAM Nested Plots Requirement



20x50 ✓

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1458	0338451	6767511	143° SE	✓	✓
50 m	1464	0338482	6767479	285° W	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1459	1460	1461	1462	1463	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		60	30	80	80	95	69
Bare Ground (%)		25	70	18	20	5	29.6
Cryptogam Cover (%)		1	0	1	2	2	1.4
Rock Cover (%)		5	0	2	0	0	1.4

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Slope	**Landform Element**	Hillslope	**Landform Pattern**	Low hill - flat	**Microrelief**	
Lithology		**Soil Surface Texture**	Mostly Leaf litter	**Soil Colour**	light brown	**Soil Depth**	-
Slope		**Aspect**		**Site Drainage**		**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	2	O	Stems present
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 25-03-2019 **Recorders:** ACM, TZ **Plot ID:** 15

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** ____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm	// =2		// =2	
50 - 79 cm	////// / =6		//// =5	
30 - 49 cm		/// =3		
20 - 29 cm		//// / =6		
10 - 19 cm		6, //// 5, 4, 4, // =26	////	
5 - 9 cm		11, 8, //// 6 =25	//	
<5 cm [b]		7, 38, 6, 18, 20 =89	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		3, 2, 3, 1, 4; 9, 7, 3, 4, 9, 10, 5, 6 =66		

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm
Silver-leaved Ironbark	83	1465	0338478	6767484	2 hollows 15cm	
"	49.5	1466	0338477	6767487	1	
"	82	1467	0338461	6767487	4 x <10cm / 1 x 15cm	
"	52	1468	0338454	6767514	1 x 10cm	
"	51	1469	0338459	6767506	1 x <10cm	
E. albens	72	1470	0338465	6767503	1	1
E. albens	54	1471	0338478	6767491	1	

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 25/3/2019	Bonshaw	15	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Eucalyptus melanophloia		20	3	T	
	Eucalyptus albens		5	1	T	
	Callitris glaucophylla		15		S	
	Pimelia stricta		0.1	21		
	Chloris truncata		0.1	10		
	Aristida ramosa		0.1	10		
	Carrinia sp.		0.1	5		
	Cymbopogon refractus		0.2	10		
	Cyperus gracilis		0.1	50		
	Opuntia auracantiaca		0.1	4		
	Digitaria diffusa		0.1	20		
	Austrostipa scabra		0.2	100		
	Einadia nutans		0.1	10		
	Cheilanthes sieberi		0.1	7		
	Rostellularia adscendens		0.1	100		
	Sida corrugata		0.1	50		
	Vittadinia sulcata		0.1	1		
	Notelaea microcarpa		0.1	6		
	Glycine clandestina		0.1	26		
	Boerhavia dominii		0.1	1		
	Enneapogon gracilis		0.3	600		
	Sclerolaena birchii		0.1	1		
	Eutolasia stricta		0.2	50		
	Dichondra sp. A		0.1	3		
	Solanum ferocissimum		0.1	1		
	Pandorea pandorana		0.1	1		
	Bothriochloa decipiens		0.1	7		
	Aristida leptopoda		0.1	5		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Total gram cover 1%

g/c live 1.5%

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

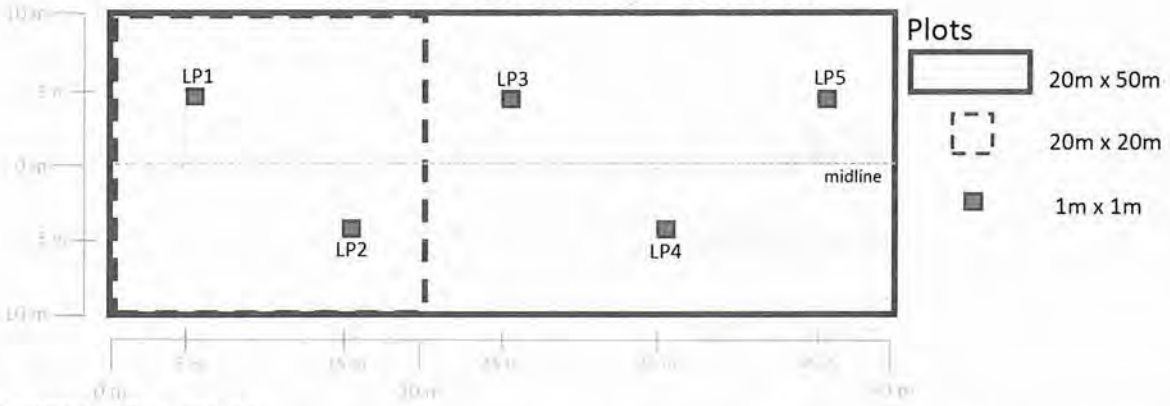
Date: 25-03-2019 **Recorders:** ACM, TZ **Plot ID:** 16

Project No: 0470861 **Project Name:** Ronsbaw Solar Farm **Zone ID:** _____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar		
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex		
Likely Vegetation Class:					Confidence H M L
Plant Community Type (PCT):	594	**EEC:**			Confidence (H) M L

BAM Nested Plots Requirement



50 x 20m ✓

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1472	0338659	6767564	255° W	✓	✓
50 m	1473	0338619	6767587	118° SE	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1477	1478	1479	1480	1481	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		80	90	85	10	1	53.2
Bare Ground (%)		20	5	5	90	98	43.6
Cryptogam Cover (%)		1	0	5	0	0	1.2
Rock Cover (%)		2	5	10	0	1	3.6

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Crest	**Landform Element**	Hillcrest	**Landform Pattern**	Hill	**Microrelief**	Open woodland
Lithology	Sandy-clay [illegible] pebbles, rocks	**Soil Surface Texture**		**Soil Colour**	light Orange-brown	**Soil Depth**	–
Slope	∩ crest	**Aspect**		**Site Drainage**		**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R - O	
Fire damage			
Storm damage			
Weediness	1	R	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 25-03-2019 **Recorders:** ACM, TZ **Plot ID:** 16

Project No: 0470861 **Project Name:** Bonshaw Solar Farm **Zone ID:** _____

Plot 20m x 50m: Tree Classes [a]

DBH Class#	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm	/ =1		/ =1	
30 - 49 cm	卌 =5		// =2	
20 - 29 cm	卌 // =2	卌 ///,5, =13		
10 - 19 cm		10,4,3 卌 卌 / =28		
5 - 9 cm		2,2,/ =5		
<5 cm [b]		// =2	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		1, 10, 4, 1, 7, 6, 3, 13; 4; 15; 3, =70		

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

Rocky crest

Holes → wombat ??

E dealbata (Tumbledown Red gum)

E albens / wolseana
E. red smooth bark
Silver-leaved ironbark

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm
Silver-leaved ironbark	43	1474	0338626	6767587	1	
Eucalyptus dealbata (smooth-redded)	44	1475	0338640	6767582	1	1
E. dealbata	58	1476	0338636	6767572	2	1

Field Data Sheet created by Dr Adriana Corona Mothe

This document has not been endorsed or approved by Office of Environment and Heritage or Mudgee Scots Environmental Landcare

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 25/3/19	Bonshaw	16	

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher	
	Eucalyptus dealbata		15		T		
	Eucalyptus melanophloia		3		T		outside plot
	Eucalyptus albens		3	1	T		
	Callitris glaucophylla		20		T		
	Hypericum sp.		0.1	20			
	Ozothamnus rosmarinoides		0.2	200			
	Cymbopogon refractus		0.1	15			
	Aristida ramosa		0.3	20			
	Dichondra sp. A		0.3	400			
	Rostellularia adscendens		0.3	200			
	Glycine clandestina		0.3	200			
	Sida corrugata		0.2	200			
	Boerhavia dominii		0.1	40			
	Cyperus gracilis		0.1	40			
	Opuntia auracantiaca		0.1	100			
	Enneapogon gracilis		0.3	200			
	Pimelia stricta		0.2	80			
	Parsonsia eucalyptifolia		0.1	10			
	Vittadinia sulcata		0.1	5			
	Solegyne bellioides		0.1	40			
	Cheilanthes sieberi		0.1	20			
	Carrissa sp.		0.1	1			

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

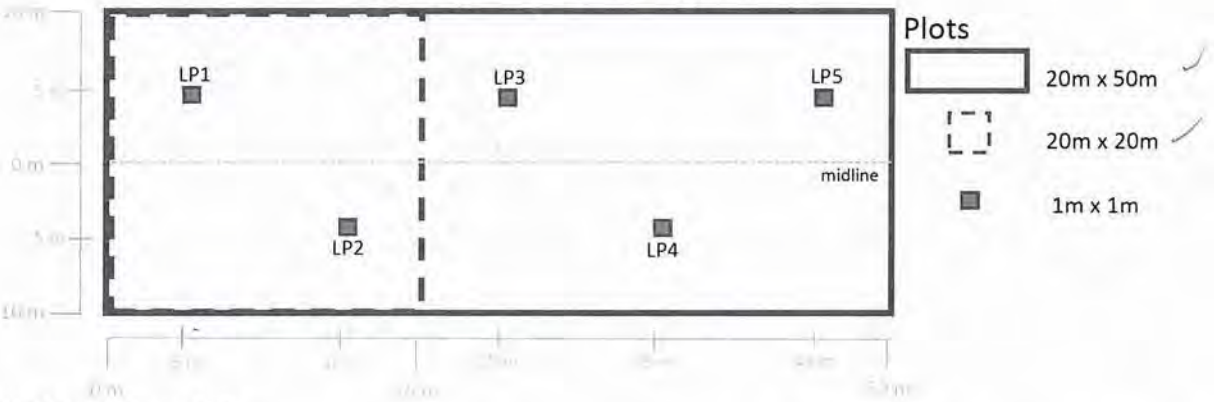
Date: 25-03-2019 **Recorders:** ACM, TZ **Plot ID:** 17

Project No: 0470861 **Project Name:** Bonshaw Solar Farm **Zone ID:** _____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar		
Datum:	94	**IBRA sub-region:**	Nandewar North Complex		
Likely Vegetation Class:					Confidence H M L
Plant Community Type (PCT):	S94 - Low (logged)	**EEC:**	X		Confidence (H) M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1485	0338763	6767760	270°W	✓	✓
50 m	1486	0338720	6767787	124°SE	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1487	1488	1489	1490	1491	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		50	20	30	10	40	30
Bare Ground (%)		30	80	68	50	50	55.6
Cryptogam Cover (%)		5	0	0	0	5	2
Rock Cover (%)		20	0	2	40	10	14.4

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Slope	**Landform Element**	Low Hill	**Landform Pattern**	Hillslope	**Microrelief**	grassy area
Lithology		**Soil Surface Texture**		**Soil Colour**	light orange brown	**Soil Depth**	—
Slope	<70%	**Aspect**	NW	**Site Drainage**	NW towards creek	**Distance to nearest water and type**	~5m

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	R	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	2	R - O	
Fire damage			
Storm damage			
Weediness	1	R	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Brunonfelli - little blue flower

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 25-03-2019 **Recorders:** ACM, TZ **Plot ID:** 17

Project No: 0470861 **Project Name:** Boorhaw Solar Farm **Zone ID:** ____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm		1		
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)	3, 2, 3, 1, 3, =12			

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

Girth of trees = (logs) = 2, 6, 1, 2, 2, 5, 3, 2, 2, 1;
→ Not touching ground. Branches are supporting main trunk

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 25/3/19	Bonshaw	17	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Evolvulus alsinoides		0.1	20		
	Callitris glaucophylla		0.1	30	S	
	Boerhavia dominii		<0.1	60		
	Vittadinia sulcata		0.1	20		
	Solanum ferocissimum		0.1	5		
	Dichondra sp. A		0.2	100		
	Sida corrugata		0.5	600		
	Glycine clandestina		0.2	70		
	Solaqyne bellioides		0.1	30		
	Hypericum sp.		0.1	40		
	Aristida ramosa		5	50		
	Oxalis perennans		0.1	16		
	Xanthium spinosum		0.1	1		
	Cleilanthes sieberi		0.1	5		
	Calotis lappulacea		0.1	5		
	Enneapogon gracilis		5	200		
	Opuntia aurantiaca		0.1	20		
	Chamaecysus drummondii		0.1	20		
	Cyperus gracilis		0.1	20		
	Pimelia stricta		0.1	5		
	Bothriochloa macra		5	50		
	Rostellularia adscendens		0.1	30		
	Heliotropium amplexicaule		0.1	1		
	Scleria mackaviensis		0.1	2		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

grasses total 15%
total cover 20%

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

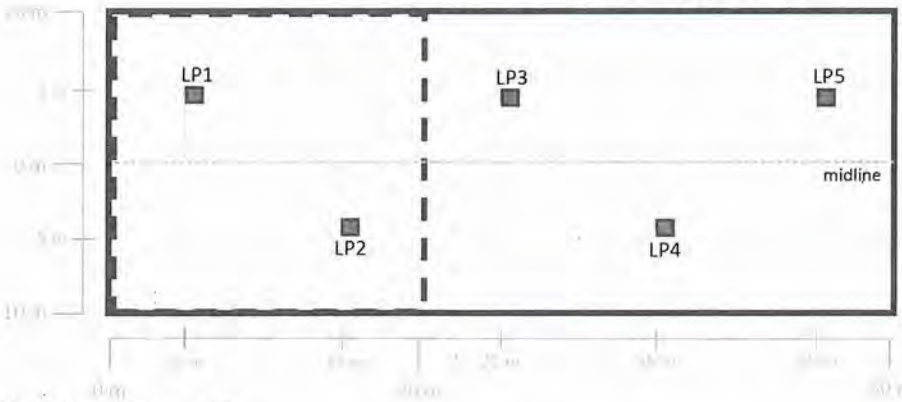
Date: 25-03-2019 **Recorders:** ACM, TZ **Plot ID:** 18

Project No: 0470861 **Project Name:** Boorabee Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar		
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex		
Likely Vegetation Class:	Grassland				Confidence H M L
Plant Community Type (PCT):	594 - DNG		**EEC:**		Confidence (H) M L

BAM Nested Plots Requirement



Grey ground Bubbler - call bird

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1492	033 83 77	67 67 858	53° NE	✓	✓
50 m	1493	033 84 22	67 67 888	229° SW	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1494	1496	1497	1498	1499	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		75	60	40	40	30	49
Bare Ground (%)		25	39	60	60	70	50.8
Cryptogam Cover (%)		0	0	0	0	0	0
Rock Cover (%)		0	1	0	0	0	0.2

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	flat	**Landform Element**	flat	**Landform Pattern**		**Microrelief**	grassland
Lithology		**Soil Surface Texture**		**Soil Colour**	light - brown	**Soil Depth**	—
Slope	flat	**Aspect**	NE	**Site Drainage**	SW	**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	2	R.O	
Fire damage			
Storm damage			
Weediness	1	R-O	
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (> 10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 25-03-2019 **Recorders:** ACM, TZ **Plot ID:** 18

Project No: 0470861 **Project Name:** Bonshaw Solar Farm **Zone ID:** ____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		12, 1, 3, 15, 1, 2, 1 = 35		

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 25/3/2019	Bonshaw	18	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Aristida ramosa		5	120		
	Cheilanthes sieberi		0.2	500		
	Dichondra sp. A		0.1	200		
	Glycine clandestina		0.2	500		
	Hypericum sp		0.1	30		
	Sida corrugata		0.1	30		
	Oxalis perennans		0.1	100		
	Sclerolaena birchii		0.1	200		
	Vittadinia sulcata		0.1	70		
	Cyperus gracilis		0.1	70		
	Einadia nutans		0.2	200		
	Solegyne bellioides		0.1	15		
	Solanum ferocissimum		0.1	10		
	Bothriochloa macra		1.5	200		
	Pimelia stricta		0.1	2		
	Cymbopogon refractus		0.1	3		
	Paspalidium distans		0.1	2		
	unidentifiable grasses		25%			
	Bothriochloa biloba		0.1	3		
	Panicum simile		0.1	2		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

total grass cover 30%

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

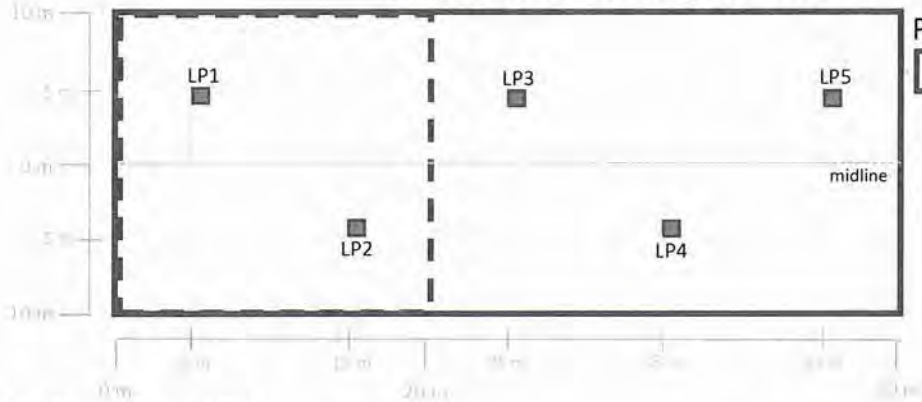
Date: 25 · 03 - 2019 **Recorders:** ACM, TZ **Plot ID:** 19

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar		
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex		
Likely Vegetation Class:					Confidence H M L
Plant Community Type (PCT):	DNG		**EEC:**	X	Confidence (H) M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1500	033 83 20	67 68 072	155° SE	✓	✓
50 m	1501	033 83 59	67 68 031	258°W		

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1502	1503	1504	1505	1506	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		30	15	40	80	40	41
Bare Ground (%)		65	85	58	20	60	57.6
Cryptogam Cover (%)		0	0	0	0	0	0
Rock Cover (%)		0	0	2	0	0	0.4

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Slat	**Landform Element**		**Landform Pattern**		**Microrelief**	
Lithology		**Soil Surface Texture**		**Soil Colour**		**Soil Depth**	
Slope	Flat	**Aspect**	SE	**Site Drainage**		**Distance to nearest water and type**	70m

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	R - O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R	
Fire damage			
Storm damage			
Weediness	1	R	
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 25-03-2019 **Recorders:** ACM, TZ **Plot ID:** 19

Project No: 047086 **Project Name:** Boonshaw Solar Farm **Zone ID:** ____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)	1.5; 1; 2 = 4.5m			

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 25/3/19	Borshaw	19	

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	Sclerolaena birchii		20	6000		
	Aristida ramosa		4	300		
	Xanthium spinulosum		0.1	2		
	Maireana microphylla		0.2	4		
	Einadia nutans		<0.1	100		
	Dichondra sp. A		<0.1	5		
	Bothriochloa [illegible] decipiens		<1	100		
	Glycine clandestina		0.2	100		
	Chamaesyce drummondii		<0.1	15		
	Cheilanthes sieberi		<0.1	8		
	Boerhavia dominii		<0.1	1		
	Gomphrena celasoides		<0.1	1		
	Rumex brownii		<0.1	1		
	Carthamus lanatus		<0.1	1		
	unidentified grasses		5			

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

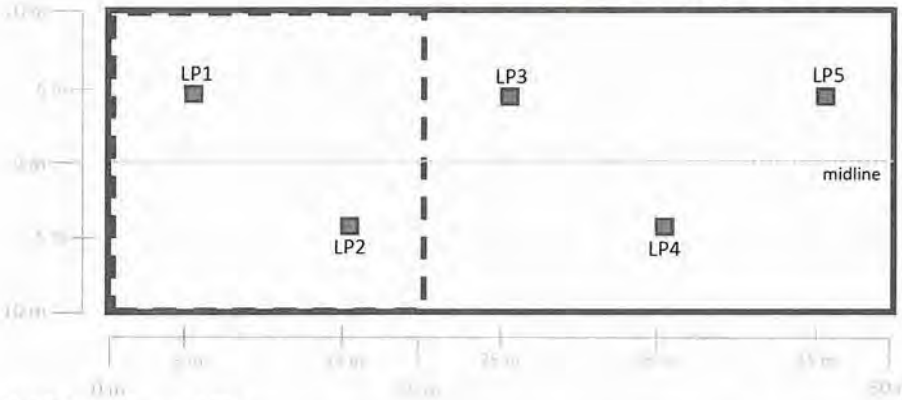
Date: 26-03-2019 **Recorders:** ACM, TZ **Plot ID:** 20

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar			
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex			
Likely Vegetation Class:	Cleared					Confidence H M L
Plant Community Type (PCT):	Cleared Land			**EEC:**	X	Confidence (H) M L

BAM Nested Plots Requirement



Plots

- 20m x 50m ✓
- 20m x 20m ✓
- 1m x 1m ✓

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1507	337983	6767855	321° NW	✓	✓
50 m	1508	338003	6767809	330° NW	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1509	1510	1511	1512	1513	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		40	25	50	70	20	31
Bare Ground (%)		60	75	50	80	80	69
Cryptogam Cover (%)		0	0	0	0	0	0
Rock Cover (%)		0	0	0	1	0	0.2

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Flat	**Landform Element**	Plain	**Landform Pattern**	Flood Plain	**Microrelief**	» bare soils Sparse ground ind
Lithology	Rich organic soils	**Soil Surface Texture**		**Soil Colour**	Dark brown	**Soil Depth**	
Slope	Flat	**Aspect**	NW	**Site Drainage**	-	**Distance to nearest water and type**	—

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	R-O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness	1	R-O	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 26-03-2019 **Recorders:** ACM, TB **Plot ID:** 20

Project No: 0470861 **Project Name:** Boorabee Solar Farm **Zone ID:** ____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)				

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	26/3/19	Bonshaw	20	TZ

GF Code	*Top 3 native species in each growth form group: Full species name mandatory* *All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Aristida leptopoda		0.2	13		
	Bothriochloa decipiens		0.2	13		
	Rumex brownii		<0.1	5		
	Rhynchosia minima		<0.1	10		
	Marreana microphylla		<0.1	1		
	Xanthium spinosum		<0.1	4		
	Notelaea microphylla		<0.1	1		
	Paspalidium distans		<0.1	1		
	Tribulus terrestris		<0.1	1		
	Convulvulus erubescens		<0.1	1		
	Also Nephania + Boerhavia					
	arenae					

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Black soil ~50% grass cover, but dead, rest bare soil
0.4% green ~~[illegible]~~ cover

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

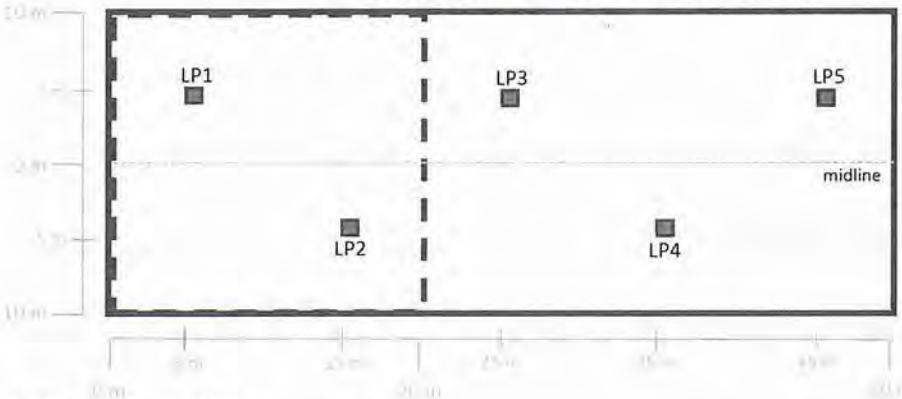
Date: 26-03-2019 **Recorders:** ALM, TZ **Plot ID:** 21

Project No: D47088 **Project Name:** Boorhaw Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar			
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex			
Likely Vegetation Class:						Confidence H M L
Plant Community Type (PCT):	594 - Low			**EEC:**	X	Confidence (H) M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1514	337855	6767956	321° NW	✓	✓
50 m	1520	337827	6767947	141° SE	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1515	1516	1517	1518	1519	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		60	35	50	30	5	36
Bare Ground (%)		30	35	70	50	95	46
Cryptogam Cover (%)		20	30	30	30	60	34
Rock Cover (%)		1	1	0	10	0	2.4

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Flat	**Landform Element**	Plain	**Landform Pattern**	Plain	**Microrelief**	open woodland (1
Lithology		**Soil Surface Texture**		**Soil Colour**	Brown	**Soil Depth**	—
Slope	Level	**Aspect**	NW	**Site Drainage**	-	**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	2	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	2	R-O	
Fire damage			
Storm damage			
Weediness	1	R	
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 26-03-2019 **Recorders:** ACM, TZ **Plot ID:** P21

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** ____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm		1 = 1		
10 - 19 cm		𝍸 𝍸 𝍸 // =17		
5 - 9 cm		6, 2, 𝍸 𝍸 // =20		
<5 cm [b]		4, //, 6; 2, 3 = 17	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		8; 2; 1, 1, 14, 6; 3, 4, 1, =40		

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

ONLY Callitris glauca

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 26/3/19	Bonshaw	21	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Bothriochloa decipiens		0.5	15		
	Enneapogon gracile		2.0	300		
	Sida corrugata		0.2	100		
	Boerhavia dominii		0.1	80		
	Einadia nutans		<0.1	20		
	Portulacca bicolor		<0.1	20		
	Opuntia aurantiaca		<0.1	2		
	Dichondra sp. A		<0.1	20		
	Cupressus semiglauca shrubs		3	15		
	Rumex brownii		<0.1	8		
	Pimelia stricta		<0.1	4		
	Glycine clandestina		0.1	30		
	Portulacca oleracea		<0.1	5		
	Tribulus terrestris		<0.1	4		
	Vittadinia sulcata		<0.1	8		
	Sclerolaena bicornis		<0.1	6		
	Convolvulus adscendens		<0.1	3		
	Rostellularia adscendens		<0.1	4		
	Aristida ramosa		3	2000		
	Oxalis perennans		<0.1	4		
	Cymbopogon refractus		<0.1	2		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

total grass cover 15 (excl Cupressus)

grass 10

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

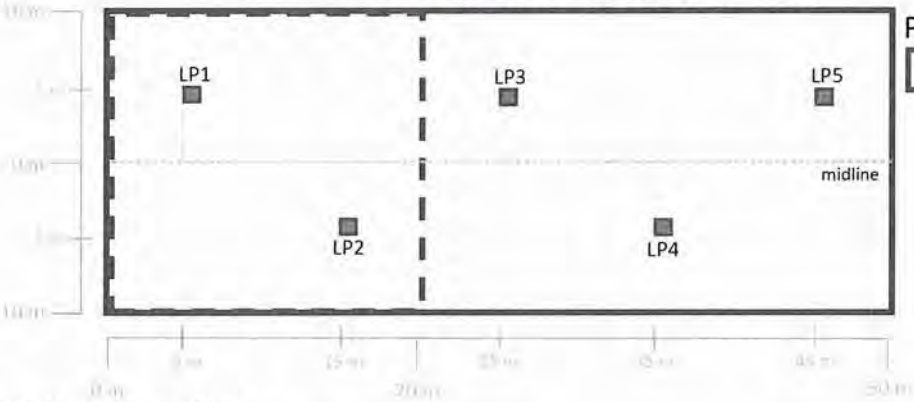
Date: 26-03-2019 **Recorders:** ACM, TZ **Plot ID:** 22

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar			
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex			
Likely Vegetation Class:						Confidence H M L
Plant Community Type (PCT):	594 - Low			**EEC:**	x	Confidence (H) M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1522	338024	6768238	248° NW	✓	✓
50 m	1523	337991	6768272	134° SE	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1524	1525	1526	1527	1528	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		60	70	25	15	20	38
Bare Ground (%)		40	30	75	85	50	62
Cryptogam Cover (%)		10	15	20	30	30	21
Rock Cover (%)		0	0	0	0	20	4

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Crest	**Landform Element**	Flat	**Landform Pattern**	Low Hill	**Microrelief**	Soil w/ pebbles
Lithology	Silty-clayed soils	**Soil Surface Texture**		**Soil Colour**	light orange-brown	**Soil Depth**	–
Slope	Very gently inclined	**Aspect**	NW	**Site Drainage**		**Distance to nearest water and type**	–

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R-O	
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 26-03-2019 **Recorders:** ACM, TZ **Plot ID:** 22

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** ____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm		𝍸		
5 - 9 cm		/// =3		
<5 cm [b]		/// =3	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		11, 2, 8, 2 = 23		

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	26/7/19	Bonshaw	22	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Cupressus semiglauca chubs		<0.1	2		
	Rostellularia adscendens		<0.1	8		
	Chamaesyce drummondii		<0.1	8		
	Glycine clandestine		0.2	50		
	Sida corrusca		<0.1	50		
	Aristida ramosa		1			
	Enneapogon gracilis		1			
	Cymbopogon refractus		<0.1	3		
	Sclerolaena birchii		<0.1	40		
	Oxalis perennans		<0.1	16		
	Pimelia stricta		<0.1	20		
	Calotis lappulacea		<0.1	1		
	Boerhavia dominii		<0.1	12		
	Portulacca bicolor		<0.1	50		
	Portulacca oleracea		<0.1	2		
	Heliotropium amplexicaule		<0.1	2		
	Convulvulus absinoides		<0.1	8		
	Desmodium varians		<.1	3		
	Opuntia ~~stricta~~ tomentosa		<0.1	2		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

total plant cover 10% of which 8% is dead

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

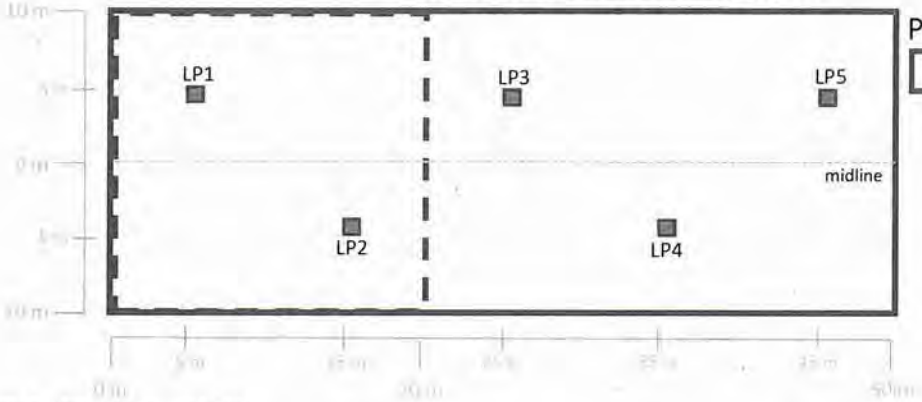
Date: 26 - 03 - 2019 **Recorders:** ACM, TZ **Plot ID:** 23

Project No: 0470861 **Project Name:** Barraba Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar		
Datum:	94	**IBRA sub-region:**	Nandewar Nastlein Complex		
Likely Vegetation Class:					Confidence H M L
Plant Community Type (PCT):			**EEC:**		Confidence H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1531	033 8490	67 68 126	159° S	✓	✓
50 m	1532	033 8504	67 68 075	331° NW	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1533	1534	1535	1536	1537	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		90	30	80	70	80	70
Bare Ground (%)		10	70	20	30	20	30
Cryptogam Cover (%)		0	0	0	0	0	0
Rock Cover (%)		0	0	0	0	0	0

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Slope	**Landform Element**	Hill slope	**Landform Pattern**	Low Hill	**Microrelief**	grassland
Lithology	-	**Soil Surface Texture**		**Soil Colour**	light - orange - brown	**Soil Depth**	-
Slope	Gentle inclined	**Aspect**		**Site Drainage**	downslope run-off	**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R	
Fire damage			
Storm damage			
Weediness	1	R-O	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 26-03-2019 **Recorders:** ACM TZ **Plot ID:** Z3

Project No: 0470961 **Project Name:** Banshaw Solar Farm **Zone ID:** ____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm		/ = 1		
10 - 19 cm		// = 2		
5 - 9 cm		/ = 1		
<5 cm [b]		/ = 1	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		2, 1, 1 = 4		

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

80
~~82~~

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 26/2/16	Bonshaw	23	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Cypressus glaucophilla shrubs		0.2	2		
	Pimelea stricta		<0.1	3		
	Aristida ramosa		1	[illegible]		
	Cymbopogon refractus		0.3	40		
	Sida corrugata		0.1	100		
	Cassinia		<0.1	1		
	Heliotropium		<0.1	18		
	[illegible]					
	Glycine		<0.1	12		
	Solegyine		<0.1	2		
	Dichondra spp		<0.1	9		
	Bothriochloa decipiens		1	1		
	Cheilanthes		<0.1	7		
	Panicum		<0.1	2		
	Boerhavia		<0.1	6		
	unidentifiable grasses		20			
	no samples					

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Total veg cover 25 %
~~[illegible]~~ dead live 25 %

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

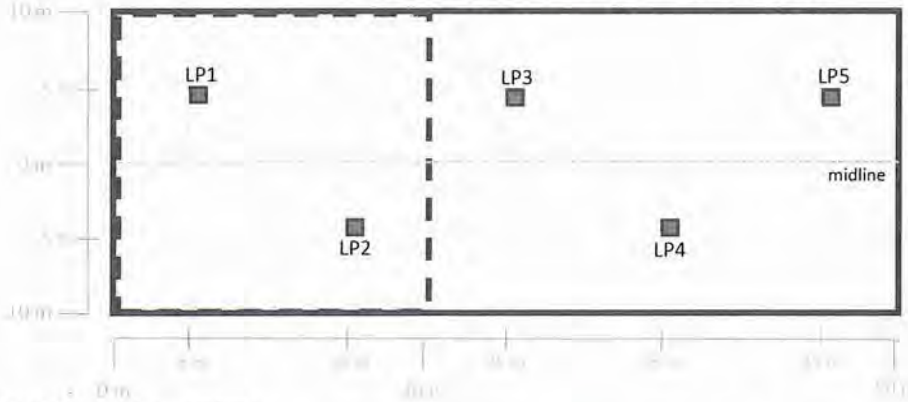
Date: 26-03-2014 **Recorders:** ACM, TZ **Plot ID:** 24

Project No: 0470861 **Project Name:** Boundary Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar			
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex			
Likely Vegetation Class:	grass					**Confidence** H M L
Plant Community Type (PCT):	596 - DNG - Low			**EEC:**		**Confidence** H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1538	338800	6768481	170°S	✓	✓
50 m	1539	338813	6768430	352° NW		

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1540	1541	1542	1543	1544	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		60	80	80	85	60	73
Bare Ground (%)		40	10	20	15	40	25
Cryptogam Cover (%)		5	30	5	10	5	11
Rock Cover (%)		0	81	0	0	0	0.2

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Flat	**Landform Element**	Plain	**Landform Pattern**	Plain	**Microrelief**	grassy area
Lithology	Silty-clay	**Soil Surface Texture**		**Soil Colour**	light orange-brown	**Soil Depth**	-
Slope	Level	**Aspect**		**Site Drainage**	-	**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R	
Fire damage			
Storm damage			
Weediness	2	R-O	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (> 10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 26-03-2019 **Recorders:** ACM, TZ **Plot ID:** 24

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** _____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)	7, 1, 2, 5, 6, = 21			

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

40
36
16
92

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400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	26/3/2019	Bonshaw	24	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Aristida ramosa		<0.1	1		
	Bothriochloa decipiens		1.5	500		
	Eragrostis brownii		<0.1	3		
	Cymbopogon refractus		0.2	4		
	Panicum simile		<0.1	3		
	Dichondra sp. A		0.5	200	— lots of dead	
	Vittadinia sulcata		<0.1	2	matter of the	
	Glycine clandestina		<0.1	16	species also	
	Sida corrugata		0.1	30		
	Cheilanthes sieberi		<0.1	5		
	Solenogyne gracilis		<0.1	12		
	Pomelia stricta		<0.1	3		
	unidentifiable grasses		25			

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

total veg cover 35%
dead 50%
bare 20%

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

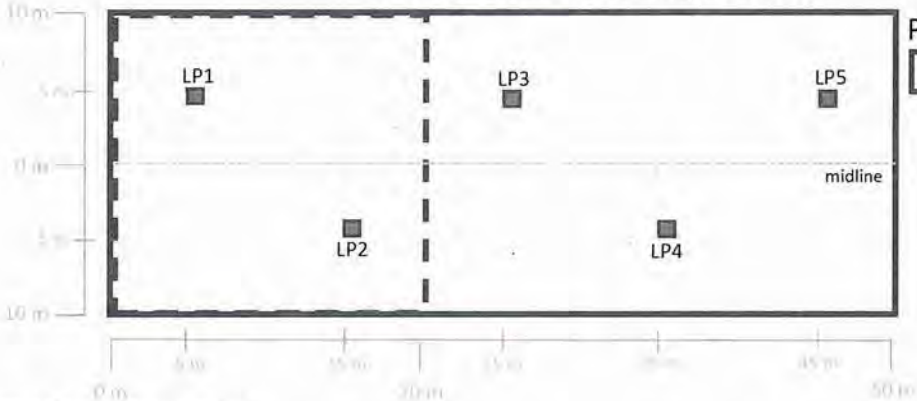
Date: 26-03-2019 **Recorders:** ACM, TZ **Plot ID:** 25

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar		
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex		
Likely Vegetation Class:					**Confidence** H M L
Plant Community Type (PCT):			**EEC:**		**Confidence** H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1545	338687	6768607	257°W	✓	✓
50 m	1551	338635	6768598	67° NE	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1546	1547	1548	1549	1550	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		90	70	90	60	60	74
Bare Ground (%)		10	30	10	40	40	26
Cryptogam Cover (%)		0	0	0	0	0	0
Rock Cover (%)		0	0	0	0	0	0

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

grazing paddock - fenced

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Flat	**Landform Element**	Plain	**Landform Pattern**	Plain	**Microrelief**	ground
Lithology	silty clay	**Soil Surface Texture**		**Soil Colour**	light orange-brown	**Soil Depth**	—
Slope	level	**Aspect**	W	**Site Drainage**	—	**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	2	R-O	
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 26-03-2019 **Recorders:** ACM, TZ **Plot ID:** 25

Project No: 0470861 **Project Name:** Bonshaw Solar Farm **Zone ID:** _____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)	8, 3 = 11			

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 26/2/2019	Bonshaw	25	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Bothriochloa decipiens		0.5	200		
	Aristida leptopoda		<0.1	3		
	Boerhavia		<0.1	3		
	Eragrostis		<0.1	2		
	Aristida racemosa		0.5	7		
	Dichanthium sp A		0.1	200		
	Vittadinia sulcata		<0.1	1		
	Heliotropium		<0.1	3		
	Sclerolaena		<0.1	12		
	Glycine		<0.1	26		
	Bothriochloa decipiens		0.1	1		
	Cymbopogon refractus		0.1	15		
	Chrysanthemoides		<0.1	2		
	Rumex		<0.1	2		
	unidentifiable grasses		25			

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

total Veg cover 25 %
dead 5-10 %
bare 10-25 %

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

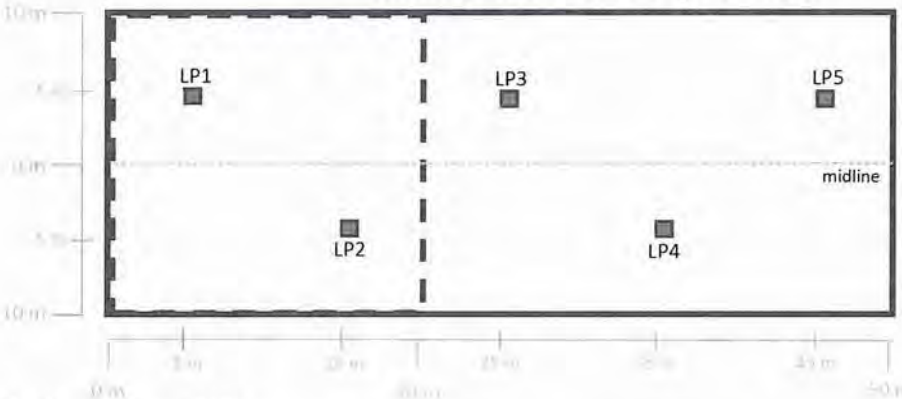
Date: 26-03-2019 **Recorders:** ACM, TZ **Plot ID:** 26

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar			
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex			
Likely Vegetation Class:						Confidence H M L
Plant Community Type (PCT):				**EEC:**	X	Confidence (H) M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1552	339225	6768 408	255° W	✓	✓
50 m	1558	339177	6768 412	87° E	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1553	1554	1555	1556	1557	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		25	20	15	30	40	26
Bare Ground (%)		75	80	84	70	60	73.8
Cryptogam Cover (%)		10	5	0	2	2	3.8
Rock Cover (%)		0	1	1	0	0	0.4

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Slope	**Landform Element**	Hill slope	**Landform Pattern**	Low Hill	**Microrelief**	grass - closed
Lithology	silty-clay	**Soil Surface Texture**		**Soil Colour**	light orange-brown	**Soil Depth**	-
Slope	Gentle inclined	**Aspect**	W	**Site Drainage**		**Distance to nearest water and type**	-

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal	3	R-O	
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness	1	R	
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (> 10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 26-03-17 **Recorders:** ACM, TZ **Plot ID:** 26

Project No: 0470861 **Project Name:** Bonshaw Solar Farm **Zone ID:** ____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm	𝍸 = 5			
5 - 9 cm				
<5 cm [b]	/ = 1	// = 2	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)	3, 2, 3, 1, 3, 2, 1, 1, 3, 2 = 21			

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	26/3/2019	Bonshaw	26	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Cupressus semiglauca		0.1	11		
	Arishda jerichoensis		0.5	150		
	Enneapogon gracilis		1.0	700		
	Convulvulus abrasides		<0.1	8		
	Boerhavia dominii		0.1	80		
	Sida corrugata		0.1	300		
	Pimelia stricta		<0.1	10		
	Cymbopogon refractus		0.1	10		
	Dichondra sp A		0.1	90		
–	[illegible]		<0.1	7		
	Hypericum		<0.1	8		
	Bothriochloa decipiens		2.0	200		
	Ercarostis brownii		<0.1	1		
	Chemaesyce drummondii		<0.1	3		
	Panicum simile		<0.1	1		
	Chloris truncata		<0.1	1		
	Eucalyptus dealbata (shrub)		0.1	1		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

total cover 5-10%
dead 10-25
rock 10
soil 50-75

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

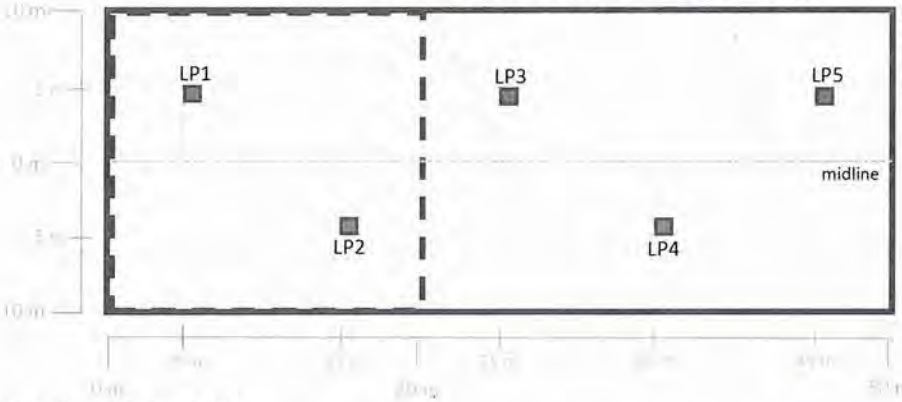
Date: 27-03-2019 **Recorders:** ACM TZ **Plot ID:** 27

Project No: 0470861 **Project Name:** Ranshaw Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar			
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex			
Likely Vegetation Class:	Grassland (1					Confidence H M L
Plant Community Type (PCT):	DNG			**EEC:**	X	Confidence (H) M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1560	33 83 44	67 68 782	184°S	✓	✓
50 m	1561	33 83 28	67 68 734	3°N	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1562	1563	1564	1565	1566	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		70	60	50	70	80	66
Bare Ground (%)		30	40	40	25	20	31
Cryptogam Cover (%)		5	5	5	0	10	5
Rock Cover (%)		1	0	0	0	0	0.2

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Slope	**Landform Element**	Very Low Hill	**Landform Pattern**	Low Hill	**Microrelief**	grassland
Lithology	Mixed soils	**Soil Surface Texture**		**Soil Colour**	light orange-brown	**Soil Depth**	
Slope	Very gently to W	**Aspect**	W	**Site Drainage**	-	**Distance to nearest water and type**	-

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R-O	
Fire damage			
Storm damage			
Weediness	1	R	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 27-03-2019 **Recorders:** ACM, TZ **Plot ID:** 27

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** _____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)				

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 21/3/18		27	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Aristida ramosa		40	200		
	Bothriochloa decipiens		2	40		
	Sclerolaena birchii		01	60		
	Heliotropium amplexicaule		0.1	100		
	Boerhavia dominii		<0.1	3		
	Cheilanthes sieberi		<0.1	30		
	Einadia nutans		<0.1	50		
	Juncus usitatus		<0.1	8		
	Dichondra repens		<0.1	8		
	Sida corrugata		<0.1	4		
	Glycine		<0.1	40		
	Dichondra sp. A		0.1	30		
	Eragrostis brownii		<0.1	15		
	Rumex brownii		<0.1	5		
	unidentifiable grasses/sedges		30			
	(Cyperus?)					
	Einadia hastata		<0.1	3		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Total veg cover 50%
Bare 30%
Litter 20%

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

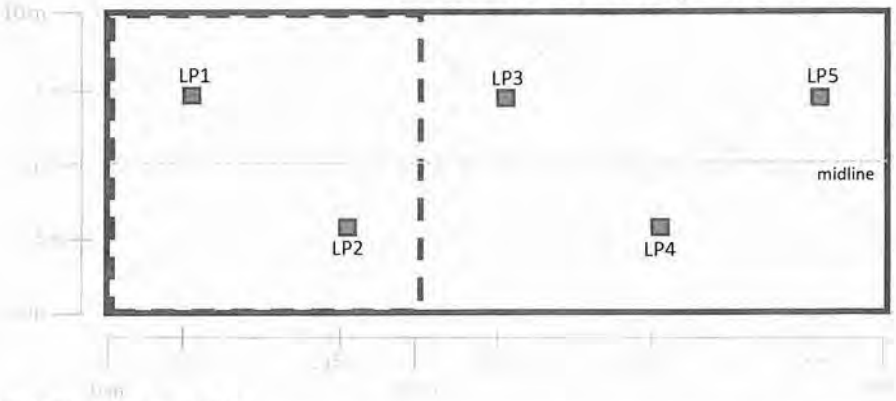
Date: 27-03-2014 **Recorders:** ACM, TZ **Plot ID:** 28

Project No: 047086 **Project Name:** Banshaw Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar			
Datum:	94	**IBRA sub-region:**	NNC			
Likely Vegetation Class:		DNG				Confidence H M L
Plant Community Type (PCT):		516 - DNG - Mod	**EEC:**	X		Confidence H M L

BAM Nested Plots Requirement



Plots

- 20m x 50m
- 20m x 20m
- 1m x 1m

Running

Grey-crowned babbler - calling

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1569	338658	6768886	183°S	✓	✓
50 m	1570	338643	6768797	355° N	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1571	1572	1573	1574	1575	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		20	50	25	30	40	33
Bare Ground (%)		80	40	75	70	60	65
Cryptogam Cover (%)		0	5	0	0	0	1
Rock Cover (%)		1	0	0	0	0	0.2

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Slope	**Landform Element**		**Landform Pattern**		**Microrelief**	
Lithology		**Soil Surface Texture**		**Soil Colour**		**Soil Depth**	
Slope		**Aspect**		**Site Drainage**		**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R-O	
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (> 10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 27-03-2019 **Recorders:** ACM, TZ **Plot ID:** 28

Project No: 470861 **Project Name:** Banshaw Solar Farm **Zone ID:** _____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)				

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 27/3/2019		28	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Aristida racemosa		25	500		
	Helio Topium amplexicaule		0.5	1200		
	Dichondra sp. A		0.1	7		
	Einadia nutans		0.1	[illegible]		
	[illegible] Calotis lapullum		<0.1	14		
	Scleiolaena birchii		0.3	150		
	Tribulus terrestris		0.1	20		
	[illegible]		0.1	20		
	Maireana microphylla		<0.1	[illegible]		
	[illegible]		[illegible]			
	Oxalis perennans		<0.1	3		
	Rumex brownii		<0.1			
	unidentifiable [illegible]		10			
	Boerhavia dominii		<1	3		
	[illegible]		[illegible]	[illegible]		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

Date: 27-03-2019 **Recorders:** ACM, TZ **Plot ID:** 29

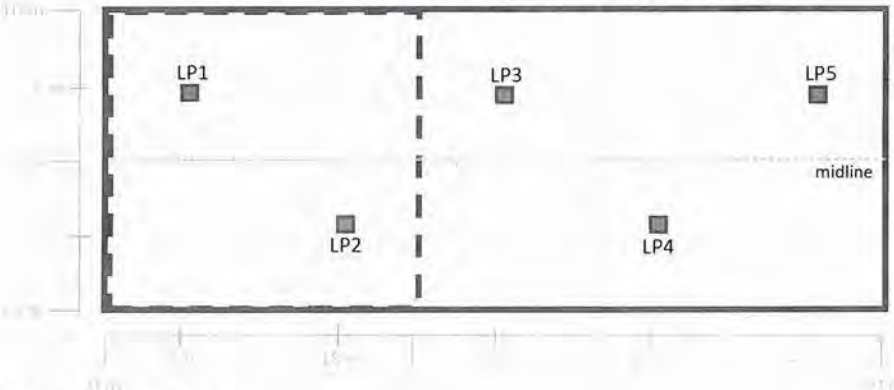
Project No: 0470861 **Project Name:** Bombaw Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar		
Datum:	UTM94	**IBRA sub-region:**	Nandewar Northern Complex		
Likely Vegetation Class:	Grassland - Cleared land				Confidence H M L
Plant Community Type (PCT):	546-DNG-Low	**EEC:**	X		Confidence (H) M L

Raining

BAM Nested Plots Requirement



Plots

- 20m x 50m ✓
- 20m x 20m ✓
- 1m x 1m ✓

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1576	33 90 52	67 68 730	178°S	✓	✓
50 m	1577	33 9047	67 68 699	347°N	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1578	1579	1580	1581	1582	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		90	80	60	65	75	72
Bare Ground (%)		10	20	10	10	25	15
Cryptogam Cover (%)		15	10	20	10	5	12
Rock Cover (%)		10	1	30	25	1	13.4

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Slope	**Landform Element**	H.V Slope	**Landform Pattern**	Low Hill	**Microrelief**	grassy
Lithology	Volcanic	**Soil Surface Texture**		**Soil Colour**	light - average brown	**Soil Depth**	-
Slope	Very gentle slope	**Aspect**	247° W	**Site Drainage**		**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R-O	
Fire damage			
Storm damage			
Weediness	1	R	
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (> 10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: _____ **Recorders:** AIM **Plot ID:** 29

Project No: _____ **Project Name:** Bonshaw **Zone ID:** _____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]	/		n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)	4,1,2,4,5,3,5,7,8,1,2,1 =43			

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 27/3/19		29	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Brizula ramosa		0.5	20		
	Eragrostis pogon gracilis		4	200		
	Dichondra sp. A.		2.3	100		
	Rostraria adominii		0.4	28		
	Vittadinia sulcata		0.1	4		
	[illegible]		[illegible]	[illegible]		
	Sida corrugata		[illegible]	[illegible]		
	[illegible]		[illegible]	[illegible]		
	Chamaesyce drummondi		[illegible]	[illegible]		
	Rumex brownii		[illegible]	[illegible]		
	Chelanthes sieberi		<0.1	10		
	Pimelia stricta		0.5	10		
	Cupressus sempiglauca		<0.1	1		
	Panicum simile		0.1	30		
	Bothriochloa decipiens		10	1000		
	Calotis [illegible]		<0.1	15		
	Convolvulus alsinoides		<0.1	4		
	Eragrostis brownii		<0.1	6		
	Cymbopogon refractus		0.5	135		
	Chloris truncata		<0.1	1		
	Eucalyptus dealbata shrub		0.2	1		
	unidentifiable grass/sedges		1			

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: .1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

total veg 25 %

dead 25 %

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

Date: 27-03-2019 **Recorders:** ACM, TZ **Plot ID:** 30

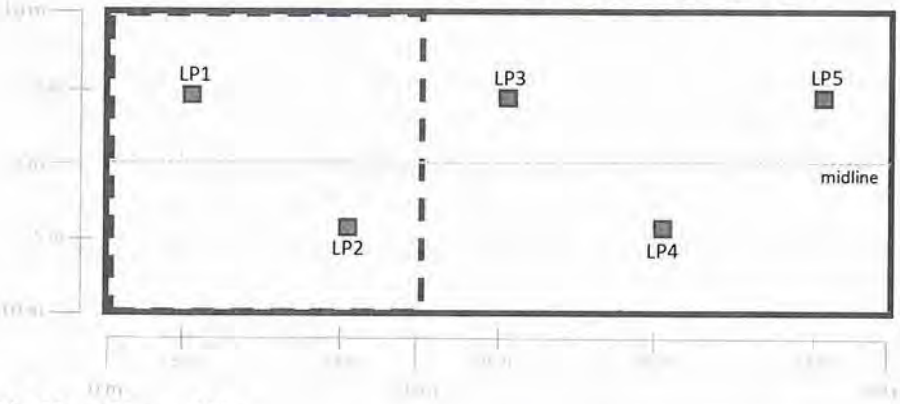
Project No: 0470861 **Project Name:** Ranshaw Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar		
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex		
Likely Vegetation Class:					Confidence H M L
Plant Community Type (PCT):	Cleared Land		**EEC:**	No	Confidence (H) M L

BAM Nested Plots Requirement

Wet - rain



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1583	33 8535	67 69 002	25° NE	✓	✓
50 m	1584	33 8565	67 69 043	211° SW	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1585	1586	1587	1588	1589	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		20	40	60	20	75	45
Bare Ground (%)		80	60	40	70	25	55
Cryptogam Cover (%)		0	0	0	0	0	0
Rock Cover (%)		0	0	0	0	0	0

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Flat	**Landform Element**	Flat plain	**Landform Pattern**	Plain	**Microrelief**	grassy covered
Lithology	sl Ay-cly	**Soil Surface Texture**		**Soil Colour**	Light orange-brown	**Soil Depth**	—
Slope	Level	**Aspect**	—	**Site Drainage**		**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R-O	
Fire damage			
Storm damage			
Weediness	1	R	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: _____ **Recorders:** _____ **Plot ID:** 30

Project No: _____ **Project Name:** _____ **Zone ID:** _____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)				

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

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400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	27/3/19	Bunshew	30	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory* *All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Aristida ramosa		0.5	20		
	Maireana microphylla		0.1	2[illegible]		
	Sclerolaena birchii		0.2	100		
	Einadia nutans		0.1	90		
	Heliotropium amplexicaule		0.2	400		
	Glycine		0.1	50		
	Sida corrugata		<0.1	50		
	Dichondra sp. A		<0.1	20		
	Boerhavia dominii		0.1	90		
	Tribulus terrestris		0.1	60		
	Vittadinia sulcata		<0.1	40		
	Chloris truncata		<0.1	3		
	Convulvulus erubescens		<0.1	30		
	Neptunia gracilis		<0.1	1		
	Rumex brownii		<0.1	7		
	Bothriochloa decipiens		0.5	200		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

[illegible] 5%
[illegible] 30%
[illegible] 65%

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

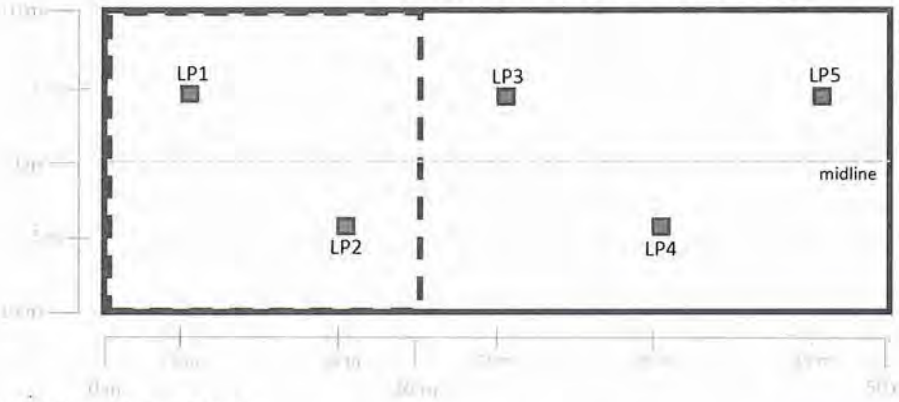
Date: 27-03-2014 **Recorders:** ACM, TZ **Plot ID:** 31

Project No: 047 0861 **Project Name:** Banshaw Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	53	**IBRA region:**	Nandewar			
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex			
Likely Vegetation Class:						Confidence H M L
Plant Community Type (PCT):	546 - Low			**EEC:**	X	Confidence (H) M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1592	338402	6769323	191°S	✓	✓
50 m	1593	338380	6769277	11°N	✓	✓

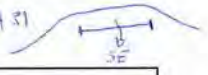
*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1594	1595	1596	1598	1599	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		70	30	50	10	80	38
Bare Ground (%)		65	50	35	10	10	34
Cryptogam Cover (%)		5	10	2	60	5	16.4
Rock Cover (%)		15	20	15	80	10	28

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;



Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Slope	**Landform Element**	Hill Crest	**Landform Pattern**	Low Hill	**Microrelief**	boulder field
Lithology	Silty-clayed soil	**Soil Surface Texture**	—	**Soil Colour**		**Soil Depth**	
Slope	Gentle Inclined	**Aspect**	120° SE	**Site Drainage**		**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R-O	
Fire damage			
Storm damage			
Weediness	1	R	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 27-03-2019 **Recorders:** ACM, TZ **Plot ID:** 31

Project No: 0470861 **Project Name:** Bonshaw Solar Farm **Zone ID:** _____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm	/		/	
30 - 49 cm				
20 - 29 cm		/		
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		2,		

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm
Silver-leaved Ironbark	54	1597			<5 cm	

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 27/3/10	Bandaw	31	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Notelaea microcarpa 3-4	m	3	1		
	Olearia tomentosa (2 m)		1-5	1		
	Maireana microphylla		0·2	6		
	Atriplex vesicaria		0·2	25		
	Enchylaena tomentosa		0·1	200		
	Chamaesyce drummondii		0·1	80		
	Opuntia aurantiaca		0·1	3		
	Sida corrugata		0·1	200		
	Schenkiana hirsuta		<0·1	40		
	Boerhavia dominii		<0·1	20		
	Heliotropium amplexicaule		<0·1	60		
	Vittadinia sulcata		<0·1	3		
	Portulaca oleracea		<0·1	2		
	Dichondra sp. A		<0·1	8		
	Solanum		<0·1	1		
	Brachyscome sp.		<0·1	4		
	unidentifiable grass / sedge		8			
	Bothriochloa decipiens		4	100		
	Cenchrus setiger (exotic)		<0·1	6		
	Cheilanthes sieberi		<0·1	8		
	Enneapogon gracilis		0·1	20		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Total veg cover (ground) 10
litter 20
bare 30
rock 30

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

Date: 27-03-2019 **Recorders:** ALM, TZ **Plot ID:** 32

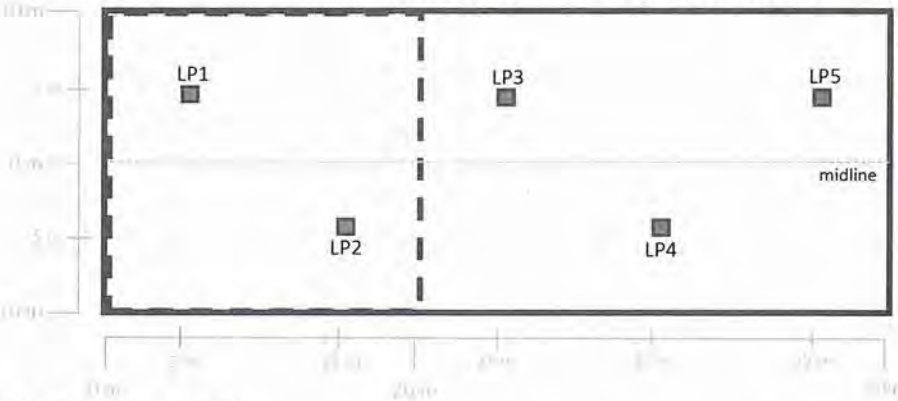
Project No: 047086 **Project Name:** Bonshaw Solar Farm **Zone ID:** ____

Grey-leaved Bubbler in tree collins

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar			
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex			
Likely Vegetation Class:	grassy - cleared land					Confidence H M L
Plant Community Type (PCT):	516 - DNG - Mod			**EEC:**	X	Confidence (H) M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1600	338518	6769371	173°S	✓	✓
50 m	1601	338517	6769320	350°N	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1602	1603	1604	1605	1606	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		70	85	80	65	80	76
Bare Ground (%)		30	15	10	25	20	20
Cryptogam Cover (%)		0	0	0	0	0	0
Rock Cover (%)		0	0	0	0	0	0

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	flat	**Landform Element**	Hill base	**Landform Pattern**	Flat	**Microrelief**	grassy
Lithology	cleyed soils	**Soil Surface Texture**		**Soil Colour**		**Soil Depth**	-
Slope	Level	**Aspect**	-	**Site Drainage**	-	**Distance to nearest water and type**	5m adjacent to creek dry

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	1	R-O	
Fire damage			
Storm damage			
Weediness	1	R	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 27-03-2019 **Recorders:** ACM, TZ **Plot ID:** 32

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** _____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)				

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

83
32
180

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400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	27/3/19		32	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Aristida ramosa		40	1200		
	Maireana microphylla		0.1	1		
	Sida corrugata		<0.1	16		
	Dorichondra whitebacker		<0.1	6		
	Glycine		<0.1	17		
	Heliotropium		<0.1	4		
	Sclerolaena birchii		<0.1	5		
	Lomandra lini		0.1	40		
	Cheilanthes		<0.1	12		
	Rumex		<0.1	8		
	Bothriocaena decipiens		<0.1	8		
	Eulalia		<0.1	1		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

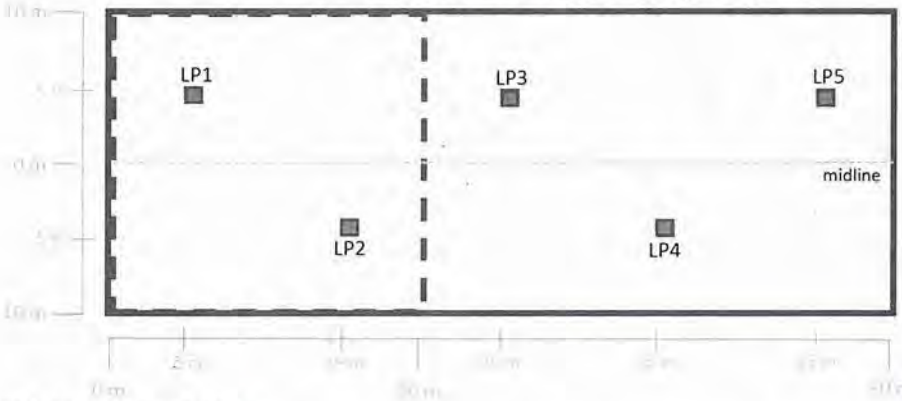
Date: 27-03-2019 **Recorders:** ACM, TZ **Plot ID:** 33

Project No: 0470861 **Project Name:** Bomaluu Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar			
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex			
Likely Vegetation Class:		Cleared → grassy				Confidence H M L
Plant Community Type (PCT):		516 - DNG - Low		**EEC:**	X	Confidence H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1607	33 83 61	67 69 671	326° NW	✓	✓
50 m	1613	33 83 58	67 69 722	273° W	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1608	1609	1610	1611	1612	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		15	10	5	5	2	7.4
Bare Ground (%)		80	65	90	85	97	83.4
Cryptogam Cover (%)		0	0	0	0	0	0
Rock Cover (%)		5	25	5	10	1	9.2

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional) cracking - scalds

Morphological Type	~~Plain~~ Flat	**Landform Element**	Plain	**Landform Pattern**	Plain	**Microrelief**	
Lithology	silty - topsoil	**Soil Surface Texture**		**Soil Colour**	dark brown	**Soil Depth**	
Slope	Leveled	**Aspect**		**Site Drainage**		**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R-O	
Fire damage			
Storm damage			
Weediness	1	R	
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (> 10 yrs)

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 27-03-2019 **Recorders:** ACM, TZ **Plot ID:** 33

Project No: 0470801 **Project Name:** Bonshaw Solar Farm **Zone ID:** ____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)				

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

90
64

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400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	27/3/19	Bonshaw	33	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Carthamus		<0.1	10		
	exotic grass, [illegible]		0.5	[illegible]		
	Heliotropium		<0.1	65		
	Convolvulus erubescens		< "	3		
	Chamaesyce		< "	6		
	Arinkata ramosa		< "	3		
	Bothriochloa decipiens		< "	35		
	Neptunia		< "	3		
	Scleroleaena birchii		< "	4		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

total veg cover green 0.5
dead 40
rocks 20
soil 40

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

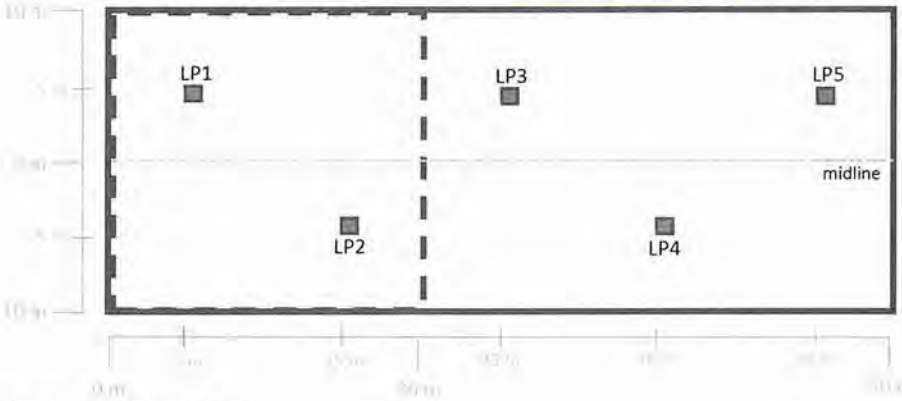
Date: 27-03-2019 **Recorders:** ACM, TZ **Plot ID:** 34

Project No: 0470861 **Project Name:** Barraw Solar Farm **Zone ID:** _____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar			
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex			
Likely Vegetation Class:	Cleared Land					**Confidence** H M L
Plant Community Type (PCT):	N/A			**EEC:**	X	**Confidence** (H) M L

BAM Nested Plots Requirement



Plots

20m x 50m ✓

20m x 20m ✓

1m x 1m ✓

Grey-crowned Babbler call @ distance
Magpie

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1614	33 8569	67 69 788	275°W	✓	✓
50 m	1620	33 8592	67 69 743	360° NW	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1615	1616	1617	1618	1619	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		40	50	5	25	10	
Bare Ground (%)		60	50	95	75	90	
Cryptogam Cover (%)		0	0	0	0	0	
Rock Cover (%)		0	0	0	1	0	

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Flat	**Landform Element**	Plain	**Landform Pattern**	Plain	**Microrelief**	grazed land
Lithology	silty-clayed soil	**Soil Surface Texture**		**Soil Colour**	light-orange brown	**Soil Depth**	-
Slope	Leveled	**Aspect**	-	**Site Drainage**	-	**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)	3	O	
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	O	
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: _____ **Recorders:** _____ **Plot ID:** 34

Project No: _____ **Project Name:** _____ **Zone ID:** _____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)				

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	27/3/19		34	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory* *All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Sclerolaena birchii		0.3	200		
	Bothriochloa dimpuris		0.2	100		
	exotic grass lite		1	80		
	dead		20	500		
	Gomphrena celosioides		0.2	150		
	Heliotropium		0.2	200		
	Chamaesyce		0.2	60		
	Einadia hutensis		0.1	100		
	Convolvulus erubescens		0.2	200		
			0.1	100		
	Nepinnia		<0.1	20		
	Eragrostis brownii		<0.1	2		
	Carthamus		<0.1	7		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

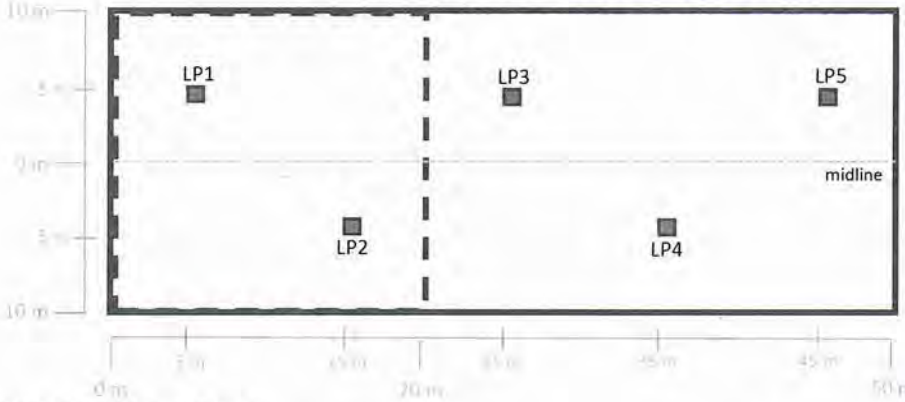
Date: 27-03-2019 **Recorders:** ACM, TZ **Plot ID:** 35

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar			
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex			
Likely Vegetation Class:	DNG					Confidence H M L
Plant Community Type (PCT):	516 - DNG - Low			**EEC:**	X	Confidence (H) M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1621	338671	6769805	262°W	✓	✓
50 m	1627	338667	6769756	346°N	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1622	1623	1624	1625	1626	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		10	85	20	5	1	24.2
Bare Ground (%)		90	15	80	95	99	75.8
Cryptogam Cover (%)		0	2	0	0	0	0.4
Rock Cover (%)		0	0	0	0	0	0

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	flat	**Landform Element**	Plain	**Landform Pattern**	Plain	**Microrelief**	
Lithology	Clayed soil	**Soil Surface Texture**	-	**Soil Colour**	light - orange - brown	**Soil Depth**	
Slope	Levelled	**Aspect**	—	**Site Drainage**		**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R-O	
Fire damage			
Storm damage			
Weediness	1	R	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 27-03-2014 **Recorders:** ACM, TZ **Plot ID:** 35

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** ____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)				

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	27/3/19	Bonshaw	35	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory* *All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Sclerolaena birchii		2.0	150		
	Portulaca oleracea		<0.1	18		
	Einadia nutans		<0.1	10		
	Maireana microphylla	3.0	[illegible]	18		
	Bothriochloa decipiens		0.8	200		
	Rumex		<0.1	10		
	Convulvulus erubescens		<0.1	6		
	Sida corrugata		<0.1	29		
	Enneapogon		0.5	50		
	Chloris truncata		<0.1	2		
	Aristida ramosa		2	29		
	Lomandra lini ii		0.1	25		
	unidentifiable generic lily		[illegible]			
	dead		25			
	Eragrostis "		<0.1	3		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code if 'top 3'.**

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

total veg. life	10
dead	50
bare	30
rock	20

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

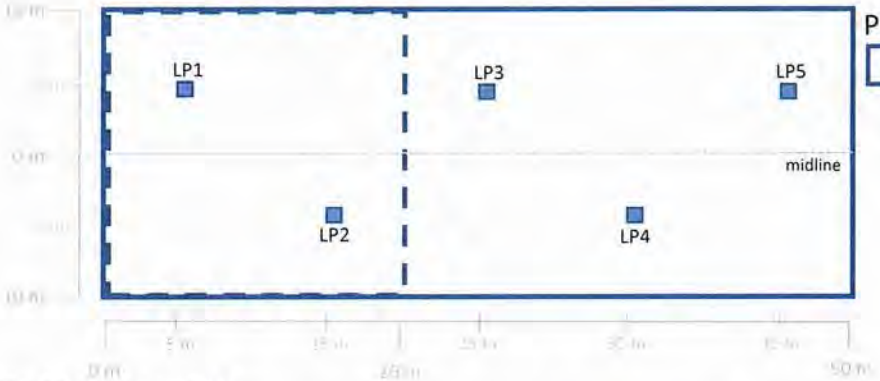
Date: 28-03-2019 **Recorders:** ACM, TZ **Plot ID:** 36

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar			
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex			
Likely Vegetation Class:						Confidence H M L
Plant Community Type (PCT):				**EEC:**		Confidence H M L

BAM Nested Plots Requirement



Plots

20m x 50m ✓

20m x 20m ✓ TZ

1m x 1m ✓

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1629	339043	6768195	315° W	✓	✓
50 m	1630	339015	6768237	147° SE	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1631	1632	1633	1634	1635	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		65	68	30	25	45	46.6
Bare Ground (%)		45	30	70	75	50	54
Cryptogam Cover (%)		15	0	5	0	5	5
Rock Cover (%)		0	2	0	0	5	1.4

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Slope	**Landform Element**	Hillside	**Landform Pattern**	Low Hill	**Microrelief**	grassy area
Lithology	Clayed soils	**Soil Surface Texture**	-	**Soil Colour**	light orange brown	**Soil Depth**	
Slope	Gently inclined	**Aspect**	W	**Site Drainage**	W, SW to creek	**Distance to nearest water and type**	10m S

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R-O	
Fire damage			
Storm damage			
Weediness	1	R	
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 28-03-2019 **Recorders:** ACM, TZ **Plot ID:** 36

Project No: 0470861 **Project Name:** Bonshaw Solar Farm **Zone ID:** ____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)	2, 7, 1, 1, 9, 2 = 22			

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus,

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

-This document has not been endorsed or approved by Office of Environment and Heritage or Muddy Boots Environmental Training-

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 28/3/19	Bonshaw	36	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Bothriochloa decipiens		7.5	600		
	Aristida ramosa + ?		0.2	15		
	Enneapogon gracilis		1.0	600		
	Sida corrugata		0.1	90		
	Cymbopogon refractus		0.1	30		
	Dichondra sp. A		0.1	100		
	Rumex brownii		<0.1	8		
	Oxalis		<0.1	90		
	Eragrostis brownii		0.1	24		
	Panicum simile		0.2	50		
	Cyperus gracilipyrus		<0.1	4		
	Boerhavia dominii		<0.1	14		
	Melichrysum amplexicaule		<0.1	4		
	Pimelea simplex		<0.1	1		
	Unidentifiable grasses		7			
			<0.1	1		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

total veg 10
dead 40
rock 20
bare 30

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

Date: 28-03-2019 **Recorders:** ACM, TZ **Plot ID:** 37

Project No: 0470861 **Project Name:** Bonshaw Solar Farm **Zone ID:** _____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar		
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex		
Likely Vegetation Class:					Confidence H M L
Plant Community Type (PCT):			**EEC:**		Confidence H M L

BAM Nested Plots Requirement

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1636	338564	6768372	177°S	✓	✓
50 m	1637	338579	6768321	327°NW	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1638	1639	1640	1641	1642	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		70	90	80	60	60	72
Bare Ground (%)		30	10	20	40	40	28
Cryptogam Cover (%)		0	0	0	0	0	0
Rock Cover (%)		0	0	0	0	0	0

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	≈ Flat	**Landform Element**	Plain	**Landform Pattern**	Plain	**Microrelief**	grazzy dand
Lithology	layered soils	**Soil Surface Texture**	–	**Soil Colour**	light orange-brown	**Soil Depth**	
Slope	Very gently inclined	**Aspect**	NW	**Site Drainage**	W to creek line	**Distance to nearest water and type**	≈ 50m W

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	stomps of felled trees present
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R-O	
Fire damage			
Storm damage			
Weediness	1	N	
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 28-03-2019 **Recorders:** ACM, TB **Plot ID:** 37

Project No: 0470861 **Project Name:** Banshaw Solar farm **Zone ID:** ____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm		/		
5 - 9 cm				
<5 cm [b]		/	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)	16, 7, 1, 1, 3, 4, 11, 7, 1, 1, 9, 4, =64			

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, [redacted]

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 28/3/14	Banshaw	37	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Sida corrugata "		<0.1	50		
	Glycine (.)		<0.1	20		
	Enneapogon gracilis		<0.1	4		
	Cymbopogon refractus		0.1	20		
	Panicum simile		0.1	11		
	Bothriochloa decipiens		3	700		
	Eragrostis brownii "		0.1	11		
	Cheilanthes sieberi		<0.1	3		
	Heliotropium amplexicaule		<0.1	3		
	Dichondra sp. A "		<0.1	7		
	Convolvulus absinoides		<0.1	3		
	Rumex brownii		<0.1	8		
			<0.1	8		
	Chamaesyce drummondii		<0.1	5		
	Juncus usitatus		0.1	6		
	Solenogyne bellioides		<0.1	7		
	unidentifiable grasses		5			
	Aristida ramosa		1	20		
	Oxalis perennans		<0.1	1		
	Pimelea simplex		<0.1	1		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

live veg 5-10
dead incl trunk 90
rock 0.1
soil 30

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

Date: 28-03-2019 **Recorders:** ACM, TZ **Plot ID:** 38

Project No: 0470861 **Project Name:** Bonshaw Solar Farm **Zone ID:** ~~38~~

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar			
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex			
Likely Vegetation Class:		Open woodland				Confidence (H) M L
Plant Community Type (PCT):		516 mend-box		**EEC:**	x	Confidence (H) M L

BAM Nested Plots Requirement

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1643	338685	6768653	235°SW	✓	✓
50 m	1644	338640	6768645	80°E	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1645	1646	1647	1648	1649	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		98	95	60	45	20	63.6
Bare Ground (%)		2	5	40	55	80	36.4
Cryptogam Cover (%)		0	0	0	0	0	0
Rock Cover (%)		0	0	0	0	0	0

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Flat	**Landform Element**	Plain	**Landform Pattern**	Plain	**Microrelief**	woodland
Lithology	Sandstone	**Soil Surface Texture**		**Soil Colour**	dark brown	**Soil Depth**	
Slope	Leveled	**Aspect**	—	**Site Drainage**	-	**Distance to nearest water and type**	~ 30m W

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	stumps (cut) present
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R	Cattle & sheep
Fire damage			
Storm damage			
Weediness	1	R	
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 28-03-2019 **Recorders:** ACM, TZ **Plot ID:** 38

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** _____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm				
30 - 49 cm	𝍸 || = 7			
20 - 29 cm	𝍸 𝍸 𝍸 𝍸 |||| = 24			
10 - 19 cm	𝍸 𝍸 | = 11			
5 - 9 cm	|| = 2			
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)	1,4,1,12,13,8,3, =42			

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, [redacted]

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

6 albers

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 28/3/14	Bonshaw	38	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Sclerolaena birchii		<0.1	12		
	Aristida ramosa		<0.1	20		
	Eucalyptus albens		50%		T	
	Maireana microphylla		<0.1	2		
	unidentifiable grasses		0.5			
	Opuntia aurantiaca		<0.1	3		
	Pimelia stricta		<0.1	1		
	Eragrostis brownii		<0.1	2		
	Rostkhovia adscendens		<0.1	3		
	Austrostipa scabra		<0.1	4		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

total veg 0.5 ground cover + 0.5% E. albens
dead & litter 75
bare 25

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

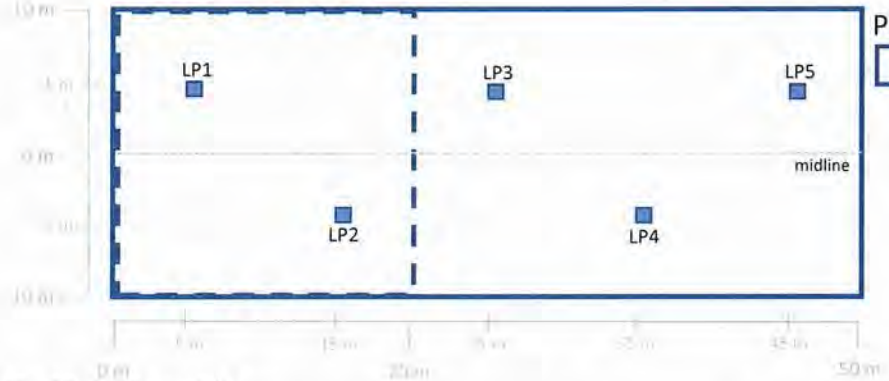
Date: 28-03-2019 **Recorders:** ACM, TZ **Plot ID:** _____

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** 39

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar			
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex			
Likely Vegetation Class:						Confidence H M L
Plant Community Type (PCT):				**EEC:**		Confidence H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1650	338676	6768698	50° NE	✓	✓
50 m	1656	~~68~~ 338720	~~698~~ 6768719	225° SW	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1651	1652	1653	1654	1655	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		95	98	80	55	80	
Bare Ground (%)		5	2	15	40	20	
Cryptogam Cover (%)		0	0	0	0	0	
Rock Cover (%)		0	0	5	5	0	

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Flat	**Landform Element**	Plain	**Landform Pattern**	Plain	**Microrelief**	
Lithology	Cleyed soil	**Soil Surface Texture**	-	**Soil Colour**	light orange-brown	**Soil Depth**	—
Slope	Leveled	**Aspect**	—	**Site Drainage**		**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	2	R-O	
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 28-03-2019 **Recorders:** ACM, TZ **Plot ID:** _____

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** 39

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)				

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

any u - small section of ≤ 10 cm Ø

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus,

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm

Field Data Sheet created by Dr Adriana Corona Mothe

40
32
72

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 28/3/19		39	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Aristida ramosa		1.5	100		
	Sida corrugata		0.1	200		
	Sclerolaena birchii		0.3	200		
	Solenogyne bellioides		20.1	40		
	Dichondra sp. A		0.2	90		
	Leichhardia nutans		<0.1	6		
	Marrubium microphyllum		0.1	1		
	unidentified grasses / seedlings		5			
	Bothriochloa decipiens		0.2	200		
	Opuntia aurantiaca		<0.1	2		
	Austrostipa scabra		0.1	4		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Total Veg 5
Dead 75
bare 20

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

Date: 28-03-2019 **Recorders:** ACM, TZ **Plot ID:** 40

Project No: 0470861 **Project Name:** Bingara Solar Farm **Zone ID:** ____

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar		
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex		
Likely Vegetation Class:					Confidence H M L
Plant Community Type (PCT):			**EEC:**		Confidence H M L

BAM Nested Plots Requirement

Plots

20m x 50m ✓

20m x 20m ✓

1m x 1m ✓

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1657	33 9305	67 68 405	40° NE	✓	✓
50 m	1663	33 9350	67 68 429	208°SW	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1658	1659	1660	1661	1662	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		30	30	25	20	40	29
Bare Ground (%)		55	55	70	70	60	64
Cryptogam Cover (%)		0	0	0	0	0	0
Rock Cover (%)		5	5	5	10	0	5

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	~~Steep~~ Crest	**Landform Element**	Hillslope	**Landform Pattern**	Hill	**Microrelief**	rocky soils
Lithology	Silty-clay	**Soil Surface Texture**	-	**Soil Colour**	light orange brown	**Soil Depth**	-
Slope	Steep	**Aspect**	315° NW	**Site Drainage**	drain slope	**Distance to nearest water and type**	~50 m N

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R O	
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 28-03-2019 **Recorders:** ACM, TZ **Plot ID:** 40

Project No: 04770861 **Project Name:** Banshaw Solar Farm **Zone ID:** ____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm	///		/	
30 - 49 cm	//		/	
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)	14, 4, 3, 2, = 23			

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus,

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm
Silver leaved Ironbark	56	1664	33 93 55	67 68 429	<10 cmØ	
"	45	1663	33 93 14	67 68405	<10 cmØ	

Field Data Sheet created by Dr Adriana Corona Mothe

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400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	28/3/19	Bonshaw	40	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Cymbopogon refractus		0.1	10		
	Enneapogon gracilis		0.2	50		
	Aristida ramosa		0.3	100		
	Opuntia aurantiaca		0.2	30		
	Aristida leptopoda		<0.1	5		
	Sida corrugata		0.1	100		
	Dichondra sp A		0.1	40		
	Rostellularia		<0.1	3		
	Glycene		<0.1	20		
	Chamaesyce drumondii		<0.1	3		
	Parsonsia eucalyptifolia		<0.1	400		
	Bothriochloa decipiens		0.1	50		
	Hypericum		<0.1	8		
	Pimelia stricta		0.1	4		
	Eucalyptus melanophloia		25%		T	
	Ozothamnus cassinioides		<0.1	1		
		?				
	Melichrus urceolatus		<0.1	1		
	Unidentifiable grasses		5			
	just outside plot: Trachorchia					
	Also Notelaea micro					

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

g/c Total veg 6
dead 60
soil 32
rock 3

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

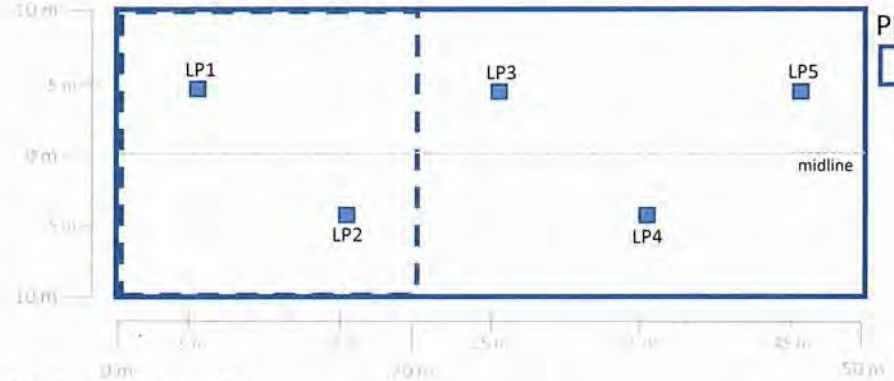
Date: 28-03-2019 **Recorders:** ACM, TZ **Plot ID:** A1

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** 41

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar		
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex		
Likely Vegetation Class:					Confidence H M L
Plant Community Type (PCT):			**EEC:**		Confidence H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1667	33 85 92	67 68 534	254° W	✓	✓
50 m	1673	33 83 41	67 68 541	82° E	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1668	1669	1670	1671	1672	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		95	10	5	1	5	23.2
Bare Ground (%)		5	90	5	99	95	58.8
Cryptogam Cover (%)		0	0	60	0	0	12
Rock Cover (%)		0	0	90	0	0	18

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint; lots of shapes of rock's shrubs

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Crest	**Landform Element**	Hill crest	**Landform Pattern**	Hill crest	**Microrelief**	rocky knoll
Lithology	Clayey soils	**Soil Surface Texture**	-	**Soil Colour**	light orange-brown	**Soil Depth**	-
Slope	Very gently inclined	**Aspect**	340° N	**Site Drainage**	-	**Distance to nearest water and type**	-

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R-O	
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form

Sheet B Page 2 of ____

Date: 28-03-2019 **Recorders:** ACM, TZ **Plot ID:** 41

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** ____

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80[+] cm				
50 - 79 cm	/		/	
30 - 49 cm				
20 - 29 cm		///		
10 - 19 cm	/	/		
5 - 9 cm		/		
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)	3, 2, =5			

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

Callitris glaucophylla

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus,

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm
Stag - Euc	53	1674	338350	6768546		2

Field Data Sheet created by Dr Adriana Corona Mothe

16/56

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400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	28/3/14	Bonshaw	41	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Cupressus semiglauca 5-7m tall		10	73	T	
	Austrostipa scabra		0.1	40		
	Maireana microphylla		0.3	7		
	Sclerolaena birchii		0.2	100		
	Sida corrugata		<0.1	50		
	Cheilanthes sieberi		<0.1	20		
	Glycera		<0.1	8		
	Oxalis perennans		<0.1	15		
	Einadia nutans		<0.1	15		
	Gomphrena		<0.1	2		
	Boerhavia dominii		<0.1	30		
	Opuntia aurantiaca		<0.1	3		
	Cynodon dactylon		20			
	Aristida ramosa		0.4	30		
	Lots of sheep + cow dung. They like to congregate here					
	Appears to have been overseen with Couch					

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

g/c veg 20
dead / manure 40
rock 25%
soil 15

BAM Plot - Field Survey Form

Sheet A Page 1 of ____

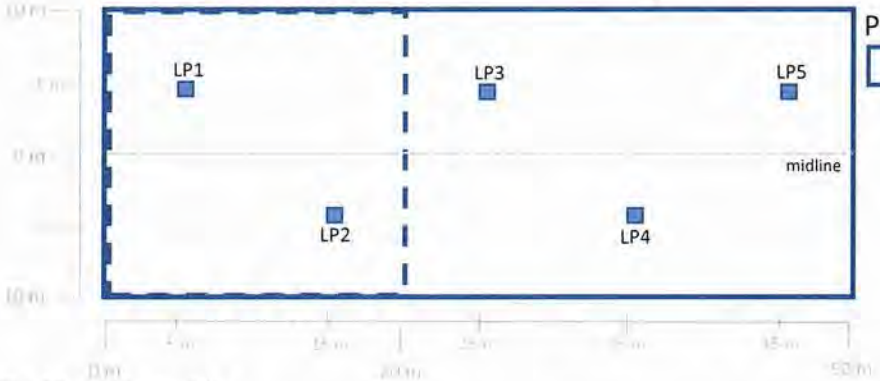
Date: 28-03-2019 **Recorders:** ACM, TZ **Plot ID:** 42

Project No: 0470861 **Project Name:** Ronshaw Solar Farm **Zone ID:** ~~47~~

Desktop Information Requirements for BAM Plot survey

Zone:	56	**IBRA region:**	Nandewar		
Datum:	94	**IBRA sub-region:**	Nandewar Northern Complex		
Likely Vegetation Class:					Confidence H M L
Plant Community Type (PCT):			**EEC:**		Confidence H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	1675	33 85 33	67 68 664	18°N	✓	✓
50 m	1681	33 85 34	67 68 715	164°S		

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	1676	1677	1678	1679	1680	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		40	30	5	90	60	55
Bare Ground (%)		10	70	95	10	40	45
Cryptogam Cover (%)		0	0	0	0	0	0
Rock Cover (%)		0	0	0	0	0	0

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP =Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	Flat	**Landform Element**	Plain	**Landform Pattern**	Plain	**Microrelief**	grass
Lithology	Clayey soils	**Soil Surface Texture**	-	**Soil Colour**	orange, brown	**Soil Depth**	
Slope	Very Gentle undulating	**Aspect**	N	**Site Drainage**		**Distance to nearest water and type**	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	3	O	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood | CWD removal			
Grazing (identify native/stock)	3	R-O	
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1= light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Field Data Sheet created by Dr Adriana Corona Mothe

BAM Plot - Field Survey Form **Sheet B** Page 2 of ____

Date: 28-03-2019 **Recorders:** ACM, TZ **Plot ID:** 42

Project No: 0470861 **Project Name:** Banshaw Solar Farm **Zone ID:** 4Z

Plot 20m x 50m: Tree Classes [a]

DBH Class[#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm	1		1	
50 - 79 cm	5			
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm [b]			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)	—			

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus,

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm
Silver-leaved Ironbark	81	1682	338539	6768671	3x <10cm	

Field Data Sheet created by Dr Adriana Corona Mothe

40
36
16
92

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400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	28/3/19	Bonshaw	42	

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
	Glycine		<0.1	30		
	Sida corrugata		0.1	40		
	Einadia nutans		<0.1	20		
	Eucalyptus melanophloia tree		20	1		
	Maireana microphylla		0.1	2		
	~~Aristida ramosa~~		3	300		
	Heliotropis amplexocaula		<0.1	13		
	Dichondra sp A		<0.1	3		
	Pimelia stricta		<0.1	1		
	Rostellularia adscendens		<0.1	15		
	Boerhavia dominii		<0.1	16		
	Opuntia aurantiaca		<0.1	2		
	Sclerolaena birchii		0.1	40		
	Tribulus terrestris		<0.1	60		
	Portulaca oleracea		<0.1	3		
	Vittadinia sulcata		<0.1	1		
	unidentifiable grasses		4			

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code if 'top 3'.**

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

g/c total veg 7
dead 52
rock 0.1
soil 40

+ tree trunk 0.2%

BAM Plot Data

Table G.1 - Summary of BAM Plot Data

					Composition						Structure						Function								
					Native Richness (count no spp)						Cover (Sum cover of spp in each growth form group)						Large Tree (P/A)	HBT	Litter Cover	Logs	Tree DBH (Tree stems - native species only) (P/A)						HTE
Plot	Zone	Easting	Northing	Bearing	Trees	Shrubs	Grasses	Forbs	Ferns	Other	Trees	Shrubs	Grasses	Forbs	Ferns	Other	>80 cm DBH	(P/A)	(average)	(m)	5-9cm DBH	10-19cm DBH	20-29cm DBH	30-49cm DBH	50-79cm DBH	<5cm DBH	(number)
1	56	337831	6767626	86 E	2	1	1	4	0	0	45.0	0.1	0.2	0.5	0.0	0.0	0	1	42	21.86	1	1	1	1	1	1	1
2	56	338406	6767613	344 N	6	3	3	2	0	3	80.5	0.3	0.3	0.2	0.0	0.3	1	1	75	49.7	1	1	1	0	1	1	1
3	56	338667	6767581	24 NE	3	3	0	2	1	0	45.2	0.4	0.0	0.2	0.1	0.0	0	1	43	37.1	1	1	1	1	1	1	1
4	56	338827	6768189	1 N	1	4	4	4	1	0	0.1	0.4	0.5	0.4	0.1	0.0	0	0	36.4	10	0	0	0	0	0	0	2
5	56	339451	6768659	239 W	3	3	2	3	1	1	35.2	0.3	0.2	0.3	0.1	0.1	0	1	75	33.5	1	1	1	1	1	1	1
6	56	339229	6768505	196 S	0	2	3	7	0	1	0.0	5.1	25.5	0.7	0.0	0.1	0	1	60	0	0	0	0	0	0	0	1
7	56	339300	6768650	236 SW	2	3	3	10	0	3	72.0	0.3	17.1	1.0	0.0	0.3	0	0	50	53	1	1	1	1	0	1	1
8	56	338603	6768514	252 W	4	6	7	7	0	1	68.5	1.9	5.6	2.0	0.0	0.1	0	1	57	54	1	1	1	1	0	1	1
9	56	338079	6768264	294 NW	1	3	9	10	1	1	35.1	0.3	2.7	1.0	0.1	0.1	0	1	24	16	1	1	1	1	0	1	1
10	56	338759	6768130	162 S	3	4	6	9	1	3	43.0	0.4	15.5	0.9	0.1	0.3	0	1	65	80	1	1	1	1	0	1	0
11	56	338572	6767919	247 SW	3	3	6	10	1	2	38.0	0.3	1.0	1.0	0.1	0.3	0	1	50	32	1	1	0	0	1	1	0
12	56	338521	6767776	207 SW	2	4	6	8	0	1	47.3	0.4	0.7	0.8	0.0	0.1	0	0	36	21	1	1	1	1	0	1	1
13	56	338198	6768336	81 E	0	2	4	5	0	1	0.0	0.2	0.9	0.5	0.0	5.0	0	0	7.4	0	0	0	0	0	0	0	1
14	56	338663	6768348	260 W	0	3	11	14	1	1	0.0	0.3	1.3	2.3	0.3	0.1	0	0	35	6	0	0	0	0	0	0	1
15	56	338451	6767511	143 SE	4	3	9	6	1	3	40.1	0.3	1.3	0.6	0.1	0.3	1	1	69	66	1	1	1	1	1	1	1
16	56	338659	6767569	255 W	4	2	4	6	1	3	41.0	0.4	0.8	1.1	0.1	0.5	0	1	53.2	70	1	1	1	1	1	1	1
17	56	338763	6767760	270 W	1	3	4	10	1	1	0.1	0.3	15.1	1.5	0.1	0.2	0	0	30	12	0	1	0	0	0	0	3
18	56	338377	6767858	53 NE	0	2	6	6	1	1	0.0	0.2	6.9	0.7	0.2	0.2	0	0	49	35	0	0	0	0	0	0	0
19	56	338320	6768072	155 SE	0	2	2	5	1	1	0.0	20.2	5.0	0.5	0.1	0.2	0	0	41	4.5	0	0	0	0	0	0	2
20	56	337983	6767855	321 NW	1	1	3	1	0	2	0.1	0.1	0.5	0.1	0.0	0.2	0	0	31	0	0	0	0	0	0	0	1
21	56	337855	6767956	321 NW	1	2	4	10	0	1	3.0	0.2	5.6	1.1	0.0	0.1	0	0	36	40	1	1	1	0	0	1	1
22	56	338024	6768238	298 NW	1	2	3	9	0	2	0.1	0.2	2.1	0.9	0.0	0.3	0	0	38	23	1	0	0	0	0	1	2
23	56	338490	6768126	159 S	1	2	4	4	1	1	0.2	0.2	2.4	0.4	0.1	0.1	0	0	26	4	1	1	1	0	0	1	1
24	56	338800	6768481	170 S	0	1	5	4	1	1	0.0	0.1	2.0	0.8	0.1	0.1	0	0	73	21	0	0	0	0	0	0	0
25	56	338687	6768607	257 W	0	0	5	5	1	1	0.0	0.0	1.3	0.5	0.1	0.1	0	0	74	11	0	0	0	0	0	0	2
26	56	339225	6768408	255 W	2	1	7	5	0	1	0.2	0.1	3.9	0.5	0.0	0.1	0	0	26	21	0	1	0	0	0	1	0
27	56	338344	6768782	184 S	0	1	3	5	1	1	0.0	0.1	40.4	0.5	0.1	0.1	0	0	66	0	0	0	0	0	0	0	1
28	56	338658	6768836	183 S	0	2	1	6	0	1	0.0	0.4	25.0	0.6	0.0	0.1	0	0	33	0	0	0	0	0	0	0	1
29	56	339052	6768750	178 S	2	1	7	8	1	1	0.2	0.1	16.3	8.0	0.1	0.1	0	0	72	43	0	0	0	0	0	1	0
30	56	338535	6769002	25 NW	0	2	3	7	0	3	0.0	0.3	1.1	0.7	0.0	0.3	0	0	45	0	0	0	0	0	0	0	0
31	56	338402	6769323	191 S	2	3	3	8	1	0	3.1	0.4	1.3	0.8	0.1	0.0	0	1	38	2	0	0	1	0	1	0	2
32	56	338518	6769371	173 S	0	2	4	2	1	1	0.0	0.2	40.3	0.2	0.1	0.1	0	0	76	0	0	0	0	0	0	0	1
33	56	338361	6769671	326 NW	0	1	2	2	0	1	0.0	0.1	0.2	0.2	0.0	0.1	0	0	7.4	0	0	0	0	0	0	0	2
34	56	338569	6769788	275 W	0	1	2	4	0	1	0.0	0.3	0.3	0.5	0.0	0.2	0	0	26	0	0	0	0	0	0	0	2
35	56	338671	6769805	262 W	0	2	6	4	0	1	0.0	5.0	3.0	0.4	0.0	0.1	0	0	24.2	0	0	0	0	0	0	0	0
36	56	339043	6768195	315 W	1	1	6	4	0	1	0.1	0.1	3.1	0.4	0.0	0.1	0	0	46.6	22	0	0	0	0	0	0	1
37	56	338564	6768372	177 S	0	1	6	7	1	1	0.0	0.1	4.4	0.7	0.1	0.1	0	0	72	64	0	1	0	0	0	1	1
38	56	338685	6768653	235 SW	1	3	2	1	0	0	50.0	0.3	0.2	0.1	0.0	0.0	0	0	63.6	42	0	1	1	1	1	0	1
39	56	338676	6768698	56 NE	0	2	3	4	0	0	0.0	0.4	1.8	0.5	0.0	0.0	0	0	81.6	0	0	0	0	0	0	0	1
40	56	339305	6768405	40 NE	1	3	5	4	0	2	25.0	0.3	0.8	0.4	0.0	0.2	0	1	29	23	0	0	0	1	1	0	1
41	56	338392	6768534	259 W	1	2	3	4	1	1	10.0	0.5	20.5	0.4	0.1	0.1	0	1	23.2	5	1	1	1	0	1	0	1
42	56	338533	6768664	18 N	1	3	1	7	0	1	20.0	0.3	3.0	0.7	0.0	0.1	1	1	55	0	0	0	0	0	0	0	2

Notes:

x = present
HTE = High Threat Exotic
HBT = Hollow-bearing Tree

P/A = Presence / Absence
1 = Present; 0 = Absent

DBH = Diameter at Breast Heght;
Logs = Length of logs with more than 10cm diameter

BAM Plot photographs

Plot 1: horizontal view from 0m midline (11 Sep 2018)

Plot 1: vertical view from 0m midline (11 Sep 2018)

Plot 2: horizontal view from 0m midline (11 Sep 2018)

Plot 2: vertical view from 0m midline (11 Sep 2018)

Plot 3: horizontal view from 0m midline (11 Sep 2018)

Plot 3: vertical view from 0m midline (11 Sep 2018)

Plot 4: horizontal view form 0m midline (12 Sep 2018)

Plot 4: vertical view from 0m midline (12 Sep 2018)

Plot 5: horizontal view from 0m midline (12 Sep 2018)

Plot 5: vertical view from 0m midline (12 Sep 2018)

Plot 6: horizontal view from 0m midline (11 Dec 2018)

Plot 6: vertical view form 0m midline (11 Dec 2018)

Plot 7: horizontal view from 0m midline (12 Dec 2018)

Plot 7: vertical view from 0m midline (12 Dec 2018)

Plot 8: horizontal view from 0m midline (13 Dec 2018)

Plot 8: vertical view from 0m midline (13 Dec 2018)

Plot 9: horizontal view from 0m midline (13 Dec 2018)

Plot 9: vertical view from 0m midline (13 Dec 2018)

Plot 10: horizontal view from 0m midline (13 Dec 2018)

Plot 10: vertical view from 0m midline (13 Dec 2018)

Plot 11: horizontal view from 0m midline (13 Dec 2018)

Plot 11: vertical view from 0m midline (13 Dec 2018)

Plot 12: horizontal view from 0m midline (13 Dec 2018)

Plot 12: vertical view from 0m midline (13 Dec 2018)

Plot 13: horizontal view from 0m midline (14 Dec 2018)

Plot 13: vertical view from 0m midline (14 Dec 2018)

Plot 14: horizontal view from 0m midline (14 Dec 2018)

Plot 14: vertical view from 0m midline (14 Dec 2018)

Plot 15: horizontal view from 0m midline (25 Mar 2019)

Plot 15: vertical view from 0m midline (25 Mar 2019)

Plot 16: horizontal view from 0m midline (25 Mar 2019)

Plot 16: vertical view from 0m midline (25 Mar 2019)

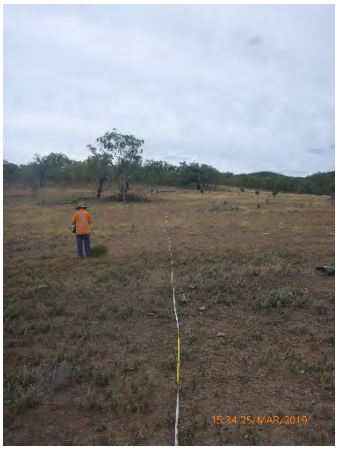
Plot 17: horizontal view from 0m midline (25 Mar 2019)

Plot 17: vertical view from 0m midline (25 Mar 2019)

Plot 18: horizontal view from 0m midline (25 Mar 2019)

Plot 18: vertical view from 0m midline (25 Mar 2019)

Plot 19: horizontal view from 0m midline (25 Mar 2019)



Plot 19: vertical view from 0m midline (25 Mar 2019)

Plot 20: horizontal view from 0m midline (26 Mar 2019)

Plot 20:horizontal view from 0m midline (26 Mar 2019)

Plot 21: horizontal view from 0m midline (26 Mar 2019)

Plot 21: horizontal view from 0m midline (26 Mar 2019)

Plot 22: horizontal view from 0m midline (26 Mar 2019)

Plot 22: horizontal view from 0m midline (26 Mar 2019)

Plot 23: horizontal view from 0m midline (26 Mar 2019)

Plot 23: horizontal view from 0m midline (26 Mar 2019)

Plot 24: horizontal view from 0m midline (26 Mar 2019)

Plot 24: horizontal view from 0m midline (26 Mar 2019)

Plot 25: horizontal view from 0m midline (26 Mar 2019)

Plot 25: horizontal view from 0m midline (26 Mar 2019)

Plot 26: horizontal view from 0m midline (26 Mar 2019)

Plot 26: horizontal view from 0m midline (26 Mar 2019)

Plot 27: horizontal view from 0m midline (27 Mar 2019)

Plot 27: horizontal view from 0m midline (27 Mar 2019)

Plot 28: horizontal view from 0m midline (27 Mar 2019)

Plot 28: horizontal view from 0m midline (27 Mar 2019)

Plot 29: horizontal view from 0m midline (27 Mar 2019)

Plot 29: horizontal view from 0m midline (27 Mar 2019)

Plot 30: horizontal view from 0m midline (27 Mar 2019)

Plot 30: horizontal view from 0m midline (27 Mar 2019)

Plot 31: horizontal view from 0m midline (27 Mar 2019)

Plot 31: horizontal view from 0m midline (27 Mar 2019)

Plot 32: horizontal view from 0m midline (27 Mar 2019)

Plot 32: horizontal view from 0m midline (27 Mar 2019)

Plot 33: horizontal view from 0m midline (27 Mar 2019)

Plot 33: horizontal view from 0m midline (27 Mar 2019)

Plot 34: horizontal view from 0m midline (27 Mar 2019)

Plot 34: horizontal view from 0m midline (27 Mar 2019)

Plot 35: horizontal view from 0m midline (27 Mar 2019)

Plot 35: horizontal view from 0m midline (27 Mar 2019)

Plot 36: horizontal view from 0m midline (28 Mar 2019)

Plot 36: horizontal view from 0m midline (28 Mar 2019)

Plot 37: horizontal view from 0m midline (28 Mar 2019)

Plot 37: horizontal view from 0m midline (28 Mar 2019)

Plot 38: horizontal view from 0m midline (28 Mar 2019)

Plot 38: horizontal view from 0m midline (28 Mar 2019)

Plot 39: horizontal view from 0m midline (28 Mar 2019)

Plot 39: horizontal view from 0m midline (28 Mar 2019)

Plot 40: horizontal view from 0m midline (28 Mar 2019)

Plot 40: horizontal view from 0m midline (28 Mar 2019)

Plot 41: horizontal view from 0m midline (28 Mar 2019)

Plot 41: horizontal view from 0m midline (28 Mar 2019)

Plot 42: horizontal view from 0m midline (28 Mar 2019)

Plot 42: horizontal view from 0m midline (28 Mar 2019)

APPENDIX H FLORA AND FAUNA SPECIES LISTS

Table H.1 Bird Species Records

Family	Common Name	Scientific Name	BC Act	EPBC Act	B1	B2	B3	B4	B5	B6	B7	Incidentals
Acanthizidae	Weebill	*Smicrornis brevirostris*				1	2					I
Acanthizidae	White-throated Gerygone	*Gerygone albogularis*										II
Acanthizidae	Inland Thornbill	*Acanthiza apicalis*										I
Acanthizidae	Speckled Warbler^	*Pyrrholaemus sagittatus*										I
Acanthizidae	Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*										I
Accipitridae	Wedge-tailed Eagle^	*Aquila audax*										I
Accipitridae	Whistling Kite	*Haliastur sphenurus*										I
Aegothelidae	Australian Owlet-nightjar	*Aegotheles cristatus*										I
Anatidae	Pacific Black-duck	*Anas superciliosa*								10		I
Artamidae	Australian Magpie	*Cracticus tibicen*			2	1		1		2	3	I
Artamidae	Grey Butcherbird	*Cracticus torquatus*			1	1	1	1			1	I
Artamidae	Pied Butcherbird	*Pied Butcherbird*								1		I
Artamidae	Pied Currawong	*Strepera graculina*			1		1	1				I
Cacatuidae	Galah	*Eolophus roseicapillus*						1		5	4	I
Cacatuidae	Little Corella	*Cacatua sanguinea*								30		
Cacatuidae	Sulphur-crested Coockatoo	*Cacatua galerita*								6		I
Campephagidae	Cicadabird	*Coracina tenuirostris*		Ma		1						I
Campephagidae	Black-faced Cuckooshrike	*Coracina novaehollandiae*										I
Campephagidae	White-winged Triller	*Lalage sueurii*										I
Charadriidae	Masked Lapwing	*Vanellus miles*										I

Family	Common Name	Scientific Name	BC Act	EPBC Act	B1	B2	B3	B4	B5	B6	B7	Incidentals
Climacteridae	Brown Treecreeper^ (eastern subspecies)	*Climacteris picumnus victoriae*	V									I
Columbidae	Crested Pigeon	*Ocyphaps lophotes*			2	2	1	1		1		I
Columbidae	Common Bronzewing	*Phaps chalcoptera*										I
Columbidae	Peaceful Dove	*Geopelia striata*										II
Corcoracidae	Apostlebird	*Struthidea cinerea*			6	2				3	2	I
Corcoracidae	White-winged Chough	*Corcorax melanorhamphos*			4							I
Corvidae	Australian Raven	*Corvus coronoides*			2							I
Corvidae	Torresian Crow	*Corvus orru*				3		1				I
Cuculidae	Channel-billed Cockoo	*Scythrops novaehollandiae*								1		I
Cuculidae	Eastern Koel	*Eudynamys orientalis*			1						1	
Estrildidae	Double-barred Finch	*Taeniopygia bichenovii*										I
Falconidae	Nankeen Kestrel	*Falco cenghroides*										I
Meliphagidae	Blue-faced Honeyeater	*Entomyzon cyanotis*						1				
Meliphagidae	Lewin's Honeyeaater	*Meliphaga lewinii*					1				1	
Meliphagidae	Little Friarbird	*Philemon citreogularis*			2	3	1		1		3	I
Meliphagidae	Noisy Miner	*Manorina melanocephala*			5	4	4	11		2	4	I
Meliphagidae	Striped Honeyeater	*Plectorhyncha lanceolata*					1					I
Meliphagidae	Brown Honeyeater	*Lichmera indistincta*										I
Monarchidae	Magpie-lark	*Grallina cyanoleuca*			2	2		1		9	1	I
Motacillidae	Australasian Pipit	*Anthus novaeseelandiae*						1			1	I
Nectariniidae	Mistletoebird	*Dicaeum hirundinaceum*										I

Family	Common Name	Scientific Name	BC Act	EPBC Act	B1	B2	B3	B4	B5	B6	B7	Incidentals
Oriolidae	Olive-backed Oriole	*Oriolus sagitattus*										I
Pachycephalidae	Grey Shrike-thrush^	*Colluricincla harmonica*										I
Pachycephalidae	Rufus Whistler	*Pachycephala rufiventris*										I
Pardalotidae	Striated Pardalote	*Pardalotus striatus*			1			1		2	1	I
Petrocidae	Eastern Yellow Robin^	*Eopsaltria australis*										I
Petrocidae	Jacky Winter^	*Microeca fascinans*										I
Petrocidae	Red-capped Robin^	*Petroica goodenovii*										I
Pomatostomidae	Grey-crowned Babbler	*Pomatostomus temporalis*	V							1	4	
Psittacidae	Pale-headed Rosella	*Platycercus adscitus*			1	5					1	I
Psittacidae	Red-rumped Parrot	*Psephotus haematonotus*				10	4	1	1			I
Psittacidae	Red-winged Parrot	*Aprosmictus erythropterus*				6	1					
Psittacidae	Eastern Rosella	*Platycercus eximius*										I
Rhipiduridae	Grey Fantail	*Rhipidura albiscapa*										I
Rhipiduridae	Willie Wagtail	*Rhipidura leucophrys*			1	1		1			2	I

Notes: # = number of individuals; I - one record; II = two records; ^ - recorded adjacent to the Subject Land only; V – Vulnerable; Ma - Marine

Table H.2 Reptile species records

Family	Common Name	Scientific Name	BC Act	EPBC Act	R1	R2	R3	R4	R5	R6	R7	R8	Incidentals
Agamidae	Eastern Bearded Dragon	*Pogona barbata*											I
Varanidae	Monitor Lizard	*Varanus varius*											I
Gekkonidae	Bynoe's Gecko	*Heteronotia binoei*											I
Scincidae	Tree Skink	*Egernia striolata*											I
Scincidae	Tree-base Litter-skink, Rainbow Skink	*Lygisaurus foliorum*											I
Gekkonidae	A Gecko	Gehyra sp.						1					
	Small brown gecko												I
	Skink												I
	Turtle												I

Table H.3 Mammal species records

Family	Common Name	Scientific Name	BC Act	EPBC Act	Incidentals
Bovidae	European Cattle*	*Bos taurus*			x
Bovidae	Sheep*	*Ovis aries*			x
Canidae	Dog*	*Canis lupus familiaris*			x
Leporidae	European Rabbit*	*Oryctolagus cuniculus*			scat, x
Macropodidae	Common Wallaroo	*Macropus robustus*			x
Macropodidae	Eastern Grey Kangaroo	*Macropus giganteus*			x
Macropodidae	Red-necked Wallaby	*Macropus rufogriseus*			x
Peramelidae	Northern Brown Bandicoot	*Isoodon macrourus*			x
Phalangeridae	Common Brushtail Possum	*Trichosurus vulpecula*			x
Suidae	Feral Pig*	*Sus scrofa*			x
Tachyglossidae	Short-beaked Echidna	*Tachyglossus aculeatus*			Scat, diggings

*Introduced species

Table H.4 Amphibian species list

Family	Common Name	Scientific Name	F1	F2	F3	Incidentals
Hyalidae	Desert Tree Frog	*Litoria rubella*	C			
Hylidae	Broad-palmed Frog	*Litoria latopalmata*				O
Hylidae	Peron's Tree Frog	*Litoria peronii*				O

Notes: C = heard calling; O = observed;

Table H.5 Microchiropteran Bat Species List

Family	Common Name	Scientific Name	BC Act	EPBC Act	S2	S3	S4	S5	S6	S7	S8
Molossidae	*Austronomus australis*	White-striped Freetail-bat	-		D	D	D	D	D	D	D
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat			D	D	D	D	D	D	D
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat			D	D	D	D	D	D	D
Vespertilionidae	*Chalinolobus picatus*	Little Pied Bat	V		D	D	D	D	P	D	D
Miniopteridae	*Miniopterus orianae oceanensis*	Eastern Bent-winged Bat	V		D	D	D	D	D	D	D
Molossidae	*Ozimops planiceps* / *O. petersi*	South-eastern Free-tailed Bat / Inland Free-tailed Bat	-	-	P	P	P	P	P	P	P
Molossidae	*Ozimops ridei*	Ride's Free-tailed Bat			D	D	D	D	D	D	D
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheath-tailed Bat	V		D	D	D	D	D	D	D
Vespertilionidae	*Scotorepens balstoni*	Inland Broad-nosed Bat			D	D	D	D	D	D	P
Vespertilionidae	*Scotorepens greyii*	Little Broadnosed Bat			17	15	46	210	26	10	27
Molossidae	*Mormopterus eleryi* *	Bristle-faced Free-tailed Bat	E		5		11	25	1	12	
Vespertilionidae	*Vespadelus troughtoni*	Eastern Cave Bat	V		P	P	P	P	P	P	P
Vespertilionidae	*Vespadelus vulturnus*	Little Forest Bat			D	D	D	D	D	D	D
Nyctophilus species - group formed by the three species below					D	D	D	D	D	D	
Vespertilionidae	*Nyctophilus corbeni*	Corben's Long-eared Bat	V	V							
Vespertilionidae	*Nyctophilus geoffroyi*	Lesser Long-eared Bat									
Vespertilionidae	*Nyctophilus gouldi*	Gould's Long-eared Bat									
Vespertilionidae/ Molosidae	*Scotorepens greyii* or *Chalinolobus nigrogriseus*[V]	Little Broad-nosed Bat or Hoary Wattled Bat	V		P	P	P	P	P	P	P
Vestertilionidae /	*Scotorepens greyii* or *Falsistrellus tasmaniensis*[V]	Little Broad-nosed Bat or Eastern False Pipistrelle	V		P	P	P	P	P	P	

*D = Definite call identification, i.e. at least one call attributed unequivocally to the species; P = Possible call identification, i.e. calls like those of the species were recorded, but were not reliably identified; V = Vulnerable; * reported as Setirostris eleryi by Balance! Environmental (see Appendix I)*

Table H.6 Flora Species List

Table H.7 Summary of Hollow Bearing Trees Observations

No	Latitude	Longitud	Scientific Name	Common Name	Type	DBH	No Hollows	Size (cm)	Notes
1	-29.1927	151.3394	*Eucalyptus moluccana*	Grey Box	T	-	1	15	-
2	-29.194	151.3394	*Eucalyptus dealbata*	Tumbledown Red Gum	S	-	1	20	-
3	-29.1943	151.3403	*Eucalyptus moluccana*	Grey Box	T	-	1	5	-
4	-29.1952	151.3413	*Angophora floribunda*	Rough-barked Apple	T	-	1	45	-
5	-29.1942	151.3419	*Angophora floribunda*	Rough-barked Apple	T	-	1	15	-
6	-29.1968	151.3438	*Eucalyptus moluccana*	Grey Box	T	-	1	30	-
7	-29.1972	151.3441	-	-	S	-	1	40	-
8	-29.1973	151.3444	-	-	S	-	1	40	-
9	-29.197	151.3446	-	-	S	-	1	-	Large top opening
10	-29.1982	151.3432	*Eucalyptus melanophloia*	Silver-leaved Ironbark	S	-	1	10	-
11	-29.2062	151.345	*Eucalyptus melanophloia*	Silver-leaved Ironbark	T	-	1	25	-
12	-29.2053	151.3453	-	-	S	-	1	25	-
13	-29.2098	151.3414	*Eucalyptus melanophloia*	Silver-leaved Ironbark	T	-	1	10	-
14	-29.2098	151.3415	-	-	S	-	1	35	-
15	-29.2056	151.3366	*Eucalyptus melanophloia*	Silver-leaved Ironbark	T	-	1	5	-
16	-29.2084	151.3373	-	-	S	-	1	10	-
17	-29.2095	151.3375	*Eucalyptus moluccana*	Grey Box	T	-	1	5	-
18	-29.2097	151.3378	*Eucalyptus moluccana*	Grey Box	T	-	1	10	-
19	-29.21	151.3331	*Corymbia dolichocarpa*	Long-fruited Bloodwood	T	-	1	20	-
20	-29.2095	151.3336	-	-	S	-	1	10	-
21	-29.2094	151.3335	-	-	S	-	1	5	-
22	-29.2093	151.3301	-	-	S	-	1	-	Split at base to 1.75m
23	-29.2086	151.3311	-	-	S	-	1	10	-
24	-29.2058	151.3318	-	-	S	-	1	5	-
25	-29.2014	151.3478	-	-	S	-	1	35	-
26	-29.2022	151.3479	*Eucalyptus melanophloia*	Silver-leaved Ironbark	T	-	1	35	-
27	-29.2018	151.3485	*Eucalyptus dealbata*	Tumbledown Red Gum	T	-	1	20	-
28	-29.2019	151.3485	*Eucalyptus dealbata*	Tumbledown Red Gum	T	-	1	25	-
29	-29.2019	151.3454	-	-	S	-	1	25	-
30	-29.2068	151.3424	*Eucalyptus moluccana*	Grey Box	S	-	1	40	-
31	-29.2073	151.3423	*Eucalyptus moluccana*	Grey Box	S	-	1	15	-
32	-29.205	151.3368	-	-	S	-	1	15	-
33	-29.1968	151.3401	*Eucalyptus moluccana*	Grey Box	T	-	1	15	-

No	Latitude	Longitud	Scientific Name	Common Name	Type	DBH	No Hollows	Size (cm)	Notes
34	-29.2095	151.3319	*Corymbia dolichocarpa*	Long-fruited Bloodwood	T	-	1	20	-
35	-29.194	151.3377	*Eucalyptus moluccana*	Grey Box	T	-	3	20	Largest hollow 20cm D
36	-29.194	151.3381	*Eucalyptus moluccana*	Grey Box	T	-	1	10	-
37	-29.1961	151.3387	*Eucalyptus moluccana*	Grey Box	S	-	1	30	-
38	-29.1977	151.3399	-	-	S	-	1	5	-
39	-29.1983	151.3399	*Eucalyptus moluccana*	Grey Box	S	80	1	30	-
40	-29.2005	151.3376	*Eucalyptus melanophloia*	Silver-leaved Ironbark	T	-	1	20	-
41	-29.2029	151.3369	*Eucalyptus moluccana*	Grey Box	T, S	-	1	10	-
42	-29.2022	151.336	*Eucalyptus moluccana*	Grey Box	T	-	1	15	-
43	-29.201	151.3385	*Eucalyptus melanophloia*	Silver-leaved Ironbark	T	-	1	10	-
44	-29.2022	151.3378	*Eucalyptus melanophloia*	Silver-leaved Ironbark	T, S*	-	1	<10	-
45	-29.2095	151.332	*Eucalyptus moluccana*	Grey Box	T	-	1	30	-
46	-29.2018	151.3426	-	-	S	-	1	15	-
47	-29.2011	151.3451	*Eucalyptus melanophloia*	Silver-leaved Ironbark	T	-	1	15	-
48	-29.2016	151.3383	-	-	S	-	1	15	-
49	-29.2056	151.3399	*Eucalyptus melanophloia*	Silver-leaved Ironbark	T	-	1	40	Hollow at approx 6m above ground level
50	-29.2068	151.3395	*Eucalyptus melanophloia*	Silver-leaved Ironbark	T	-	1	7	-
51	-29.2087	151.3384	*Eucalyptus melanophloia*	Silver-leaved Ironbark	T	-	1	10	-
52	-29.2107	151.3358	*Eucalyptus melanophloia*	Silver-leaved Ironbark	T	-	1	10	-
53	-29.21	151.3415	*Corymbia dolichocarpa*	Long-fruited Bloodwood	T	-	1	30	-
54	-29.2077	151.3418	Eucalyptus melanophloia	Silver-leaved Ironbark	T	-	1	20	-
55	-29.2074	151.3411	-	-	T	-	1	15	-
56	-29.2071	151.3409	*Eucalyptus melanophloia*	Silver-leaved Ironbark	T	-	1	35	-
57	-29.2062	151.3415	-	-	T	-	1	10	-
58	-29.2063	151.3446	*Eucalyptus dealbata*	Tumbledown Red Gum	T	-	1	15	-
59	-29.2	151.344	*Eucalyptus melanophloia*	Silver-leaved Ironbark	T	-	1	15	-
60	-29.1996	151.3393	*Eucalyptus moluccana*	Grey Box	T	-	1	40	-

APPENDIX I MICROCHIROPTERAN BAT CALL REPORT

Microbat Call Identification Report

Prepared for ("Client"):	ERM
Survey location/project name:	Bonshaw area (NSW)
Survey dates:	10-14 December 2018
Client project reference:	0470861
Job no.:	ERM-1901
Report date:	22 February 2019

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Methods

Data received

Balance! Environmental received 8351 full-spectrum (WAV format) audio files, recorded using Song Meter SM2BAT detectors at seven sites (S2-S8) over four consecutive nights (10-13 December 2018). A file note included with the submitted data indicated that another site ("S1") was sampled but no data was obtained.

Call identification

Data were analysed in *Kaleidoscope Pro* (Version 5.1.7; Wildlife Acoustics, Maynard MA, USA). The first-pass analysis utilised the "Cluster Analysis" function, to scan all WAV files and automatically group recognised bat calls into clusters with similar call characteristics (based on zero-crossing analysis). Clusters were then assigned species identifications by manually reviewing call spectrograms and derived metrics and comparing them with those of regionally-relevant reference calls and/or with published call descriptions (Reinhold et al. 2001; Pennay *et al.* 2004). Consideration was also given to the probability of species' occurrence based on published distribution information (e.g. Churchill 2008; van Dyck *et al.* 2013) and on-line database records (e.g. http://www.ala.org.au).

Species identification was based largely on search-phase call sequences; however, where good-quality foraging sequences were available (*i.e.* a call sequence with contiguous search-phase, attack-phase and feeding-buzz components), those calls were used to provide additional evidence of some species' presence. The feeding buzzes of *Miniopterus* species (bent-winged bats) and some Molossids (free-tailed bats) are quite distinctive, compared with those of Vespertilionids (vesper bats) with which they often share search-phase characteristics (Corben 2010).

Reporting standard

The format and content of this report follows Australasian Bat Society standards for the interpretation and reporting of bat call data (Reardon 2003), available on-line at http://www.ausbats.org.au/.

Species nomenclature follows Jackson & Groves (2015), which uses several new genus/species names compared with common field guides (*e.g.* Churchill 2008; Van Dyck *et al.* 2013). New names used in this report include:

Ozimops ridei (Ride's Free-tailed Bat) – formerly *Mormopterus ridei* and *M.* 'species 2';

O. petersi (Inland Free-tailed Bat) – formerly *M. petersi* and *M.* 'species 3';

O. planiceps (Southern free-tailed Bat) – formerly *M. planiceps* and *M.* 'species 4';

Setirostris eleryi (Bristle-faced Free-tailed Bat) – formerly *M. eleryi* and *M.* 'species 6'; and

Miniopterus orianae (Large or Eastern Bent-winged Bat) – formerly *M. schreibersii.*

Results & Discussion

Cluster analysis output

The Cluster Analysis recognised 7705 bat calls and grouped them into 54 clusters; however, many clusters contained slight variants of the same species' calls. Three-quarters of the recognised calls were positively identified, with the other 25% unable to be allocated reliably to a single species. These were assigned to "unresolved species" groups. A breakdown of the numbers of calls attributed to species or unresolved groups for each site is provided at **Appendix 1**.

Species recorded

At least 12 and up to 16 species were recorded during the Bonshaw survey (see **Table 1**). Eleven call types were positively identified to individual species, while one call type was attributed to the genus *Nyctophilus*, within which species cannot be reliably differentiated using call characteristics. Three *Nyctophilus* species potentially occur in the study area: *N. corbeni; N. geoffroyi;* and *N. gouldi*. Half (3907) of the total recorded calls were reliably attributed to just three species: *Miniopterus orianae oceanensis* (Eastern Bent-winged Bat); *Ozimops ridei* (Eastern Free-tailed Bat); and *Saccolaimus flaviventris* (Yellow-bellied Sheath-tailed Bat).

Several call types that potentially represented multiple species were allocated to "unresolved" species groups. Where calls were allocated to one these "unresolved" groups, all group members are listed as "possibly present" in **Table 1** unless other, more typical calls form one or more members were also observed for the relevant site. Three of the "unresolved" species groups included species that were not otherwise found in the positively-identified call data. These include:

- *Ozimops ridei / O. petersi / O. planiceps*
    - *O. ridei* was positively identified where calls had typical *Ozimops* pulse-shape characteristics (predominantly flat search-phase pulses) and characteristic frequency (Fc) of 30-35 kHz
    - Calls allocated to this "unresolved" group had similar pulse shapes but Fc27-30 kHz
    - It is likely these were all low-frequency variants of *O. ridei*, but it is possible that *O. planiceps* and (remotely possible) *O. petersi* also occur in the study area
- *Vespadelus vulturnus / V. troughtoni*
    - *V. vulturnus* positively identified from numerous calls having typical steep, curvilinear pulses with hooked bodies (up-swept tail) and Fc~46-48 kHz
    - A number of calls with the same typical *Vespadelus* pulse-shape had Fc~48-50 kHz may have been form either of these species
- *Vespadelus* spp. / *Chalinolobus morio*
    - Calls were similar to above group but had mixed pulse shape and duration, varying from the shorter, hooked *Vespadelus* pulse-shape to longer, flatter pulse bodies with no tail or down-swept tail more typical of *C. morio*
    - *C. morio* calls were reliably identified only where all pulses showed consistent shape with flatter characteristic section and obvious down-swept tail

Sample spectrograms of all call-types are shown at Appendix 1.

Threatened species

Several of the identified species are listed as threatened under State and Commonwealth nature conservation legislation (Environment Protection and Biodiversity Conservation Act 1999 [EPBC Act] – Cwlth; Biodiversity Conservation Act 2016 [BCA] – New South Wales; Nature Conservation Act 1992 [NCA] – Queensland). These include:

- *Chalinolobus picatus* (Little Pied Bat) – Vulnerable, BCA
- *Nyctophilus corbeni* (Corben's Long-eared Bat) – Vulnerable, EPBC, BCA, NCA
    - Note that this species was not positively identified, but may have been responsible for some of the calls allocated to the *Nyctophilus* genus
- *Vespadelus troughtoni* (Eastern Cave Bat) – Vulnerable, BCA
    - Note that this species was not positively identified but may have been responsible for some of the unresolved calls allocated to two multi-species groups (see previous section)
- *Miniopterus orianae oceanensis* (Eastern Bent-winged Bat) – Vulnerable, BCA
- *Setirostris eleryi* (Bristle-faced Free-tailed Bat) – Endangered, BCA
- *Saccolaimus flaviventris* (Yellow-bellied Sheath-tailed Bat) – Vulnerable, BCA

Table 1. Microbat species recorded during the ERM Bonshaw survey, 10-14 December 2018.

♦ = 'definite' - at least one call was attributed unequivocally to the species

□ = 'possible' - calls like those of the species were recorded, but were not reliably identified

Site code:	S2	S3	S4	S5	S6	S7	S8
Chalinolobus gouldii	♦	♦	♦	♦	♦	♦	♦
Chalinolobus morio	♦	♦	♦	♦	♦	♦	♦
Chalinolobus picatus	♦	♦	♦	♦	□	♦	♦
Nyctophilus species	♦	♦	♦	♦	♦	♦	
Scotorepens balstoni	♦	♦	♦	♦	♦	♦	□
Scotorepens greyii	♦	♦	♦	♦	♦	♦	♦
Vespadelus vulturnus	♦	♦	♦	♦	♦	♦	♦
Vespadelus troughtoni	□	□	□	□	□	□	□
Miniopterus orianae oceanensis	♦	♦	♦	♦	♦	♦	♦
Austronomus australis	♦	♦	♦	♦	♦	♦	♦
Ozimops ridei	♦	♦	♦	♦	♦	♦	♦
Ozimops planiceps / O. petersi	□	□	□	□	□	□	□
Setirostris eleryi	♦	♦	♦	♦	♦	♦	♦
Saccolaimus flaviventris	♦	♦	♦	♦	♦	♦	♦

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Glossary

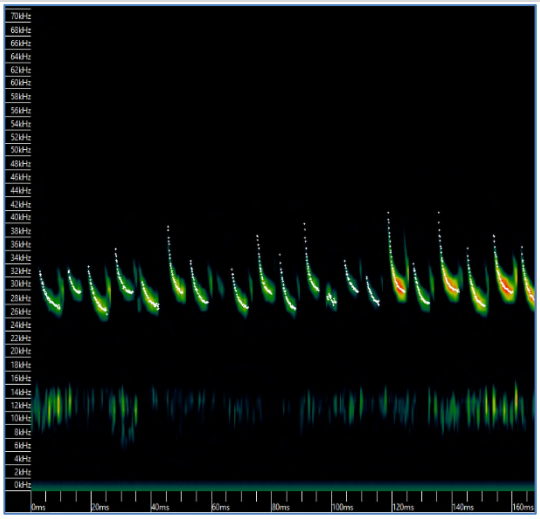
Technical terms used in this report are described in the following table.

Approach phase	The part of a bat *call* emitted as the bat starts to home in on a detected prey item; a transitional series of *pulses* between the *search phase* and *feeding buzz*, that become progressively steeper and shorter in duration.
Call	Refers to a single bat call, made up of a series of individual sound *pulses* in one or more *phases* (*search, approach, feeding buzz*).
CF (=Constant Frequency)	A type of *pulse* in which the dominant component consists of a more-or-less 'pure tone' of sound at a Constant Frequency; with *shape* appearing flat on the sonogram. Often also contains a brief *FM* component at the beginning and/or end of the CF component (*viz.* FM-CF-FM).
Characteristic frequency (Fc)	The frequency of the flattest part of a *pulse*; usually the lowest frequency reached in the *qCF* component of a pulse. This is often the primary diagnostic feature for species identification.
Duration	The time period from the beginning of a *pulse* to the end of the pulse.
Feeding buzz	The terminal part of a *call*, following the *approach phase*, emitted as the bat catches a prey item; a distinctive, rapid series of very steep, very short-duration pulses.
FM (=Frequency Modulated)	A type of *pulse* in which there is substantial change in frequency from beginning to end; *shape* ranges from almost vertical and linear through varying degrees of curvature.
FC range	Refers to the range of frequencies occupied by the *characteristic frequency* section of *pulses* within a call or set of calls.
Frequency sweep or "band-width"	The range of frequencies through which a *pulse* sweeps from beginning to end; Maximum frequency (Fmax) – minimum frequency (Fmin).
Knee	The transitional part of a *pulse* between the initial (usually steeper) frequency sweep and the *characteristic frequency* section (usually flatter); time to knee (Tk) and frequency of knee (Fk) can be diagnostic for some species.
Pulse	An individual pulse of sound within a bat *call*; the *shape*, *duration* and *characteristic frequency* of a pulse are the key diagnostic features used to differentiate species.
Pulse body	The part of the *pulse* between the *knee* and *tail* and containing the *characteristic frequency* section.
Pulse shape	The general appearance of a *pulse* on the sonogram, described using relative terms related to features such as slope and degree of curvature. See also *CF, qCF* and *FM*.
qCF (=quasi Constant Frequency)	A type of *pulse* in which there is very little change in frequency from beginning to end; *shape* appears to be almost flat. Some pulses also contain an *FM* component at the beginning and/or end of the qCF component (*viz.* FM-qCF).
Search phase	The part of a bat *call* generally required for reliable species diagnosis. A consistent series of *pulses* emitted by a bat that is searching for prey or and/or navigating through its habitat. Search phase pulses generally have longer duration, flatter slope and more consistent shape than *approach phase* and *feeding buzz* pulses.
Sequence	Literally, a sequence of *pulses* that may be from one or more bats; but generally refers to a *call* or part (e.g. *phase*) of a call.
Tail	The final component of a *pulse*, following the *characteristic frequency* section; may consist of a short or long sweep of frequencies either upward or downward from the Fc; or may be absent.

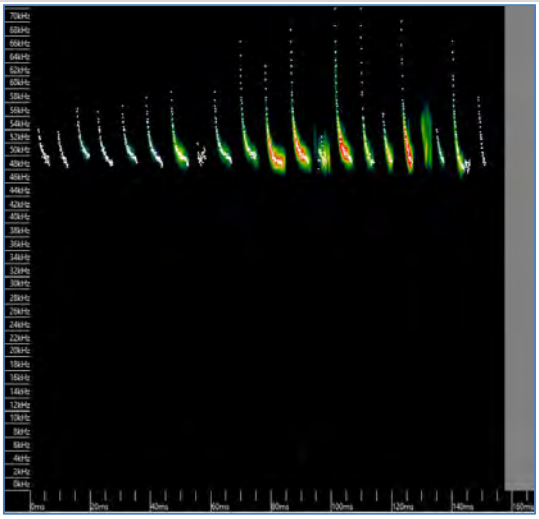
Appendix 1 Bats recorded during the Bonshaw survey: number of calls allocated to each species or unresolved group.

Site code:	S2	S3	S4	S5	S6	S7	S8	Species totals
Positively identified calls								
Chalinolobus gouldii	46	44	33	267	43	9	13	455
Chalinolobus morio	1	3	1	3	1	3	3	15
Chalinolobus picatus	10	12	3	54		5	7	91
Nyctophilus species	5	2	1	11	5	13		37
Scotorepens balstoni	2	1	2	15	12	2		34
Scotorepens greyii	19	6	32	273	17	8	18	373
Vespadelus vulturnus	11	8	15	62	2	7	3	108
Miniopterus orianae oceanensis	69	150	10	390	19	52	67	757
Austronomus australis	24	38	13	16	62	26	14	193
Ozimops ridei	351	227	98	440	216	163	158	1653
Setirostris eleryi	70	40	79	270	31	48	26	564
Saccolaimus flaviventris	343	491	104	377	79	30	73	1497
Unresolved calls								
C. gouldii/O. ridei	181	106	64	257	97	60	60	825
C. gouldii/S. balstoni	16	8	20	111	42	2	6	205
S. balstoni/O. ridei	26	11	4	44	9	4		98
S. greyii/C. picatus	1	5	4	31	3	5		49
S. greyii/S. eleryi		4	7	44	5	6		66
Ozimops species	59	31	15	31	25	31	34	226
V. vulturnus/M. o. oceanensis	32	27	10	75	5	13	3	165
V. vulturnus/V. troughtoni	11	10	117	66	10	10	5	229
V. vulturnus/V. troughtoni/C. morio	6	22	16	12	4	3	2	65
Total calls from site:	1283	1246	648	2849	687	500	492	7705

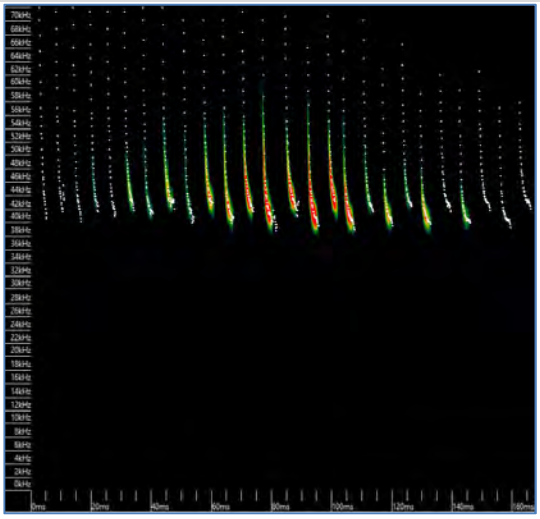
Appendix 2 Representative call sequences from the Bonshaw survey, 10-14 December 2018.
Kaleidoscope spectrograms with zero-crossing overlay (white); time between pulses removed



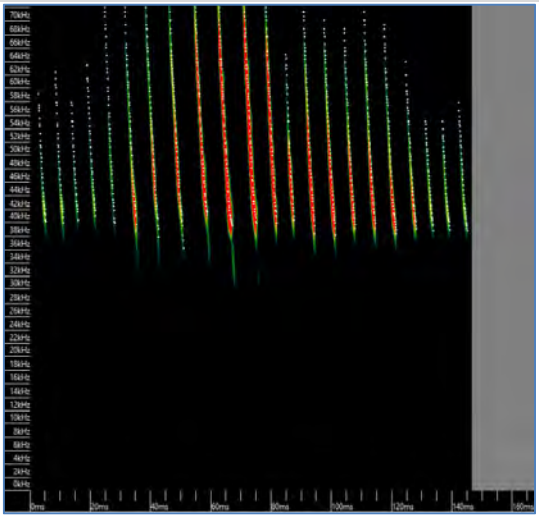
Chalinolobus gouldii



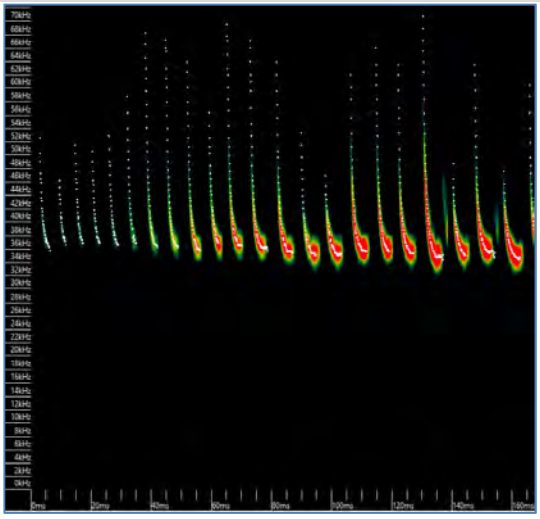
Chalinolobus morio



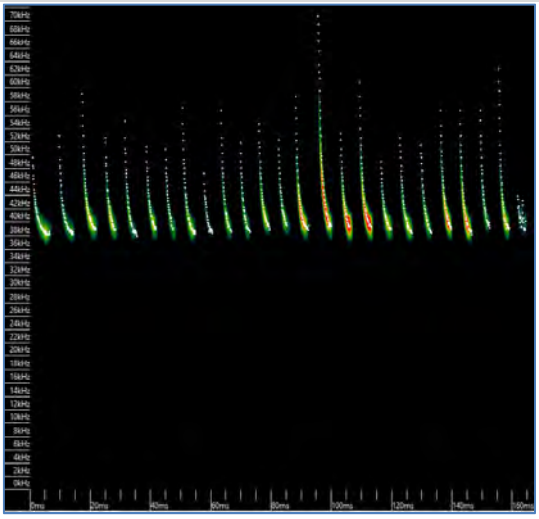
Chalinolobus picatus



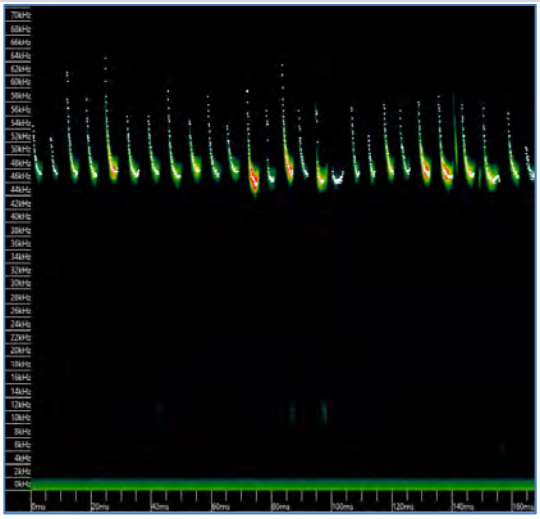
Nyctophilus species



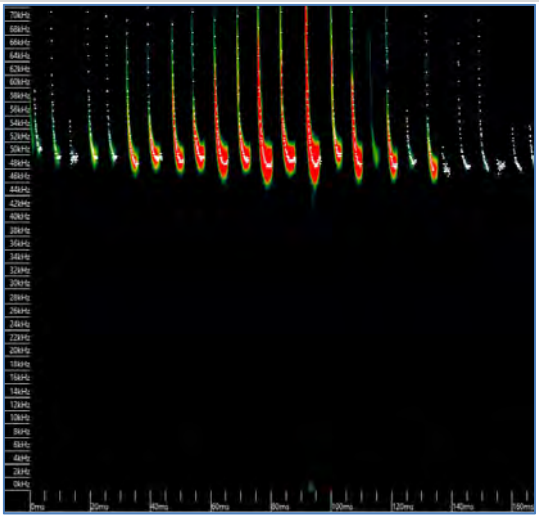
Scotorepens balstoni



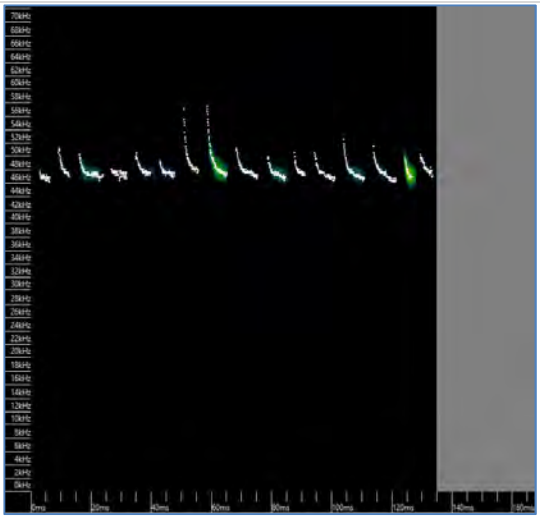
Scotorepens greyii



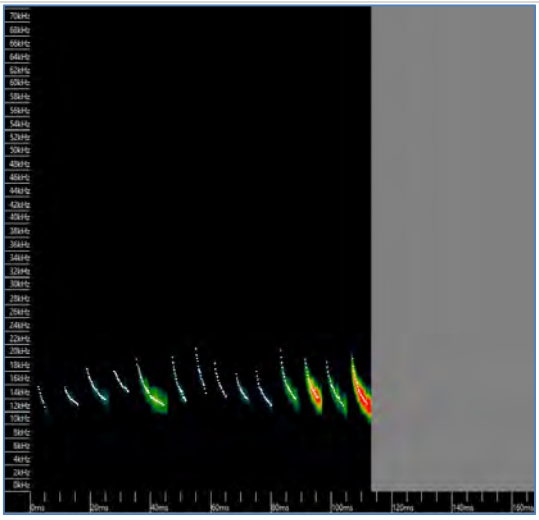
Vespadelus vulturnus



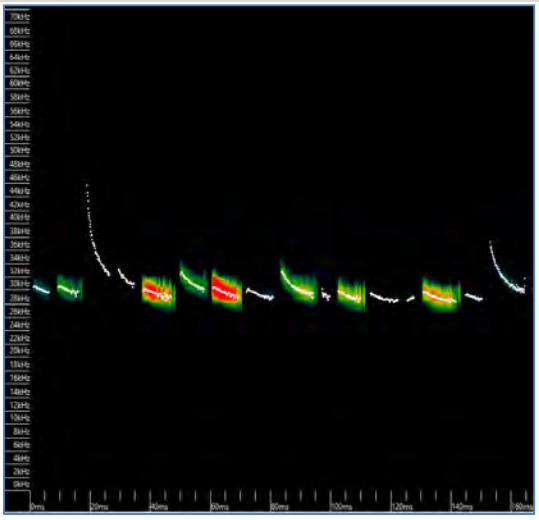
V. vulturnus / V. troughtoni



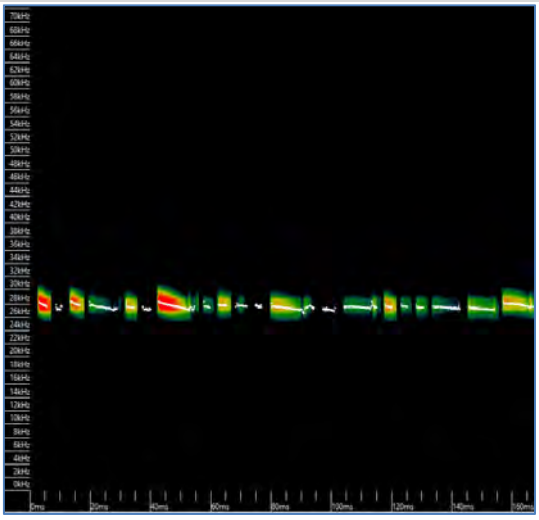
Miniopterus orianae oceanensis



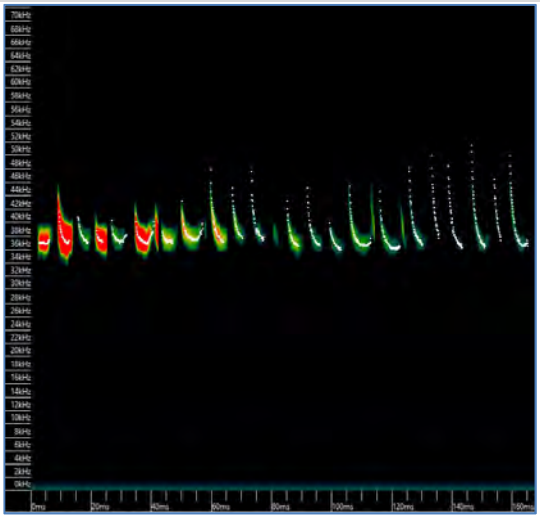
Austronomus australis



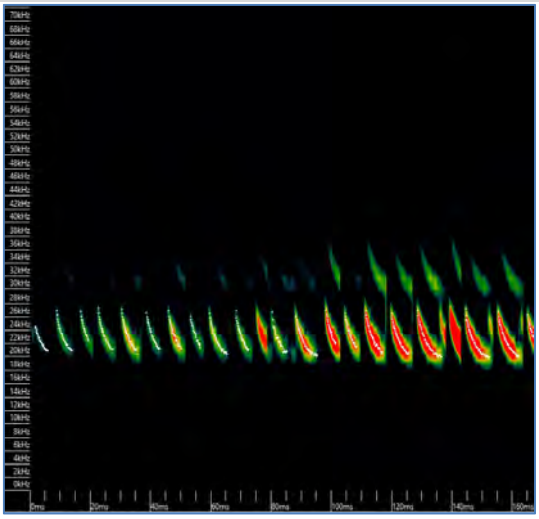
Ozimops ridei



O. ridei / O. petersi / O. planiceps



Setirostris eleryi



Saccolaimus flaviventris

APPENDIX J BAM REPORTS – VEGETATION INTEGRITY ASSESSMENT

BAM Credit Summary Report

Proposal Details

Assessment Id
00015157/BAAS18113/19/00015159

Proposal Name
Bonshaw Solar Farm

BAM data last updated *
26/11/2019

Assessor Name
Matt Jenkins

Report Created
17/03/2020

BAM Data version *
22

Assessor Number
BAAS18029

BAM Case Status
Open

Date Finalised
To be finalised

Assessment Revision
1

Assessment Type
Part 4 Developments (General)

* 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 SAII	Ecosystem credits
Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion								
1	516_Very_Low	20.7	3.0	0.25	High Sensitivity to Potential Gain	2.00		31
2	516_Derived_Moderate	24.7	2.8	0.25	High Sensitivity to Potential Gain	2.00		34

3	516_Disturbed_Grassland	15.8	7.4	0.25	High Sensitivity to Potential Gain	2.00		0
							Subtotal	**65**
Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion								
12	544_Low	35.0	0.8	0.25	High Sensitivity to Potential Gain	2.00	TRUE	15
							Subtotal	**15**
Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion								
4	594_Moderate	61.3	4.1	0.25	High Sensitivity to Potential Gain	1.75		110
5	594_Low	33.3	9.5	0.25	High Sensitivity to Potential Gain	1.75		139
6	594_Disturbed_Grassland	11.8	49.8	0.25	High Sensitivity to Potential Gain	1.75		0
							Subtotal	**249**
Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion								
7	596_Moderate	62.6	11.2	0.25	High Sensitivity to Potential Gain	1.50		262
8	596_Low	38.2	0.3	0.25	High Sensitivity to Potential Gain	1.50		4
9	596_Very_Low	23.6	0.3	0.25	High Sensitivity to Potential Gain	1.50		3
10	596_Derived_Low	8.0	9.0	0.25	High Sensitivity to Potential Gain	1.50		0

11	596_Disturbed_Grassland	5.6	50.6	0.25	High Sensitivity to Potential Gain	1.50		0
							Subtotal	**269**
							Total	**598**

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAII	Species credits
Ninox connivens / Barking Owl (Fauna)						
516_Very_Low	20.7	3	0.25	2	False	31
594_Moderate	61.3	4.1	0.25	2	False	126
594_Low	33.3	9.54	0.25	2	False	159
596_Moderate	62.6	11.15	0.25	2	False	349
544_Low	35.0	0.83	0.25	2	False	15
					Subtotal	**680**
Setirostris eleryi / Bristle-faced Free-tailed Bat (Fauna)						
516_Very_Low	20.7	3	0.25	2	False	31
516_Disturbed_Grassland	15.8	7.39	0.25	2	False	58
594_Moderate	61.3	4.1	0.25	2	False	126
594_Low	33.3	9.54	0.25	2	False	159

594_Disturbed_Grassland	11.8	49.81	0.25	2	False	293
596_Moderate	62.6	11.15	0.25	2	False	349
596_Low	38.2	0.25	0.25	2	False	5
596_Very_Low	23.6	0.3	0.25	2	False	4
596_Disturbed_Grassland	5.6	50.34	0.25	2	False	140
544_Low	35.0	0.83	0.25	2	False	15
					Subtotal	**1180**
Tyto novaehollandiae / Masked Owl (Fauna)						
516_Very_Low	20.7	3	0.25	2	False	31
594_Moderate	61.3	4.1	0.25	2	False	126
594_Low	33.3	9.54	0.25	2	False	159
596_Moderate	62.6	11.15	0.25	2	False	349
544_Low	35.0	0.83	0.25	2	False	15
					Subtotal	**680**
Vespadelus troughtoni / Eastern Cave Bat (Fauna)						
516_Very_Low	20.7	3	0.25	3	True	46
594_Moderate	61.3	4.1	0.25	3	True	189
594_Low	33.3	9.54	0.25	3	True	238
596_Moderate	62.6	11.15	0.25	3	True	523

596_Low	38.2	0.25	0.25	3	True	7
596_Very_Low	23.6	0.3	0.25	3	True	5
544_Low	35.0	0.83	0.25	3	True	22
					Subtotal	**1030**

APPENDIX K BAM CALCULATOR CREDIT REPORT

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00015157/BAAS18113/19/00015159	Bonshaw Solar Farm	26/11/2019
Assessor Name	Assessor Number	BAM Data version *
Matt Jenkins	BAAS18029	22
Proponent Names	Report Created	BAM Case Status
GAIA Australia	17/03/2020	Open
Assessment Revision	Assessment Type	Date Finalised
1	Part 4 Developments (General)	To be finalised

* 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.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
White Box Yellow Box Blakely's Red Gum Woodland	Endangered Ecological Community	544-Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion

Species
Vespadelus troughtoni / Eastern Cave Bat
Vespadelus troughtoni / Eastern Cave Bat
Vespadelus troughtoni / Eastern Cave Bat

Vespadelus troughtoni / Eastern Cave Bat
Vespadelus troughtoni / Eastern Cave Bat
Vespadelus troughtoni / Eastern Cave Bat
Vespadelus troughtoni / Eastern Cave Bat

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

Predicted Threatened Species Not On Site

Name
Calyptorhynchus lathami / Glossy Black-Cockatoo
Haliaeetus leucogaster / White-bellied Sea-Eagle

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	Number of credits to be retired
516-Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion	Not a TEC	13.2	65.00
594-Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion	Not a TEC	63.5	249.00

596-Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	Not a TEC	71.1	269.00
544-Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion	White Box Yellow Box Blakely's Red Gum Woodland	0.8	15.00

516-Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion

Like-for-like credit retirement options

Class	Trading group	HBT	IBRA region
Western Slopes Grassy Woodlands This includes PCT's: 201, 202, 266, 267, 274, 275, 276, 277, 278, 280, 282, 283, 286, 301, 337, 383, 426, 433, 437, 441, 444, 483, 509, 516, 589, 590, 593, 599, 847, 955, 1303, 1304, 1315, 1329, 1383, 1695	Western Slopes Grassy Woodlands - ≥ 70% - <90% cleared group (including Tier 4 or higher).	Yes	Nandewar Northern Complex, Binghi Plateau, Inverell Basalts, Northern Basalts, Severn River Volcanics, Stanthorpe Plateau and Tenterfield Plateau. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

544-Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion

Like-for-like credit retirement options

Name of offset trading group	Trading group	HBT	IBRA region
White Box Yellow Box Blakely's Red Gum Woodland This includes PCT's: 2, 74, 75, 83, 250, 266, 267, 268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 506, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1601, 1606, 1608, 1611, 1691, 1693, 1695, 1698	-	Yes	Nandewar Northern Complex, Binghi Plateau, Inverell Basalts, Northern Basalts, Severn River Volcanics, Stanthorpe Plateau and Tenterfield Plateau. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

594-Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion	**Like-for-like credit retirement options**			
	Class	Trading group	HBT	IBRA region
	North-west Slopes Dry Sclerophyll Woodlands This includes PCT's: 228, 429, 435, 517, 527, 529, 564, 588, 594, 595, 597, 598, 856, 1165, 1306, 1308, 1317, 1387, 1586, 1607	North-west Slopes Dry Sclerophyll Woodlands - ≥ 50% - < 70% cleared group (including Tier 6 or higher).	Yes	Nandewar Northern Complex, Binghi Plateau, Inverell Basalts, Northern Basalts, Severn River Volcanics, Stanthorpe Plateau and Tenterfield Plateau. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
596-Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	**Like-for-like credit retirement options**			
	Class	Trading group	HBT	IBRA region

	North-west Slopes Dry Sclerophyll Woodlands This includes PCT's: 228, 380, 381, 382, 384, 385, 386, 389, 390, 391, 393, 394, 412, 413, 418, 429, 432, 435, 453, 506, 517, 527, 529, 543, 549, 555, 562, 563, 564, 573, 587, 588, 591, 594, 595, 596, 597, 598, 856, 1165, 1306, 1308, 1317, 1387, 1560, 1586, 1587, 1605, 1606, 1607, 1611, 1613	North-west Slopes Dry Sclerophyll Woodlands - < 50% cleared group (including Tier 7 or higher).	Yes	Nandewar Northern Complex, Binghi Plateau, Inverell Basalts, Northern Basalts, Severn River Volcanics, Stanthorpe Plateau and Tenterfield Plateau. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Area	Credits
Ninox connivens / Barking Owl	28.6	680.00
Setirostris eleryi / Bristle-faced Free-tailed Bat	136.7	1180.00
Tyto novaehollandiae / Masked Owl	28.6	680.00
Vespadelus troughtoni / Eastern Cave Bat	29.2	1030.00

Ninox connivens/ Barking Owl	516_Very_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region

		Ninox connivens/Barking Owl	Any in NSW
	544_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Ninox connivens/Barking Owl	Any in NSW
	594_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Ninox connivens/Barking Owl	Any in NSW
	594_Moderate	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Ninox connivens/Barking Owl	Any in NSW

	596_Moderate	**Like-for-like credit retirement options**
		Spp / IBRA region
		Ninox connivens/Barking Owl / Any in NSW
Setirostris eleryi/ Bristle-faced Free-tailed Bat	516_Disturbed_Grassland	**Like-for-like credit retirement options**
		Spp / IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat / Any in NSW
	516_Very_Low	**Like-for-like credit retirement options**
		Spp / IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat / Any in NSW
	544_Low	**Like-for-like credit retirement options**
		Spp / IBRA region

		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
	594_Disturbed_Grassland	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
	594_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
	594_Moderate	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW

596_Disturbed_Grassland	**Like-for-like credit retirement options**	
	Spp	IBRA region
	Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
596_Low	**Like-for-like credit retirement options**	
	Spp	IBRA region
	Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
596_Moderate	**Like-for-like credit retirement options**	
	Spp	IBRA region
	Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
596_Very_Low	**Like-for-like credit retirement options**	

		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
Tyto novaehollandiae/ Masked Owl	516_Very_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW
	544_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW
	594_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW

Tyto novaehollandiae/ Masked Owl	594_Low	
	594_Moderate	**Like-for-like credit retirement options**
		Spp / IBRA region
		Tyto novaehollandiae/Masked Owl / Any in NSW
	596_Moderate	**Like-for-like credit retirement options**
		Spp / IBRA region
		Tyto novaehollandiae/Masked Owl / Any in NSW
Vespadelus troughtoni/ Eastern Cave Bat	516_Very_Low	**Like-for-like credit retirement options**
		Spp / IBRA region
		Vespadelus troughtoni/Eastern Cave Bat / Any in NSW

Vespadelus troughtoni/ Eastern Cave Bat	544_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Vespadelus troughtoni/Eastern Cave Bat	Any in NSW
	594_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Vespadelus troughtoni/Eastern Cave Bat	Any in NSW
	594_Moderate	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Vespadelus troughtoni/Eastern Cave Bat	Any in NSW
	596_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region

		Vespadelus troughtoni/Eastern Cave Bat	Any in NSW
	596_Moderate	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Vespadelus troughtoni/Eastern Cave Bat	Any in NSW
	596_Very_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Vespadelus troughtoni/Eastern Cave Bat	Any in NSW

APPENDIX L PERSONNEL

Personnel involved in preparation of this BDAR and their contribution is summarised in Table L1 below.

Table L.1 Summary of Personnel and Duties

Name	Position	Tasks and Responsibilities
Joanne Woodhouse	Principal Ecologist and Project Manager	■ Project Management including liaison with client, BCD and other stakeholders ■ Technical review ■ Bird survey and BAM plot support (Spring 2018)
Matt Jenkins North Coast Ecology	Project Ecologist Accredited BAM Assessor	■ Field ecologist: Summer 2020 survey ■ Additional field work design and BAM plots ■ Report writing and BAM Calculator report to support Response to Submission (RTS) and revised BDAR
Dr Adriana Corona Mothe	Field Ecologist Accredited BAM Assessor	■ Field ecologist: fauna survey and BAM plots (2018-2019 survey periods) ■ Field work design and BAM plots ■ Report writing and BAM Calculator reports to support EIS submission
Tom Cotter	Biodiversity and GIS Consultant	■ Field Ecologist: fauna and BAM plots (summer 2018). ■ Vegetation mapping, species polygon ■ Draft figures
Dr Toivo Zoete	Senior Environmental Consultant	■ Flora assessment in the 20m x 20m sub-plot of BAM plots (Autumn 2019).
Georgina Race	GIS Consultant	■ Vegetation mapping and area calculations ■ GIS Support
Viet Nguyen	GIS Consultant	■ GIS Support ■ Vegetation area calculations ■ Figure preparation
Danielle Robinson	GIS Consultant	■ GIS Support ■ Field figure preparation ■ Field map layers preparation

APPENDIX M UPDATED SPECIES POLYGONS AND CREDIT REPORTS JUNE 2020

The following updated species polygons and credit report have been provided as requested by the Department of Planning, Industry and Environment (DPIE) in response the Response to Submissions (RTS) provided in May 2020.

Provide an addendum to the BDAR, addressing:

- *The species polygons for the Masked Owl and Barking Owl must be expanded to include each of the recorded hollow bearing trees (green dots) within the development site as identified in figure 5.3 of the BDAR, because hollow bearing trees are an important part of the breeding and foraging habitat for these owls. The expanded species polygons do not need to include extensive areas of disturbed grassland.*
- *The Bristle-faced Free-tailed bat species polygon currently covers the entire development site, including the mapped disturbed grassland areas. We note the precautionary approach of including large areas of disturbed grassland for potential foraging habitat. However, due to the large area of disturbed grassland, we would also accept a reduced species polygon, that aims to capture the more viable bat habitat components, such as hollow bearing trees, similar to that described above for the owls.*

Based on these amendments as detailed below, the proposed Bonshaw Solar Farm development in its current footprint requires a total offset of 598 ecosystem credits and 2,244 species credits.

Retirement of these credits will be carried out in accordance with the Biodiversity Conservation Regulation 2017 and the NSW Biodiversity Offsets Scheme.

Bristle-faced Free-tailed Bat

In accordance with Table 1 of the OEH (2018b) '*Species Credit' threatened bats and their habitats guide*, and based on advice from DPIE, the revised species polygon for the Bristle-faced Free-tailed Bat has been prepared and includes the following features:

- *All woodland PCT on the Subject Land where the Subject Land is within 500m of a river, creek or riparian area; and*
- *A 50m buffer to all hollow-bearing trees recorded within the Subject Land.*

Disturbed grasslands have been excluded from the updated species polygons. The updated species polygon for the Bristle-faced Free-tailed Bat is provided in **Figure L-1**.

No amendments have been made to the Eastern Cave Bat species polygon (refer to Figure 5.3 in the main document).

Barking Owl

The TBDC provides that where a breeding site has been identified in accordance with the BAM the species polygon should be established by providing a circular buffer with a 100m radius around the nest tree. This includes suitable habitat for male roosts, feeding/grooming perches and fledgling requirements. It does not account for foraging habitat. The shape of the buffer can be modified where evidence indicates an alternative shape would better meet the species needs in the context of the assessment site.

As no targeted surveys (e.g. call playback and identification of nest trees) were completed for this dual credit species, breeding habitat has been assumed to be present by identifying suitable habitat. As requested by DPIE, a species polygon has been mapped for this species by including all mapped hollow-bearing trees that contained hollows of a suitable size (i.e. >20cm wide) and height above the ground (i.e. >4m) in accordance with breeding habitat constraints provided in BAM-C. The updated species polygon for the Barking Owl is provided in **Figure L-2**.

As a dual credit species, potential foraging habitat is addressed within the ecosystem credit requirement for PCTs associated with this species. Conservation management of these PCTs will

increase the quality and suitability of forage habitat for this species through improvement of structure and function components and likely associated increases in prey items (i.e. from habitat enhancement and feral predator control). Therefore, the species polygons have been revised to include potential breeding sites only as required in the BAM.

Given the approach described above, the species polygon for Barking Owl is considered to represent a conservative overestimate of actual/potential breeding habitat in that all hollow-bearing trees of a suitable size (i.e. >20cm wide) have been included rather than a single confirmed nest tree.

Masked Owl

The TBDC provides that where a breeding site has been identified in accordance with the BAM the species polygon should be established by providing a circular buffer with a 100m radius around the nest tree. This includes suitable habitat for male roosts, feeding/grooming perches and fledgling requirements. It does not account for foraging habitat. The shape of the buffer can be modified where evidence indicates an alternative shape would better meet the species needs in the context of the assessment site.

As no targeted surveys (e.g. call playback and identification of nest trees) were completed for this dual credit species, breeding habitat has been assumed to be present by identifying suitable habitat. Although no breeding habitat constraints are explicitly identified in BAM-C for this species, the Approved Recovery Plan for Large Forest Owls (DEC 2006) states that the Masked Owl nests in hollows greater than 40cm wide and greater than 100cm deep, with hollow entrances at least 3m above ground, in trees of at least 90cm diameter at breast height. The TBDC also provides that large tree hollows used.

As requested by DPIE, a species polygon has been mapped for this species by including all mapped hollow-bearing trees that contained hollows of a suitable size (i.e. >40cm wide). The updated species polygon for the Masked Owl is provided in **Figure L-3**.

As a dual credit species, potential foraging habitat is addressed within the ecosystem credit requirement for PCTs associated with this species. Conservation management of these PCTs will increase the quality and suitability of forage habitat for this species through improvement of structure and function components and likely associated increases in prey items (i.e. from habitat enhancement and feral predator control). Therefore, the species polygons have been revised to include potential breeding sites only as required in the BAM.

Given the approach described above, the species polygon for Masked Owl is considered to represent a conservative overestimate of actual/potential breeding habitat in that all hollow-bearing trees of a suitable size (i.e. >40cm wide) have been included and particularly given that this species is generally known to roost and breed in more forested habitats in NSW. The Approved Recovery Plan for Large Forest Owls (DEC 2006) also provides that the Masked Owl prefers unlogged or lightly logged forest with high densities of old hollow trees and avoids young regrowth.

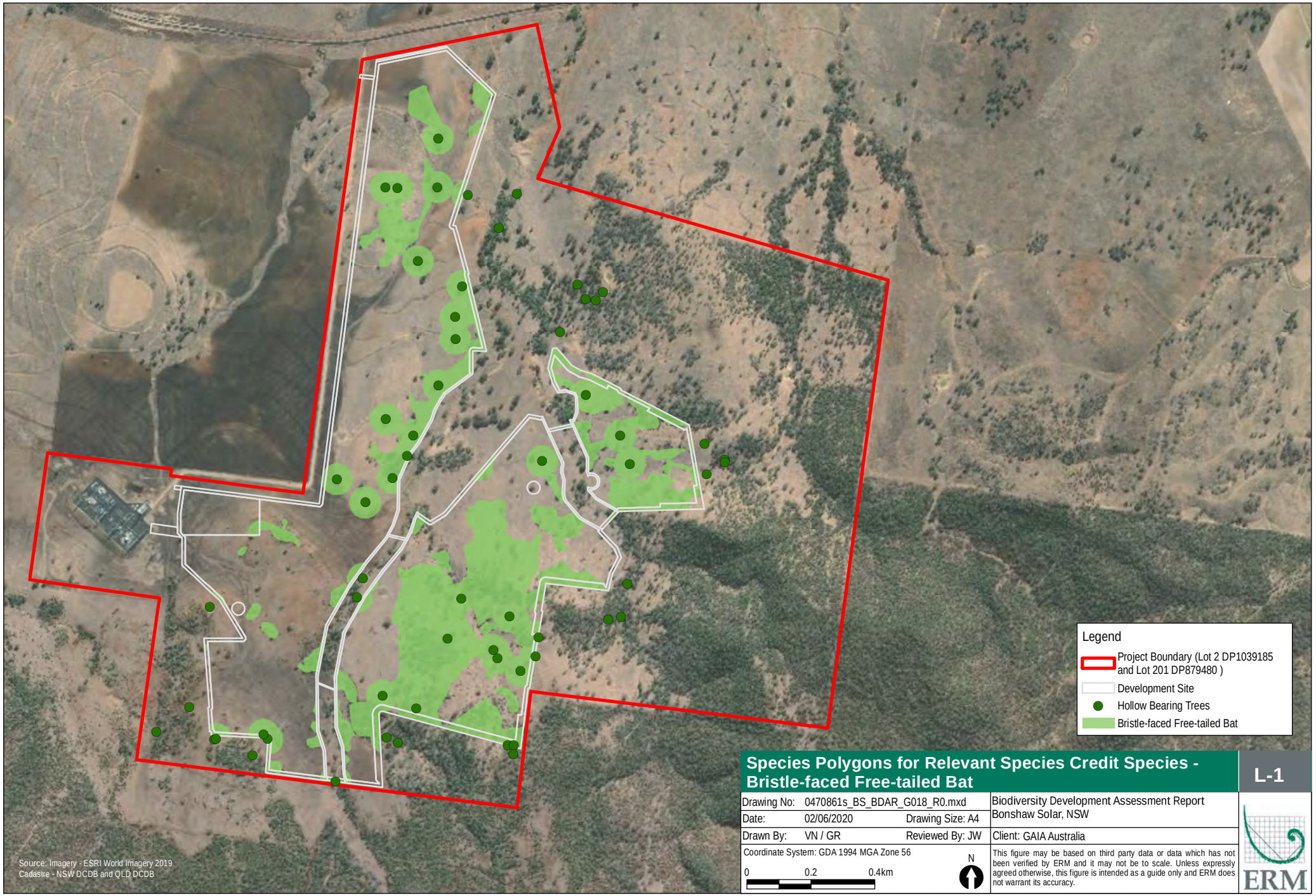
Revised Credit Obligations

Based on the updated mapping of the threatened species polygons, impacts to habitat of Threatened Species requiring offsets now include:

- Habitat for the Bristle-faced Free-tailed Bat requiring 827 species credits;
- Foraging habitat for Eastern Cave Bat requiring 1,030 species credits;
- Potential (assumed) breeding habitat for Masked requiring 104 species credits; and
- Potential (assumed) breeding habitat for Barking Owl requiring 283 species credits.

A total of 598 ecosystem credits are also required to offset the impacts of the project.

The proposed Bonshaw Solar Farm development in its current footprint requires a total offset of 598 ecosystem credits and 2,244 species credits. Retirement of these credits will be carried out in accordance with the Biodiversity Conservation Regulation 2017 and the NSW Biodiversity Offsets Scheme.



Species Polygons for Relevant Species Credit Species - Bristle-faced Free-tailed Bat

L-1

Drawing No:	0470861s_BS_BDAR_G018_R0.mxd		Biodiversity Development Assessment Report Bonshaw Solar, NSW
Date:	02/06/2020	Drawing Size: A4	
Drawn By:	VN / GR	Reviewed By: JW	Client: GAIA Australia

Coordinate System: GDA 1994 MGA Zone 56

0 0.2 0.4km

N

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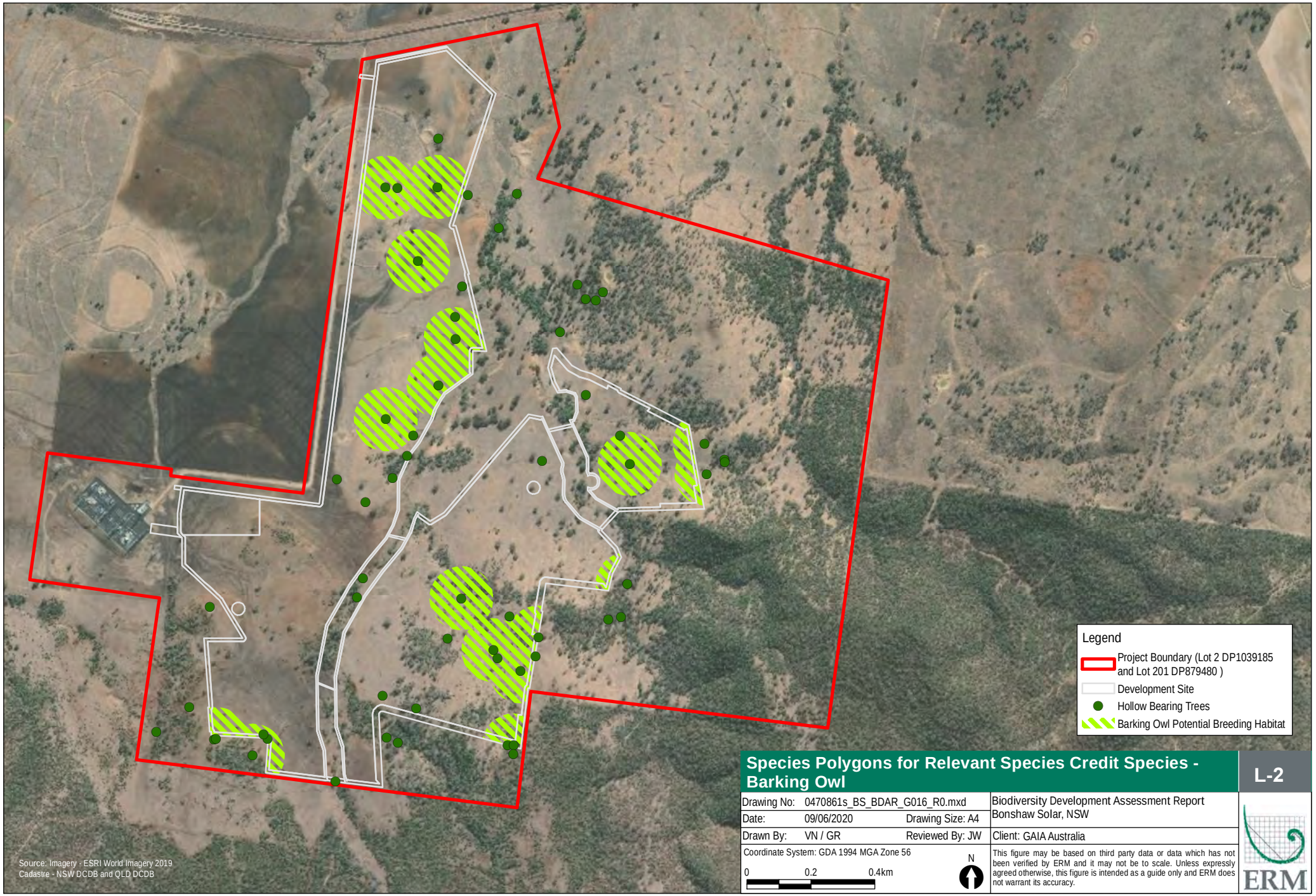
ERM



Species Polygons for Relevant Species Credit Species - Barking Owl

L-2

Drawing No:	0470861s_BS_BDAR_G016_R0.mxd		Biodiversity Development Assessment Report Bonshaw Solar, NSW
Date:	09/06/2020	Drawing Size: A4	
Drawn By:	VN / GR	Reviewed By: JW	Client: GAIA Australia

Coordinate System: GDA 1994 MGA Zone 56

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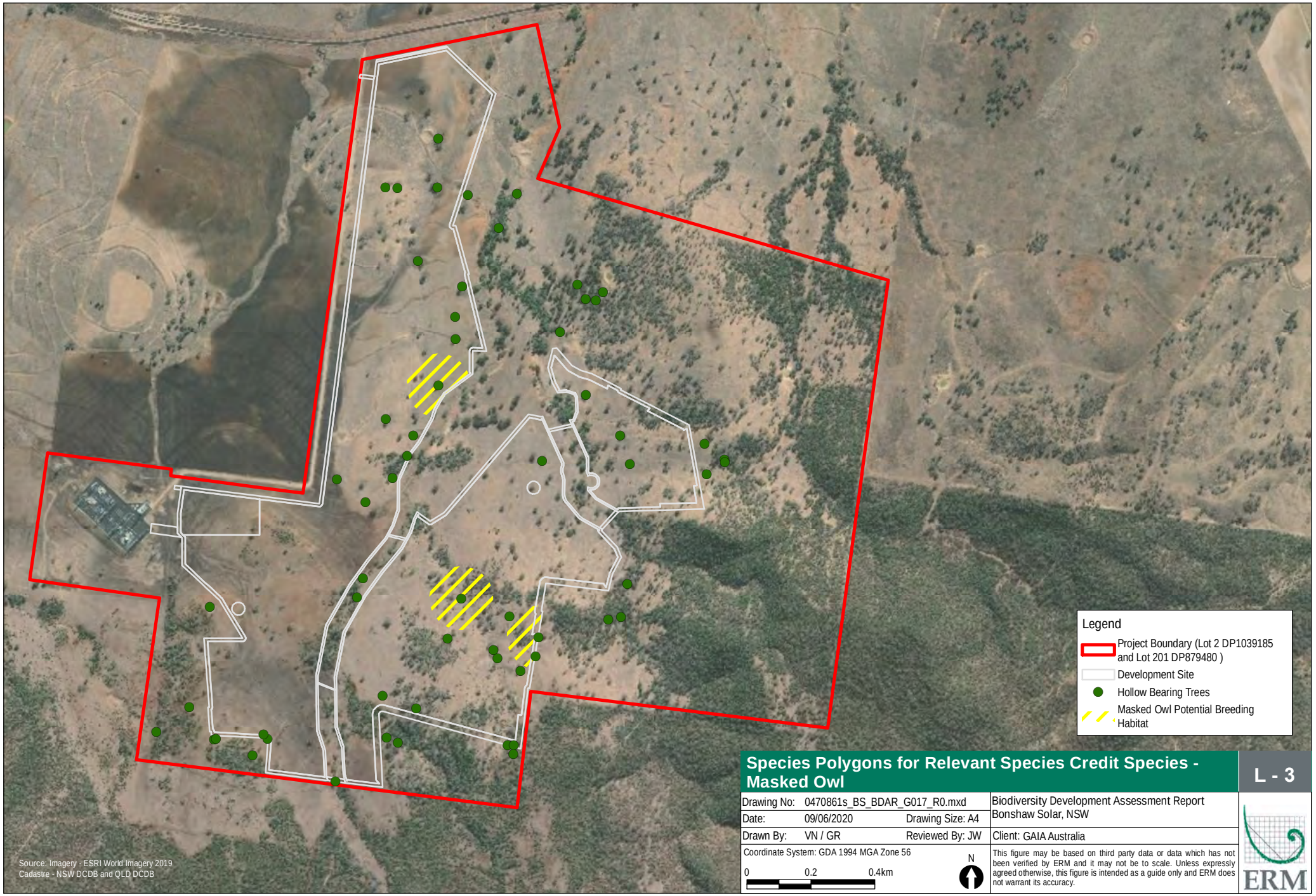
N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



Species Polygons for Relevant Species Credit Species - Masked Owl

L - 3

Drawing No:	0470861s_BS_BDAR_G017_R0.mxd		Biodiversity Development Assessment Report Bonshaw Solar, NSW
Date:	09/06/2020	Drawing Size: A4	
Drawn By:	VN / GR	Reviewed By: JW	Client: GAIA Australia

Coordinate System: GDA 1994 MGA Zone 56

0 0.2 0.4km

N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id 00015157/BAAS17014/19/00015159	Proposal Name Bonshaw Solar Farm	BAM data last updated * 04/06/2020
Assessor Name Matt Jenkins	Assessor Number BAAS18029	BAM Data version * 27
Proponent Names GAIA Australia, GAIA Australia Pty Ltd	Report Created 17/06/2020	BAM Case Status Finalised
Assessment Revision 1	Assessment Type Part 4 Developments (General)	Date Finalised 17/06/2020

* 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.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
White Box Yellow Box Blakely's Red Gum Woodland	Endangered Ecological Community	544-Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion

Species
Vespadelus troughtoni / Eastern Cave Bat
Vespadelus troughtoni / Eastern Cave Bat
Vespadelus troughtoni / Eastern Cave Bat

Vespadelus troughtoni / Eastern Cave Bat
Vespadelus troughtoni / Eastern Cave Bat
Vespadelus troughtoni / Eastern Cave Bat
Vespadelus troughtoni / Eastern Cave Bat

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

Predicted Threatened Species Not On Site

Name
Calyptorhynchus lathami / Glossy Black-Cockatoo
Haliaeetus leucogaster / White-bellied Sea-Eagle

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	Number of credits to be retired
516-Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion	Not a TEC	13.2	65.00
594-Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion	Not a TEC	63.5	249.00

596-Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	Not a TEC	71.3	269.00
544-Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion	White Box Yellow Box Blakely's Red Gum Woodland	0.8	15.00

516-Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion

Like-for-like credit retirement options

Class	Trading group	HBT	IBRA region
Western Slopes Grassy Woodlands This includes PCT's: 201, 202, 266, 267, 274, 275, 276, 277, 278, 280, 282, 283, 286, 301, 337, 383, 426, 433, 437, 441, 444, 483, 509, 516, 589, 590, 593, 599, 847, 955, 1303, 1304, 1315, 1329, 1383, 1695	Western Slopes Grassy Woodlands >=70% and <90%	Yes	Nandewar Northern Complex, Binghi Plateau, Inverell Basalts, Northern Basalts, Severn River Volcanics, Stanthorpe Plateau and Tenterfield Plateau. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

544-Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion

Like-for-like credit retirement options

Name of offset trading group	Trading group	HBT	IBRA region
White Box Yellow Box Blakely's Red Gum Woodland This includes PCT's: 2, 74, 75, 83, 250, 266, 267, 268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 506, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1601, 1606, 1608, 1611, 1691, 1693, 1695, 1698	-	Yes	Nandewar Northern Complex, Binghi Plateau, Inverell Basalts, Northern Basalts, Severn River Volcanics, Stanthorpe Plateau and Tenterfield Plateau. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

594-Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion	**Like-for-like credit retirement options**			
	Class	Trading group	HBT	IBRA region
	North-west Slopes Dry Sclerophyll Woodlands This includes PCT's: 228, 429, 435, 517, 527, 529, 564, 588, 594, 595, 597, 598, 856, 1165, 1306, 1308, 1317, 1387, 1586, 1607	North-west Slopes Dry Sclerophyll Woodlands >=50% and <70%	Yes	Nandewar Northern Complex, Binghi Plateau, Inverell Basalts, Northern Basalts, Severn River Volcanics, Stanthorpe Plateau and Tenterfield Plateau. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
596-Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	**Like-for-like credit retirement options**			
	Class	Trading group	HBT	IBRA region

	North-west Slopes Dry Sclerophyll Woodlands This includes PCT's: 228, 380, 381, 382, 384, 385, 386, 389, 390, 391, 393, 394, 412, 413, 418, 429, 432, 435, 453, 506, 517, 527, 529, 543, 549, 555, 562, 563, 564, 573, 587, 588, 591, 594, 595, 596, 597, 598, 856, 1165, 1306, 1308, 1317, 1387, 1560, 1586, 1587, 1605, 1606, 1607, 1611, 1613	North-west Slopes Dry Sclerophyll Woodlands <50%	Yes	Nandewar Northern Complex, Binghi Plateau, Inverell Basalts, Northern Basalts, Severn River Volcanics, Stanthorpe Plateau and Tenterfield Plateau. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Area	Credits
Ninox connivens / Barking Owl	32.9	283.00
Setirostris eleryi / Bristle-faced Free-tailed Bat	56.2	827.00
Tyto novaehollandiae / Masked Owl	7.1	104.00
Vespadelus troughtoni / Eastern Cave Bat	29.2	1030.00

Ninox connivens/ Barking Owl	516_Derived_Moderate	**Like-for-like credit retirement options**	
		Spp	IBRA region

		Ninox connivens/Barking Owl	Any in NSW
	516_Disturbed_Grassland	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Ninox connivens/Barking Owl	Any in NSW
	516_Very_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Ninox connivens/Barking Owl	Any in NSW
	544_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Ninox connivens/Barking Owl	Any in NSW

594_Disturbed_Grassland	**Like-for-like credit retirement options**	
	Spp	IBRA region
	Ninox connivens/Barking Owl	Any in NSW
594_Low	**Like-for-like credit retirement options**	
	Spp	IBRA region
	Ninox connivens/Barking Owl	Any in NSW
594_Moderate	**Like-for-like credit retirement options**	
	Spp	IBRA region
	Ninox connivens/Barking Owl	Any in NSW
596_Derived_Low	**Like-for-like credit retirement options**	

		Spp	IBRA region
		Ninox connivens/Barking Owl	Any in NSW
	596_Disturbed_Grassland	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Ninox connivens/Barking Owl	Any in NSW
	596_Moderate	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Ninox connivens/Barking Owl	Any in NSW
	596_Very_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Ninox connivens/Barking Owl	Any in NSW

Setirostris eleryi/ Bristle-faced Free-tailed Bat	516_Derived_Moderate	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
	516_Disturbed_Grassland	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
	516_Very_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW

Setirostris eleryi/ Bristle-faced Free-tailed Bat	516_Very_Low	
	544_Low	**Like-for-like credit retirement options**
		Spp / IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat / Any in NSW
	594_Disturbed_Grassland	**Like-for-like credit retirement options**
		Spp / IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat / Any in NSW
	594_Low	**Like-for-like credit retirement options**
		Spp / IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat / Any in NSW
	594_Moderate	**Like-for-like credit retirement options**

		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
	596_Derived_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
	596_Disturbed_Grassland	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
	596_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW

	596_Moderate	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
	596_Very_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
Tyto novaehollandiae/ Masked Owl	516_Derived_Moderate	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW

Tyto novaehollandiae/ Masked Owl	516_Disturbed_Grassland	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW
	516_Very_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW
	594_Disturbed_Grassland	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW
	594_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region

		Tyto novaehollandiae/Masked Owl	Any in NSW
	596_Derived_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW
	596_Disturbed_Grassland	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW
	596_Moderate	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW

Vespadelus troughtoni/ Eastern Cave Bat	516_Very_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Vespadelus troughtoni/Eastern Cave Bat	Any in NSW
	544_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Vespadelus troughtoni/Eastern Cave Bat	Any in NSW
	594_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Vespadelus troughtoni/Eastern Cave Bat	Any in NSW
	594_Moderate	**Like-for-like credit retirement options**	

		Spp	IBRA region
		Vespadelus troughtoni/Eastern Cave Bat	Any in NSW
	596_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Vespadelus troughtoni/Eastern Cave Bat	Any in NSW
	596_Moderate	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Vespadelus troughtoni/Eastern Cave Bat	Any in NSW
	596_Very_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Vespadelus troughtoni/Eastern Cave Bat	Any in NSW

Biodiversity payment summary report

Assessment Id	Payment data version	Assessment Revision	Report created
00015157/BAAS17014/19/00015159	63	1	17/06/2020

Assessor Name	Assessor Number	Proposal Name	BAM Case Status
Matt Jenkins	BAAS18029	Bonshaw Solar Farm	Finalised

Assessment Type	Date Finalised
Part 4 Developments (General)	17/06/2020

PCT list

Price calculated	PCT common name	Credits
Yes	**516 -** Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion	65
Yes	**594 -** Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion	249
Yes	**596 -** Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	269
Yes	**544 -** Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion	15

Species list

Price calculated	Species	Credits
Yes	***Ninox connivens*** (Barking Owl)	283
Yes	***Tyto novaehollandiae*** (Masked Owl)	104
Yes	***Vespadelus troughtoni*** (Eastern Cave Bat)	1030
Yes	***Setirostris eleryi*** (Bristle-faced Free-tailed Bat)	827

Biodiversity payment summary report

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

IBRA sub region	PCT common name	Threat status	Offset trading group	Risk premium	Administrative cost	Methodology adjustment factor	Price per credit	No. of ecosystem credits	Final credits price
Nandewar Northern Complex	**516 -** Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion	No	Western Slopes Grassy Woodlands >=70% and <90%	34.31%	$800.02	2.0046	$ 27,662.63	65	$ 1,798,070.77
Nandewar Northern Complex	**594 -** Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion	No	North-west Slopes Dry Sclerophyll Woodlands >=50% and <70%	34.31%	$80.00	2.3073	$1,694.69	249	$421,978.15
Nandewar Northern Complex	**596 -** Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	No	North-west Slopes Dry Sclerophyll Woodlands <50%	23.65%	$80.00	2.0204	$1,698.34	269	$456,852.33

Nandewar Northern Complex	**544 -** Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion	No	Western Slopes Grassy Woodlands >=50% and <70%	34.31%	$80.00	2.3617	$907.80	15	$13,617.00

Subtotal (excl. GST) **$2,690,518.25**

GST **$269,051.82**

Total ecosystem credits (incl. GST) $2,959,570.08

Species credits for threatened species

Species profile ID	Species	Threat status	Price per credit	Risk premium	Administrative cost	No. of species credits	Final credits price
10561	***Ninox connivens*** (Barking Owl)		$173.02	34.3100%	$80.00	283	$88,404.43
10820	***Tyto novaehollandiae*** (Masked Owl)		$447.26	34.3100%	$80.00	104	$70,794.35
10829	***Vespadelus troughtoni*** (Eastern Cave Bat)		$741.31	34.3100%	$80.00	1030	$1,107,923.06
10923	***Setirostris eleryi*** (Bristle-faced Free-tailed Bat)		$636.69	34.3100%	$80.00	827	$773,359.41

Subtotal (excl. GST) **$2,040,481.25**

	GST	**$204,048.12**
Total species credits (incl. GST)		**$2,244,529.38**
	Grand total	**$5,204,099.46**

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ATTACHMENT D EVIDENCE OF WATER SUPPLIER ABILITY

From: **Trident Water** tridentwaterrad@gmail.com
Subject: Re: Regarding drinking water delivery for 200 construction workers
Date: 20 May 2020 at 11:46 am
To: Shawn HawnKi LEE shawn.lee@gaiaau.com

Good Morning Shawn,

Thank you very much for your email.

Please excuse the delay in getting back to you. Attached is a presentation of Trident Waters capability to service the Bonshaw Energy Park.

Trident Water is approved to operate by NSW Health. All our trucks adhere to strict guidelines regarding quality assurance for water transport and storage. With the advent of Covid-19 this now has become more relevant than ever.

Since it inception in 2019 we have successfully and safely delivered over 500 kilolitres to our clients.

We are proud to be council approved locally in the Northern Rivers, comprising of the following shires Inverell, Tenterfield, Richmond Valley and Rous City Council which incorporates three council areas. They are Lismore City, Ballina Shire and the Byron Shire.

Trident Water can offer assurances that no matter what adverse supply or climate conditions are presented. Our supply network is able to meet all your water logistical needs over the duration of both phases of the Bonshaw Solar Farm - Construction and operational.

The most relevant to the Bonshaw Solar farm are the Inverell and Tenterfield Shires. Being approved for both shires we are in a unique position to service the BonShaw Solar Farm within 2 hours from Inverell and 1.5 hours from Tenterfield. As our trucks are fully laden with water these times may vary slightly due to road conditions.

Fleet

Mercedes Unimog 4x4 Heavy duty crane truck. 5 kilolitre tank. Specialist remote access utility vehicle, 1.35 ton crane with a 5.1 metre reach. Water supply, dust suppression, fire mitigation
Hino 500 series: Mine Spec for construction. 15 kilolitre tank. Civil Construction specialist water supply, dust suppression, fire mitigation.

Both trucks are fitted with CB radios and reverse cameras and 100% redundancy via a spare pump should there be any mechanical issues. We can always get your supply to you.

We are currently expanding our fleet to include an 8x8 - 18kl Water truck and a Unimog trailer fitted with a 7kl tank.

Expanding our total capacity to 45 kilolitres in Q4 of this financial year.

I hope this has clarified a few questions as to the capability of Trident Water to supply the Bonshaw Solar Farm.

We are proud to be local and are here to help in any way we can Shawn. It would be an honour to be involved in a project of this magnitude. Please feel free to get in contact.

Best Regards

Roman Guerra
Trident Water
0412580564
tridentwaterrad@gmail.com

From: **Trident Water** tridentwaterrad@gmail.com
Subject: Re: Regarding drinking water delivery for 200 construction workers
Date: 23 January 2020 at 9:35 am
To: Shawn HawnKi LEE shawn.lee@gaiaau.com

Good Morning Shawn,

Thank you for your for choosing to getting in contact with a local business regarding Water supply to the proposed GAIA Solar farm site in Bonshaw,NSW.
.
We would be more than happy to liaise with you regarding this project and provide you with presentation as requested.

In order to do so we will need some more detailed information regarding the camp requirements.

Is the quote just intended just for drinking supply?

Just off the top of my head for a 200 man construction site , consumption rate would be average 2.5(winter) to 5(Summer) litres a day x 200 men= 500 -1000 litres. consumed on site per day.

A year and half program 548 days construction time x 1kl per day = 548kl consumed for the entire project.

This is just a rough estimate of consumption as your construction is due to start in July 2020(winter) and go through two summer seasons til completion. During the summer season the consumption rates may double and may halve during the winter months.

We would need to factor in other variables for your site such as:

Camp kitchen requirements- Catering crew

Steward services for cleaning of offices,amenities, mess, laundry and accommodation blocks.

On site dust suppression for the crew to work safely whist installing the farm- what is the area size of the whole site.

Is it close to any residential areas as this will play a major role for your sites water usage due to council requirements.

Shawn would it be possible for us to schedule a time to discuss your requirements. It would enable us give you the best and most detailed presentation factoring all the above , terms and payment schedules .

We look forward to having a discussion and getting a proposal together for you.

Best Regards

Roman Guerra
Trident Water
0412580564

On Wed, 22 Jan 2020 at 11:08, Shawn HawnKi LEE <shawn.lee@gaiaau.com> wrote:

> Hi,
>
> This is Shawn Lee from GAIA Australia Pty. Ltd., which is preparing for a Sola Farm business in Bonshaw area.
> Site location is next to the Transgrid Dumaresq Substation.
>
> It will be 100MW Solar PV electricity generating facility, and now we are expecting to start the construction from coming July this year.
>
> Accordingly, then we need to have enough amount of drinking water for about 200 workers(peak time) under construction.
> In average, there will be 150 workers on site during construction. It will take 1.5 years for construction from July, 2020.
>
> Please let us know about your quote and some details, such as payment plan, kinds of services, delivery time and so on, anything we should know before order(or contract). Please contact me via email or phone call for any issues.
>
> Best regards,

ATTACHMENT E UPDATED ABORIGINAL CULTURAL HERITAGE ASSESSMENT

GAIA Australia

Bonshaw Solar Farm

Cultural Heritage Assessment

19 June 2020

Project No.: 0464261

The business of sustainability

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Document details	
Document title	Bonshaw Solar Farm
Document subtitle	Cultural Heritage Assessment
Project No.	0464261
Date	19 June 2020
Version	3.0
Author	Katherine Deverson
Client Name	GAIA Australia

Document history

				ERM approval to issue		
Version	Revision	Author	Reviewed by	Name	Date	Comments
Draft	00	Katherine Deverson	Erin Finnegan	Paul Douglass	11 April 2019	Approved for issue to Client
Draft	01	Katherine Deverson	Erin Finnegan	Paul Douglass	18 April 2019	Approved for issue to Client
Final	02	Katherine Deverson	Amanda Antcliff	Paul Douglass	12 July 2019	Approved for issue to Client
Final	03	Stephanie Moore	Erin Finnegan	David Dique	13 February 2020	Response to Submission
Final	04	Lachlan Giles	Michael Rookwood	David Dique	19 June 2020	Addressing AHIMS Location

Signature Page

19 June 2020

Bonshaw Solar Farm

Cultural Heritage Assessment

Stephanie Moore
Heritage Consultant

Erin Finnegan
Principal Heritage Consultant

Amanda Antcliff
Project Manager

David Dique
Partner

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Acronyms and Abbreviations

AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
BP	Before Present
BSS	Battery Storage System
Burra Charter	The Australia ICOMOS Charter for Places of Cultural Significance
CHA	Cultural Heritage Assessment
CHL	Commonwealth Heritage List
CIV	Capital Investment Value
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DECCW	Department of Environment, Climate Change and Water
DP&E	Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ERM	Environmental Resources Management Australia Pty Ltd
ESD	Ecologically Sustainable Development
GAIA	GAIA Australia
IHO	Interim Heritage Orders
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area
LLS	Local Land Services
MW	Megawatts
MWh	Megawatt hour
NNTT	National Native Title Tribunal
NP&W Act	National Parks and Wildlife Act 1974
NPWS	NSW National Parks and Wildlife Service
NTS Corp	Native Title Services corporation
OEH	Office of Environment and Heritage
PA	Project Area
PAD	Potential Archaeological Deposit
PV	Photovoltaic
QA	Quality Assurance
RAP	Registered Aboriginal Party
SEPP	State Environmental Planning Policy
SHI	State Heritage Inventory
SHR	State Heritage Register
SSD	State Significant Development
SU	Survey Unit

1. INTRODUCTION

1.1 Overview

ERM was commissioned to undertake a heritage assessment to support an Environmental Impact Statement (EIS) being prepared for the proposed Bonshaw Solar Farm (the 'Project'), located off the Bruxner Highway, Bonshaw NSW.

This work has been conducted to conform to the Secretary's Environmental Assessment Requirements (SEARs) for the Project. In line with the SEARs, this Cultural Heritage Assessment (CHA) has been prepared in accordance with the *Code of Practice for Archaeological Investigations of Aboriginal Objects in New South Wales (Code of Practice)* (DECCW 2010a), the *Aboriginal Cultural Heritage Consultation requirements for Proponents* (DECCW 2010b), *The Australia ICOMOS Charter for Places of Cultural Significance, The Burra Charter*, 2013 (Burra Charter), and the NSW Heritage Manual.

1.2 Objectives

This CHA assesses the potential impacts of the Project on Aboriginal and historic cultural heritage, and prepares strategies to manage risks to identified heritage values during construction and operation.

This report documents:

- the consultation process undertaken with Aboriginal communities for the Project and their involvement in the Project;
- the landscape and natural resources of the Project Area (PA) in order to establish background parameters;
- a synthesis of local and regional Aboriginal archaeological research to develop a contextual basis for predictive models;
- a review of relevant heritage databases including Australian Heritage Database, the NSW Office of Environment and Heritage (OEH) Aboriginal Heritage Information Management System (AHIMS) database; the NSW State Heritage Inventory, and Schedule 5 of the Inverell Local Environmental Plan 2013;
- a review of the PA's non-Aboriginal history to gain an understanding and appreciation of past land uses and associated historical ground disturbance;
- a predictive model for Aboriginal and historic site types and location relevant to the PA;
- the archaeological methodology implemented during the study;
- the cultural and archaeological sensitivity of landforms that may be subject to impacts;
- the field survey results;
- the significance of any located Aboriginal objects and places;
- a description of the Project and whether or not it has the potential to result in impacts to Aboriginal cultural heritage and historic heritage items; and
- provision of management and mitigation measures based on the results of the investigation.

1.3 Description of the Proposed Development

1.3.1 Location

The proposed Bonshaw Solar Farm is located in the Inverell Local Government Area (LGA) approximately 16 km south of Bonshaw and 66 km north of Inverell. The PA, as shown in *Figure 1.1*, is approximately 352 ha with elevations ranging from 329 m to 500 m Australian Height Datum (AHD) and is located on Lot 2, DP1039185 (the 'Site').

The landholder has been consulted and provided in principle support to be finalised with a landholder agreement. Lot subdivision is not proposed.

The PA is partially bounded on its northern boundary by the Bruxner Highway. The eastern boundary is partially bounded by Glenrock Road. An unsealed road extends perpendicularly from Bruxner Highway towards the southern end of the PA then bends westerly towards the existing 330kV TransGrid Dumaresq Substation located to the south-western from the Subject Land.

The PA consists of open space, and creek and bush areas. Aerial imagery suggests that a significant proportion of the land across the PA had previously been cleared with portions historically being used for agriculture purposes.

1.3.2 Proposed Development

GAIA is proposing to develop a large scale solar photovoltaic (PV) generation facility and associated infrastructure with a capacity of 500 MW within the PA.

The Project will involve the construction, operation and maintenance of a solar PV generation facility and associated infrastructure, supplying electricity to the national electricity grid. The development footprint is approximately 700 ha within the PA. The proposed development footprint is shown in *Figure 1.2.*

The Project would include:

- a network of PV modules in a fixed or tracking arrangement;
- a site office (two proposed options);
- a access tracks from Bruxner Highway;
- underground or overhead cabling for connection between arrays and inverters and transformers;
- parking and internal access tracks;
- perimeter security fencing;
- battery storage; and
- two grid connection options to the 330kV TransGrid Dumaresq Substation, on the boundary of the PA.

The location within the PA of the PV modules, cabling, battery storage and substation and switchyard infrastructure is subject to further detailed design during the preparation of the EIS.

1.4 Authorship

Katherine Deverson (ERM Heritage Consultant) authored the report and Erin Finnegan (Principal Heritage Consultant) undertook a technical review. Amanda Antcliff (ERM Project Manager) and Paul Douglass (ERM Partner) undertook quality assurance (QA) reviews of the report.

1.5 Report Structure

Chapter 1 Introduction;

Chapter 2 Legislative framework and statutory requirements;

Chapter 3 Aboriginal community consultation process undertaken for the CHA;

Chapter 4 Environmental and landscape background relating to the PA;

Chapter 5 Archaeological context of the PA, including known and potential heritage sites within and in near vicinity to the PA;

Chapter 5 Aboriginal heritage predictive model;

Chapter 6 Historical background of the PA;

Chapter 7 Survey methodology and results;

Chapter 8 *S*ignificance assessment of heritage sites located within the PA;

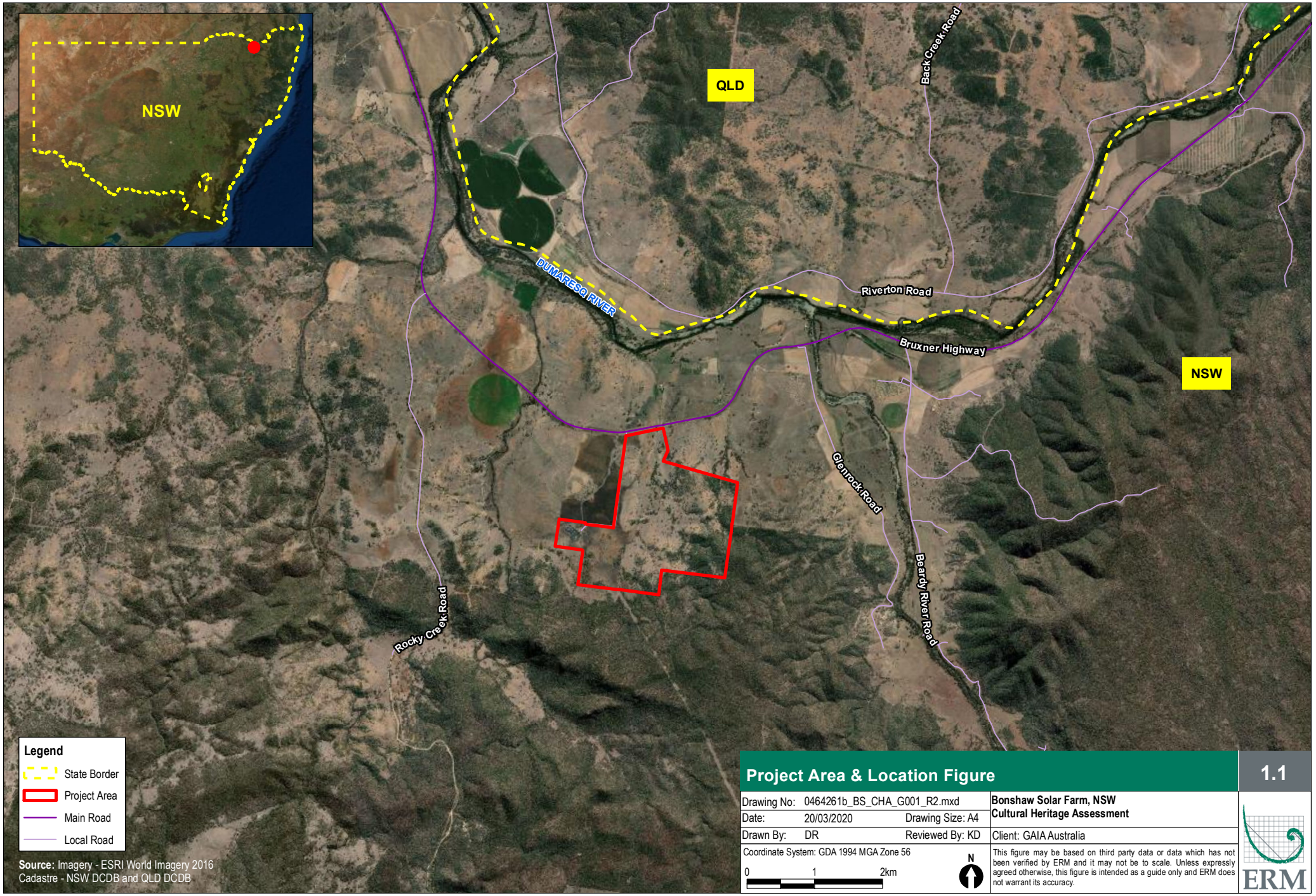
Chapter 9 Impact assessment; and

Chapter 10 Conclusions and Recommendations.

Appendix A Aboriginal Stakeholder Consultation Log

Appendix B Survey Methodology

Appendix C AHIMS Database Search Results


NSW
QLD
Back Creek Road
DUMARESQ RIVER
Riverton Road
Bruxner Highway
NSW
Glenrock Road
Beardy River Road
Rocky Creek Road
Legend
State Border
Project Area
Main Road
Local Road
Source: Imagery - ESRI World Imagery 2016
Cadastre - NSW DCDB and QLD DCDB
Project Area & Location Figure
1.1
Drawing No: 0464261b_BS_CHA_G001_R2.mxd
Date: 20/03/2020
Drawing Size: A4
Drawn By: DR
Reviewed By: KD
Coordinate System: GDA 1994 MGA Zone 56
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Bonshaw Solar Farm, NSW
Cultural Heritage Assessment
Client: GAIA Australia
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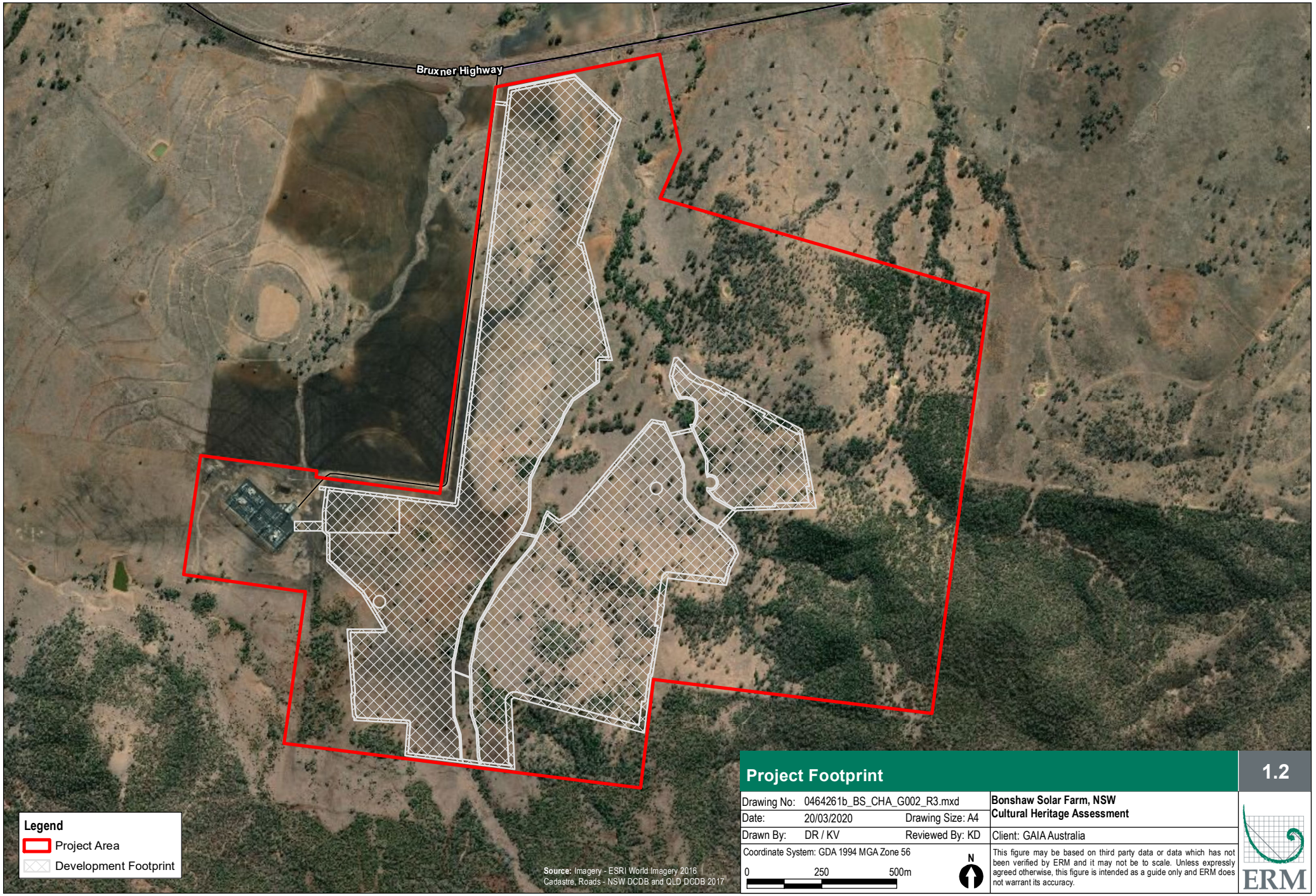

Project Footprint

1.2

Drawing No:	0464261b_BS_CHA_G002_R3.mxd		Bonshaw Solar Farm, NSW Cultural Heritage Assessment
Date:	20/03/2020	Drawing Size: A4	
Drawn By:	DR / KV	Reviewed By: KD	Client: GAIA Australia
Coordinate System: GDA 1994 MGA Zone 56			This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

0 250 500m

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2. RELEVANT LEGISLATION

Together with best practice principles outlined in documents such as *The Burra Charter* (Australia ICOMOS 2013a), the following legislative and regulatory context forms the basis of the framework within which the historic and Aboriginal heritage values of the PA must be considered.

Aboriginal cultural heritage in NSW is protected by the *National Parks and Wildlife Act 1974* (NP&W Act). Land managers are required to consider the effects of their activities, or proposed development, on the environment under several pieces of legislation, principally the *Environmental Planning and Assessment Act* 1979 (EP&A Act). Cultural heritage, which includes Aboriginal and historical heritage, is subsumed within the definition of "environment". In certain circumstances, Commonwealth legislation protecting heritage may also apply to heritage places in NSW. The key legislation applying to the Project is summarised below in *Table 2.1.*

Table 2.1 Key Legislation

State Legislation
Environmental Planning and Assessment Act 1979 (NSW)
The principal NSW planning legislation is the *Environmental Planning and Assessment Act 1979* (EP&A Act). The EP&A Act provides a system of environmental planning and assessment administered by the NSW Department of Planning and Environment (DP&E). The EP&A Act establishes when and how a development or activity is to be assessed and who is the relevant approval or determining authority. Section 4.36 (2) of the EP&A Act states that *"a State environmental planning policy may declare any development, or any class or description of development, to be State significant development"*. Part 2 Clause 8 of the State Environmental Planning Policy (State and Regional Development) 2011 (State and Regional Development SEPP) states that: *1. Development is declared to be State significant development for the purposes of the Act if:* *a. the development on the land concerned is, by the operation of an environmental planning instrument, not permissible without development consent under Part 4 of the Act, and* *b. the development is specified in Schedule 1 or 2.* Schedule 1 and 2 of the State and Regional Development SEPP contains an extensive list of developments that are considered State Significant Development (SSD). Schedule 1 Cl 20 identifies the following as SSD: ***Electricity generating works and heat or co-generation*** *Development for the purpose of electricity generating works or heat or their co-generation (using any energy source, including gas, coal, biofuel, distillate, waste, hydro, wave,* ***solar*** *or wind power) that:* *a. has a capital investment value of more than $30 million, or* *b. has a capital investment value of more than $10 million and is located in an environmentally sensitive area of State significance.* The project is a development for the purpose of electricity generation using a solar energy source with a capital investment value (CIV) of more than $30 million. The Site is not located in an environmentally sensitive area of State Significance (as defined in the State and Regional Development SEPP). Solar Energy Systems are considered permissible with consent through clause 34 (7) of State Environmental Planning Policy (Infrastructure) 2007. The project meets both the requirements of clause 8 of the State and Regional Development SEPP as it is not permissible without development consent and is development specified in Schedule 1. Therefore, the project is SSD for the purposes of the EP&A Act.

State Legislation

National Parks and Wildlife Act 1974 (NSW)

The NSW National Parks and Wildlife Services (NPWS) provide guidelines for Aboriginal heritage assessment, including those conducted under the EP&A Act. Where Aboriginal heritage assessment is conducted under the Integrated Development Approval process, a more detailed set of NPWS guidelines applies.

All Aboriginal objects within the State of New South Wales are protected under Part 6, and particularly Section 90, of the NPW Act.

Under Section 5 of the Act, "Aboriginal Object" means any deposit, object or material evidence (not being a handicraft made for sale) relating to the Indigenous habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains.

Sites of traditional significance that do not necessarily contain archaeological materials may be gazetted as 'Aboriginal places' and are protected under Section 84 of the Act. This protection applies to all sites, regardless of their significance or land tenure. Under Section 90, a person who, without first obtaining the consent of the Director-General, knowingly destroys, defaces or damages, or knowingly causes or permits the destruction or defacement of or damage to, an Aboriginal object or Aboriginal place is guilty of an offence.

Heritage Act 1977 (NSW)

The NSW *Heritage Act 1977* establishes the NSW Heritage Council and the State Heritage Register (SHR). The aim of the Act is to conserve the heritage of New South Wales. The aim of heritage management is not to prevent change and development, but to ensure that the heritage significance of recognised heritage items is not harmed by changes.

The SHR is a separate listing to the State Heritage Inventory and includes items which are accorded SHR listing through gazettal in the NSW Government Gazette. Nominated items are considered by the NSW Heritage Council which then makes a recommendation to the Minister for Heritage. The Minister is empowered to place Interim Heritage Orders (IHO) on an item of potential State significance on the basis of advice received from the Heritage Council:

a. An item is important in the course, or pattern, of NSW's cultural or natural history.
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.
c. An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW.
d. An item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons.
e. An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history.
f. An item possesses uncommon, rare, or endangered, aspects of NSW's cultural or natural history.
g. An item is important in demonstrating the principal characteristics of a class of NSW's a) cultural or natural places: or b) cultural or natural environments.

Refer to *Section 6.2* of this CHA for results of SHR search relating to the PA.

Commonwealth Legislation

Environment Protection And Biodiversity Conservation Act 1999 (Commonwealth)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the Act as matters of national environmental significance. The EPBC Act focuses on the protection of matters of national environmental significance, with the states and territories having responsibility for matters of state and local significance.

The Commonwealth Heritage List (CHL) is established under the EPBC Act and comprises places on Commonwealth land or owned by Commonwealth Agencies that are determined to have "significant" heritage value to Australia. The Act also establishes the National Heritage List, comprising places considered to be of "outstanding" heritage value to Australia.

State Legislation
Refer to *Section 6.2* of this CHA for results of CHL search relating to the PA.
Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Commonwealth)
The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* protects areas and/or objects which are of significance to Aboriginal people and which are under threat of destruction. The Act can, in certain circumstances override state and territory provisions, or it can be implemented in circumstances where state or territory provisions are lacking or are not enforced. A significant area or object is defined as one that is of particular importance to Aboriginal people according to Aboriginal tradition. The Act must be invoked by or on behalf of an Aboriginal or Torres Strait Islander or organisation.

3. ABORIGINAL COMMUNITY CONSULTATION

This chapter contains details of the Aboriginal community consultation undertaken regarding the Aboriginal cultural heritage of the PA. In accordance with the guideline Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (DECCW, 2010b), consultation with Aboriginal people is an essential part of the heritage assessment process to:

- determine potential harm on Aboriginal cultural heritage from proposed activities; and
- inform decision making for any management and mitigation measures where it is determined that harm cannot be avoided.

The guideline also sets out four stages of consultation requirements. Fulfilment of these requirements is outlined below.

3.1 Stage 1: Notification of Project Proposal and Registration of Interest

On behalf of the Proponent, ERM has actively sought to identify stakeholder groups or people wishing to be consulted about the Project and has invited them to register their interest as follows.

To identify relevant stakeholders, letters about the Project (dated 3 July 2018) were supplied to the following bodies:

- Moombahlene Local Aboriginal Land Council (LALC);
- Local Land Services (LLS) South-East Region;
- National Native Title Tribunal (NNTT);
- Native Title Services Corporation (NTS Corp);
- NSW OEH Regional Operations Coffs Harbour Branch;
- Office of the Registrar, Aboriginal Land Rights Act (1983);
- Tenterfield Shire Council; and
- Inverell Shire Council.

The results from the letters indicated two Aboriginal parties with potential interest in the PA. A Project notification letter was sent to each of the identified parties on 24 July 2018. Correspondence from the LLS has suggested that the Site is located within the Toomelah LALC boundaries. Our review of the boundaries placed the Site within Moombahlene LALC. ERM contact the Toomelah LALC to confirm that it is not in Toomelah region, a map with the known LALC boundaries and PA location was generated and forward to the LALC for their review and comment. No response was received following this correspondence.

A local press advertisement requesting Aboriginal party participation was placed in the Inverell Times and Tenterfield Star on 3 July 2018, the advertisements were published on 6 July 2018 and 11 July 2018 respectively (refer to *Appendix A*). The response period for Aboriginal stakeholders to register an interest in the Project was open for two consecutive weeks.

3.2 Stage 2: Presentation of Information about the Proposed Project

The Aboriginal parties that registered an interest in being consulted are presented in *Table 3.1.*

Table 3.1 Registered Aboriginal Parties (RAPs)

Organisation
Aboriginal Cultural Sites Services
Edgerton Kwiambal
Moombahlene LALC

A study methodology was sent to each of the registered parties (dated 9 August 2018). The letter included:

- an outline of proposed works;
- the proposed methodology and dates for pedestrian survey;
- a request for Aboriginal parties to identify any particular areas of interest within the PA to survey; and
- an invitation to attend a site survey between 11 to 13 September 2018.

No comments were received in relation to the proposed methodology. All three groups agreed to attend the site survey.

3.3 Stage 3: Gathering Information about Cultural Significance

All Registered Aboriginal Parties (RAPs) were invited to participate in the field survey on Tuesday 11, Wednesday 12, and Thursday 13 September 2018. Emails and telephone calls were made to each party to confirm attendance and clarify any potential questions or issues about the methodology, and to determine meeting locations and times for each survey day (refer to *Appendix A*).

Information was also sought regarding cultural knowledge of the PA. All groups expressed that the PA holds or possesses potential cultural sensitivity, through historic family connection to and knowledge of the area.

ERM recognise and value the input of all Aboriginal stakeholders in the consultation process. All RAPs were invited to discuss the Project and the results of the field survey during and following the site survey. The aim of this was to ensure that management actions and consultation commitments are developed in full consultation and are based on the recognised cultural heritage values of the sites.

3.4 Stage 4: Review of Draft Cultural Heritage Assessment Report

A draft copy of the CHA report was provided to all Aboriginal parties who registered an interest in the project on 9 May 2019, for the purposes of receiving written or oral general comments and more specific comments on the cultural significance of the PA and the identified sites and the recommended management and mitigation measures.

Feedback was received from two of the RAPs (also refer to *Appendix A*):

- Edgerton Kwiambal endorsed the draft ACHA.
- Aboriginal Cultural Sites Services provided the comments below that highlight the cultural importance of the area:

> *Yes comment on site I recommend that an AHIP BE ON the sites that they will construct the solar panels .Remove to a safe spot, or find another area for farmers the area is a high occupancy area that was used my Ancestors.*

4. ENVIRONMENTAL BACKGROUND

4.1 Environmental Context

Interactions between people and their surroundings are of integral importance in both the initial formation and the subsequent preservation of the archaeological record. The nature and availability of resources, including water, flora, fauna, and stone materials had (and continues to have) a significant influence over the way in which people utilise the landscape.

Alterations to the natural environment also impact upon the preservation and integrity of cultural materials within that environment. Current vegetation and erosional regimes also affect the visibility and detectability of archaeological evidence. For these reasons, it is essential to consider environmental factors as a component in any cultural heritage assessment.

4.1.1 The Northern Highlands Bioregion

Bioregions and sub-bioregions are large, geographically distinct areas of land with common characteristics such as geology, landform patterns, climate, ecological features and plant and animal communities. The Interim Biogeographic Regionalisation for Australia (IBRA) provides a regional and national planning framework for the systematic development of a comprehensive, adequate and representative National Reserve System. Bioregions delineate salient environmental characteristics which can highlight patterns in Aboriginal site patterning.

The PA is located within the Nandewar Bioregion, which is located inland from the coastal regions and bordered by the North Coast, New England Tablelands and Brigalow Belt South. The region includes parts of NSW, and extends into Queensland. The total area of this bioregion is 2,700,313 hectares (equating to 2.59% of NSW) (NSW NPWS 2003).

Table 4.1 Nandewar Bioregion Attributes

Characteristic	*Description*
Geology	The bioregion overlies part of the New England Fold Belt. The New England Fold Belt is the youngest structural feature in NSW and is separated from the Lachlan Fold Belt by the Sydney-Bowen Basin that is filled with Mesozoic sediments. The oldest rocks in the sequence are Devonian sedimentary and volcanic rocks, formed in an island arc environment. The youngest are Triassic sandstones and shales deposited by rivers on the edge of the Gunnedah Basin, about 250 million years ago, at a time when New England was being lifted by intrusions of granite. Major volcanic eruptions occurred in two phases: in the lava field flood basalts of the Inverell area (34-32 and 22-19 millions of years ago), and in a central volcano similar to that in the Nandewar Ranges (21-17 million years ago). The maximum preserved thickness of the flows is 800m in the variety of lavas present. Only the core of the Nandewar volcano remains as exposed plugs and dykes. Flows from the New England centres buried river gravels and lake sediments that are now being exposed and contain deposits of tin, sapphires and diamonds. A narrow strip of ultrabasic rocks, including serpentinites that are derived from a deep ocean floor, marks the suture where a former island arc complex was linked to the Australian mainland. These rocks pass through Woodsreef and Tamworth where they are associated with limestones in which karst landscapes are formed. The composition of these rocks is so unusual that they always have distinct soils and vegetation

Characteristic	*Description*
Landforms	The Nandewar Bioregion is formed on Palaeozoic sedimentary rocks on the western edge of the New England Tablelands and includes the Tertiary basalts of Inverell and Kaputar. The hilly landscapes are warmer but drier than the tablelands and carry vegetation communities more typical of the western slopes, with some tableland species.
Soils	The bioregion is characterised by clay or loam soils, but siliceous soils derived from acid volcanic rocks are also found. On the sedimentary rocks, shallow stony soils occur on ridges passing to texture contrast soils on almost all slopes. These change in colour from red brown subsoils on upper slopes to yellow subsoils on lower slopes. They support diverse vegetation communities that are also affected by altitude. The granites develop gritty shallow profiles between outcrops and tors on the crests, grading to harsh texture contrast soils with yellow clay subsoils that are prone to gully development on the lower slopes. Basalt areas on Kaputar have frequent rock outcrops interspersed with shallow, stony, brown loams. Black earths are found on lower slopes and in valleys. In the Inverell area the basalts develop black earth profiles that thicken downslope and, where the underlying sands and gravels are exposed, the coarse sandy soils may develop podsol pans and support different vegetation. Alluvial loams and clays with moderate to high fertility are found in the valleys. Dark, alkaline, pedal clays develop on limestone, and the serpentinites have shallow stony profiles with concentrations of elements that are toxic to many plants.
Vegetation	The vegetation of the Nandewar Bioregion is influenced primarily by geology and the influence of altitude on temperature and rainfall. The bioregion is characterised by box woodlands that occur on clay or loam soils, typically at low to mid elevation in agriculturally productive areas. The principal dominants of these box woodlands are white box (Eucalyptus albens), yellow box (Eucalyptus melliodora), Blakely's red gum (Eucalyptus blakelyi) and grey box (Eucalyptus mollucana). Bimbil box (Eucalyptus populnea subsp. bimbil), fuzzy box (Eucalyptus conica) and western grey box (Eucalyptus microcarpa) also occur, particularly in the western half of the bioregion.

Source: Taken directly from https://www.environment.nsw.gov.au/bioregions/NandewarBioregion.htm

4.1.2 Topography and Landforms

The topographical setting incorporates a variety of landforms which have been classified in this assessment according to the definitions set out in Speight (2009). Speight (2009) states that a landscape can be classified by its landform pattern, and then further classified by individual landform elements. The wider landform pattern, for instance, could be one of flood plains or hills. These landscapes can be further categorised into individual landform elements within the wider landform pattern, for instance cliff, foot slopes or valley flats.

According to these definitions, topographic mapping conducted for the Project indicates that the PA is comprised of several landforms that include gentle slopes, upper flats, crests and open depressions. These landforms would have provided suitable areas for hunter gatherers to undertake a range of subsistence activities (for example camping, hunting and tool making). Certain landforms such as flat or gently sloping raised areas near a water source or ridge flats may have been more frequently occupied than others such as areas away from water, where land use may have been more transient in nature.

4.1.3 Flora and Fauna

Prior to European initiated land clearance, the PA would have supported a range of flora and fauna that would have been be utilised by Aboriginal people for subsistence purposes. A broad range of plants would have been available such as white box (Eucalyptus albens), yellow box (Eucalyptus melliodora), Blakely's red gum (Eucalyptus blakelyi) and grey box (Eucalyptus mollucana). Bimbil box (Eucalyptus populnea subsp. bimbil), fuzzy box (Eucalyptus conica) and western grey box (Eucalyptus microcarpa). "Riparian forests of river oak (Casuarina cunninghamiana), sometimes with river red gum (Eucalyptus camaldulensis), occur along the major watercourses, with Blakely's red gum and rough-barked apple (Angophora floribunda) forming the common association along minor drainage lines. Forest and woodlands of northern smooth-barked apple (Angophora leiocarpa) and dirty gum (Eucalyptus chloroclada) are associated with sandstone parent material on the north-western edge of the bioregion" (NSW NPWS 2003).

There is a high diversity of fauna within the bioregion including, woodland birds, diurnal birds such as regent honeyeaters, lorikeets, and little corellas, nocturnal birds such as several owls and bush stone curlews, frogs, turtles, lizards, snakes, koalas, squirrel gliders, greater gliders, and various bats.

4.1.4 Land Use and Disturbance

The PA generally consists of a cleared pastoral landscape primarily utilised for sheep and cattle grazing. Some areas of the upper soil horizon within the PA have been affected by ploughing. Ploughing generally disturbs the upper 300mm of soil horizons (i.e. 300mm is the maximum plough depth), however, depending on ploughing method, it is possible that up to 600mm could be disturbed. Therefore, deeper soil deposits may retain *in situ* Aboriginal archaeological sites. For this reason, the plough zone is not considered as an area of significant disturbance, however, any artefacts located within the top 300-600mm of the soil horizon may be considered as not to be *in situ*, depending on ploughing methods applied in that area in the past.

Other land disturbances to the PA include the construction of roads, land clearance and fencing. Other ground disturbances have also occurred within the PA such as soil erosion and bioturbation (bioturbation is the reworking of soils and sediments by animals and plants). These post depositional processes have likely adversely affected the archaeological record in the PA.

5. ARCHAEOLOGICAL BACKGROUND

The preliminary archaeological and cultural landscape context discussed in this report has been established through a review of documentation relating to regional ethnographic accounts, information from the AHIMS database, and previously conducted archaeological projects and reports. It is noted that there are several limitations to the use of this existing information such as:

- Aboriginal people involved in previous studies may not have disclosed relevant cultural knowledge and the cultural significance of certain areas due to sensitivities in Aboriginal politics;
- no responsibility can be taken by ERM for errors or omissions in primary and secondary source material cited in this report; and
- the AHIMS search results presented below are based on previous archaeological work and is therefore limited to specific locations and field conditions (visibility, time constraints, etc.) and therefore may not necessarily be a true reflection of the archaeological record.

5.1 Ethno-History

Ethnographic information relating to the Aboriginal occupation of the PA has been obtained from sources containing knowledge that has been passed down from Aboriginal people, as well as documentation written by early European settlers and government officials during the mid to late 18th century (Barwick 1984). Human occupation of south east Australia dates from at least 20,000 years BP. Evidence of early Aboriginal occupation of the State has been provided by sites such as the Burrill Lake rock shelter (Lampert 1971), Cloggs Cage (Flood 1980) and New Guinea 2 (Ossa 1995). The major Aboriginal groups thought to traditionally occupy the wider Nandewar Bioregion were the Anaiwan, the Kamilaroi, the Weraerai, and the Kwaimbul (NSW NPWS 2003).

ERM recognises that Indigenous people are the primary source of information on their heritage and culture; the Anaiwan, Kamilaroi, Weraerai, and the Kwaimbul people are the Aboriginal traditional owners of the wider area. This brief history of the region has been compiled through desktop research, regional studies and historical documents. It should be recognised that most of the available ethnographic information relating to the early Aboriginal occupation of the area comes predominantly from historical documentation written by early European settlers and government officials during the mid to late 19th century. However, the Aboriginal ties to the land and cultural significance of the broader region is recognised within this CHA.

The broader area around the PA forms part of the New England Ranges encompassing eastern and western river systems. Walker describes the region as being dominated by undulating uplands, extending as a tableland belt of varying width, with gently rolling country with shallow valleys terminating in the eastern escarpment east of Walcha (1977, pp.11). Australian Aboriginal people occupied the land according to a complex system of spatial organisation and landscape use (Clark 1990, pp.11-14). Individual groups were intimately familiar with their own geographical regions and the seasonal availability of resources within it. Sutton (1989, pp.7-8) writes that Aboriginal people of the area utilised the surrounding natural resources and landscape formations as a part of their subsistence procurement strategies in addition to more traditional hunting methods; for example, they used the trees to trap macropods via nets strung between them and then herded the animals into the nets and they used traps, nets and baskets in the swamps to catch fish, crayfish, hunt water birds and collect their eggs (Rosen 2009). Indigenous people were also able to supplement their diet by digging for yams, roots and foraging for other edible plants, berries and seeds. Grasslands were maintained by burning or 'fire stick farming' to regenerate local plants and vegetation as well as attract large game into the area for hunting (Rosen 2009). Of the flowering and fruiting plants available as food a large number of them grew in spring and summer including geebung, wild parsnip, Apple Berry, spreading *brachyloma* and Honey Pots (Rosen 2009). A number of these species are encouraged to grow and flower by fire, including the *Xanthorrhoea* species, and the *Imperata cylindrical* (Rosen 2009).

The nature of their subsistence practices required Indigenous groups to be seasonally mobile, moving through the landscape and taking advantage of seasonal fluctuations in available resources. As cited in Hudson (2006), researchers McBryde and Belshaw state that Aboriginal populations on the Tablelands moved to warmer climates (eastern coastal and western slopes) during the colder winter months and occupied rock shelters and overhangs likely adapting their diet and subsistence practices to suit their environment as they moved through the landscape. Many plant resources present in the area are known to have been used by Aboriginal people prior to and after European occupation (Rosen 2009). A number of edible plants were available all year round although spring and summer typically would have been the most productive seasons with a proliferation of species including saw-sedge, bearded heath, Australian Bluebell, ferns and the *Styphelia triflora* (Rosen 2009).

Tools used by Aboriginal people of the Northern Tablelands region included spears, clubs, waddies, boomerangs, shields, paddy-melon sticks and fire sticks made of wood; stone was also utilised to create tools including knives, scrapers, ground-edge axes and even composite technologies like hafted stone chisels (McBryde 1974). Spears were both hand-thrown and thrown with the aid of woomeras (spear throwers). Stone axes were sharpened by pulling or rubbing the axe head through cracks or gaps in other stone outcrops or on bedrock material such as granite or sandstone (Rosen 2009).

Traditional or tribal boundaries were not delineated by treaties or surveyor demarcation but were often defined by the people who occupied them and their culture traditions including linguistic associations, social relations and kinship systems, and spiritual links to the land. Through this commonality and shared culture they may have also controlled and regulated who accessed and passed through their territory. Thus, traditional boundaries were most likely fluid and changed position over time. In light of this, the tribal boundaries recorded by European people at, or after, the point of contact can only be considered as current to that period and were probably quite different prior to European observation (Flood 1980, pp.2). To make things more ambiguous, the few European accounts of Aboriginal groups in the Armidale region are limited in detail, often confused in regard to Aboriginal group names and give varying interpretations of territorial boundaries.

Norman Tindale (1974) in his landmark analysis of the 'Aboriginal Tribes of Australia' cites the PA area as the traditional home of the Kwiambal people (refer to *Figure 5.1*).

Figure 5.1 Map of Tribal Boundaries in Aboriginal Australia, PA indicated with blue circle (Tindale 1974)

5.2 Regional Archaeological Background

While many archaeological studies have been carried out in the region, much is focused on the coastal areas of northern NSW rather than the regional area containing the PA. A significant and early example of these studies was carried out by McBryde in 1974 (OzArk EHM 2011). This study dated a rockshelter site to 6,400±300BP, which is the oldest occupation date so far recorded in the coastal region.

Most hinterland studies in the region have been related to development related assessments, these include a series of transmission line assessments carried out by OzArk in the 2000s and at least once by Navin Offer in the 1990s (OzArk EHM 2011). These studies as well as others in the region suggest that the most common Aboriginal site type is an 'open site' (or stone artefact scatter), although art sites, modified trees, rockshelters, grinding grooves, and quarry sites have also been recorded. It has been noted that sites are most likely to appear on ridgelines, spurs, and slopes rather than along creek lines (Navin Officer 1990).

In 2013 Tenterfield Shire Council commissioned an Aboriginal Heritage Study (AMBS 2013) which aimed to identify places of significance within the LGA and to inform the listing of heritage items on the LEP. The study was carried out in consultation with Aboriginal stakeholders in the area. It identified 174 previously recorded Aboriginal cultural heritage sites within the LGA, noting that sites general occurred near watercourses in elevated areas. The study also noted that the distribution of sites that had been recorded reflected locations of previous studies, carried out as part of development activities or for academic purposes, rather than reflecting an accurate or complete distribution of sites likely to be found across the landscape (AMBS 2013).

5.3 Local Archaeological Context

There has been limited previous archaeological research within the PA; however at least one development project has been undertaken in its proximity which has required cultural heritage assessment. The results of this investigation helps to provide an indication of the range, nature and distribution of archaeological sites within the local area.

5.3.1 Dumaresq to Lismore Transmission Line Aboriginal and Historic Heritage Assessment

Between 2009 and 2011 OzArk EHM undertook Aboriginal and Historic heritage assessments as part of a project which proposed a transmission line between the Dumaresq Switching Station (approximately 75m from the PA's western boundary) and the Lismore Substation in far north NSW (OzArk 2011). In 2011, an assessment was carried out on the section of the proposed transmission line easement. Prior to completing the assessment information about previously recorded sites in proximity were gathered from AHIMS, it was noted that 49.2% of previously recorded sites in the area were open sites / artefacts scatters, and 15.2% were modified (scarred) trees. The assessment identified 50 previously unrecorded Aboriginal cultural heritage sites. The assessment found that most cultural heritage sites were located near a water source and that sites in the area are likely to be artefact scatters or modified trees.

5.3.2 OEH AHIMS Register

The AHIMS database provides information concerning previously recorded Aboriginal sites in NSW. AHIMS stores data regarding a sites location, site type, site features and a unique site identification number for all registered Aboriginal heritage sites in NSW. Mapping of an AHIMS database search results will identify any known sites which could be impacted by proposed works as well as help to determine the overall pattern of Aboriginal sites in an area. A summary of the various site types that could be located in the PA can be found in *Table 5.1* and will aid in the development of a site prediction model for the PA.

Table 5.1 Cultural Heritage Site Types Definitions

Site types	Definition
Stone artefact scatters (or open camp sites)	Stone artefact scatter sites, also known as open camp sites, are usually indicated by surface scatters of stone artefacts and sometimes fire blackened stones and charcoal. Where such sites are buried by sediment they may not be noticeable unless exposed by erosion or disturbed by modern activities. The term camp site is used as a convenient label which, in the case of open sites, does not necessarily imply that Aboriginal people actually camped on the sites; rather it indicates only that some type of activity was carried out there.
Isolated finds	Sites consisting of only one identified stone artefact, isolated from any other artefacts or archaeological evidence. They are generally indicative of sporadic past Aboriginal use of an area.
Shell middens	Middens consist of accumulations of shell that represent the exploitation and consumption of shellfish by Aboriginal people. Shell species may be marine, estuarine or freshwater depending on the environmental context and middens may also include other faunal remains, stone artefacts, hearths and charcoal.
Shelter sites	Sandstone shelters and overhangs were used by Aboriginal people to provide camp sites sheltered from the rain and sun. The deposits in such sites are commonly very important because they often contain clearly stratified material in a good state of preservation.
Grinding grooves	Grooves resulting from the grinding of stone axes or other implements are found on flat areas of suitable sandstone. They are often located near waterholes or creek beds as water is necessary in the sharpening process. In areas where suitable outcrops of rock were not available, transportable pieces of sandstone were used.
Quarries	These are areas where stone was obtained for flaked artefacts or ground-edge artefacts, or where ochre was obtained for rock paintings, body decoration or decorating wooden artefacts.
Art sites	Aboriginal paintings, drawings and stencils are commonly to be found where suitable surfaces occur in sandstone shelters and overhangs. These sites are often referred to as rock shelters with painted art. Rock engravings, carvings or peckings are also to be found on sandstone surfaces both in the open and in shelters. These are referred to as rock engraving sites.
Scarred trees	Scarred trees bear the marks of bark and wood removal for utilisation as canoes, shields, boomerangs or containers. It is commonly very difficult to confidently distinguish between Aboriginal scars and natural scars or those made by Europeans.
Burial sites	Burials may be of isolated individuals, or they may form complex burial grounds.
Stone arrangements, carved trees and ceremonial grounds	These site types are often interrelated. Stone arrangements range from simple cairns or piles of rocks to more elaborate arrangements; patterns of stone laid out to form circles and other designs, or standing slabs of rock held upright by stones around the base. Carved trees are trees with intricate geometric or linear patterns or representations of animals carved into their trunks. Ceremonial grounds and graves were often marked by such trees. Bora grounds are a common type of ceremonial site and they are generally associated with initiation ceremonies. They comprise two circles, generally edged with low banks of earth but sometimes of stone, a short distance apart and connected by a path.

A targeted AHIMS search conducted for the PA on 5 March 2018 and again on 28 February 2019 revealed that one site had been previously recorded within the PA, and another nine sites had been previously recorded within 1.5 km of the PA.

The results of the AHIMS searches are shown in *Tables 5.2* and *5.3,* and *Figure 5.2*.

Table 5.2 AHIMS Extensive Search Details

Date	Client Service ID	Latitude	Longitude	Number of Sites
5 March 2018	331690	From: -29.2336 To: -29.1502	From: 151.2741 To: 151.4063	10

Table 5.3 AHIMS Registered Sites

Site ID	Site Name	Site Features	Site Types	Approximate Distance to Project Area	Status
11-3-0083	Tenterfield-Dumeresq OS14	Artefact	Open Site	Within PA	Valid
11-3-0041	S19	Artefact (Isolated Find)	Open Site	>1.5 km	Valid
11-3-0047	EL35	Artefact	Open Site	>1.5 km	Valid
11-3-0063	EL34	Artefact	Open Site	>1.5 km	Valid
11-3-0064	EL33	Art (Pigment or Engraved)	Open Site	>1.5 km	Valid
11-3-0065	EL32	Artefact	Open Site	>1.5 km	Valid
11-3-0066	EL36	Artefact	Open Site	>1.5 km	Valid
11-3-0080	TSR Dumaresq River OCS	Artefact (500)	Open Site	>1.5 km	Valid
11-3-0084	Tenterfield-Dumeresq OS15	Artefact	Open Site	>1.5 km	Valid
11-3-0093	Tenterfield Dumaresq OS 4 & PAD	Artefact	Open Site	>1.5 km	Valid

5.3.2.1 Discussion of AHIMS Site #11-3-0083

Only one previously registered site was identified within the PA. The site, identified as AHIMS #11-3-0083 (Tenterfield-Dumaresq OS14) is recorded as an open artefact scatter, containing at least one culturally modified tree. Details from the site recording card indicate that the site covers six (6) discrete scatters, identified within 50 m of each other. The size of the site complex is estimated to be 100 m by 80 m (see *Figure 5.2*). The following description of the site is provided in the site card:

> *TD-OS14 is located at the confluence of two unnamed water courses 750m to the east of the Dumaresq Switching Station. Artefacts were recorded on both the east bank, central promontory between the water courses and on the west bank of the water courses. Artefact densities appear to be greater on the east bank and to the south of the easement: although, within the proposed transmission line easement, artefacts are present on both banks of the water courses, albeit in lower densities. Across TD-OS14 there appeared to be very little soil depth and it is assessed that there is a low probability of subsurface archaeological deposits being present. The site is also affected by erosion and stock movement .Recorded artefacts were of a local dark chert (that was noted in the water courses adjacent to TD-OS14), quartz, quartzite and a fine-grained indurated mudstone. Modified tree at Northern end.*

The description provided in the site recording card suggests that AHIMS Site #11-3-0083 consists of an open camp site, comprised of a number of discrete scatters that may represent activity areas. Considering the location of the site at the confluence of two smaller creeks, there is a possibility that the site extends beyond the recorded boundary.

AHIMS #11-3-0083 was assessed as having moderate to high cultural significance and moderate to low scientific significance at the time of recording.

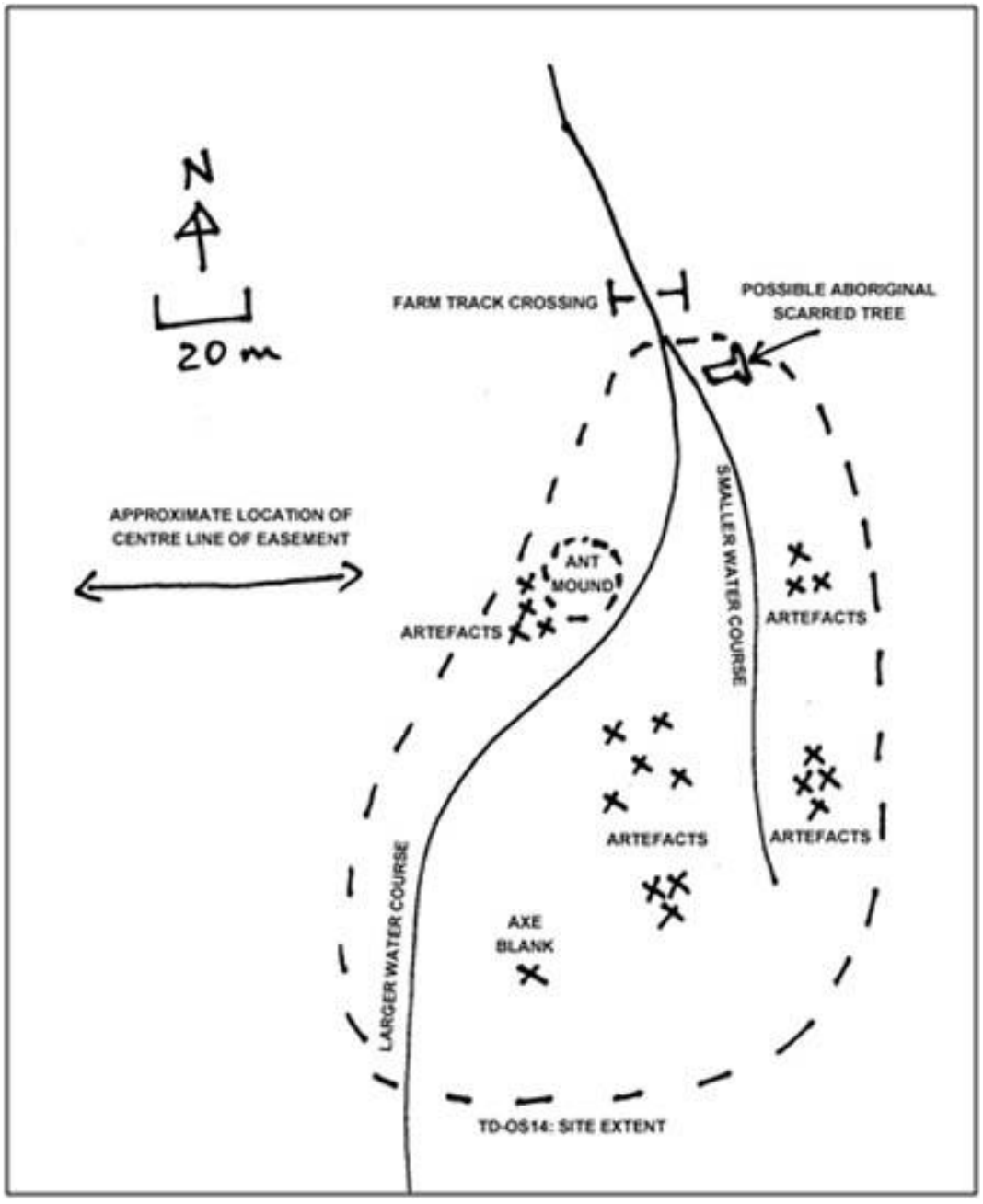
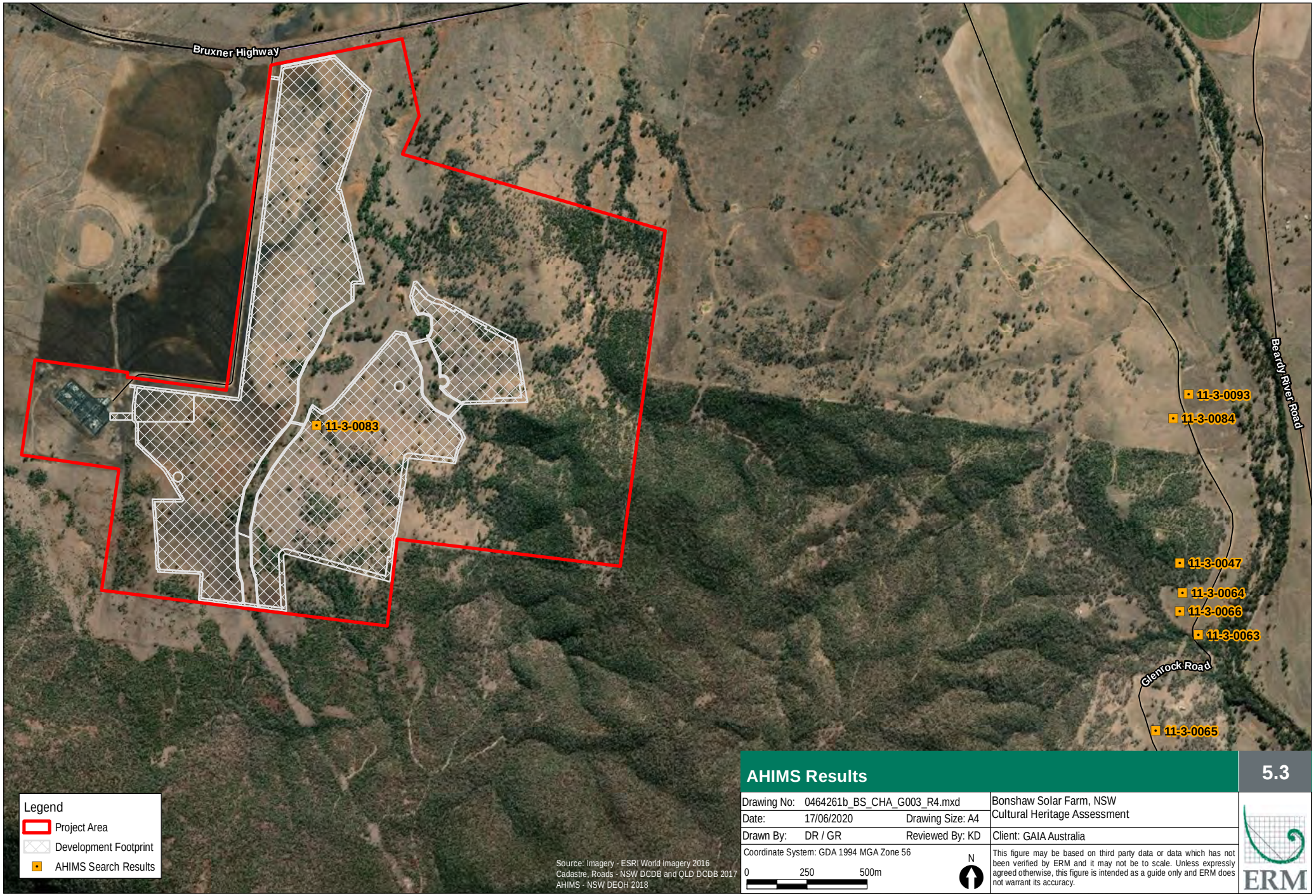


Figure 5.2 Reference Map from Site Recording Card #11-3-0083 (OzArk 2011)



AHIMS Results

5.3

Drawing No:	0464261b_BS_CHA_G003_R4.mxd		Bonshaw Solar Farm, NSW Cultural Heritage Assessment
Date:	17/06/2020	Drawing Size: A4	
Drawn By:	DR / GR	Reviewed By: KD	Client: GAIA Australia
Coordinate System: GDA 1994 MGA Zone 56			This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

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5.4 Implications for the Project Area – Predictive Model

It is important to note that the level of archaeological potential relates to the likelihood of discovering an Aboriginal object or site, within a location. Further description should then be made as to the potential condition and integrity of the soil matrix and potential site itself. Only once all these factors have been considered, can scientific value start to be assessed for an area with potential. Therefore, whilst scientific value and potential are linked, it must be noted that these values and potentials are not the same and can differ substantially for any single site or area with potential.

Areas with archaeological potential were assessed according to the definitions in *Table 5.4* and includes a consideration of landforms, distance to resources, historic disturbances and past land use, and the results of previous surveys. Proximity to a permanent water supply and landform is the primary factor appearing to determine the location of Aboriginal campsites within the region and scar trees can occur anywhere that trees of a suitable age remain.

Table 5.4 Definitions of Archaeological Potential

Rank	Definition	Example
Very Low potential	Artefacts are very unlikely to occur in situ.	Eroded landforms, reconstructed landscapes, hazardous landscape, developed areas.
Low potential	Artefacts are not normally found in comparable contexts but could occur in low densities making detection unlikely.	Landforms with no specific focus for use, i.e. areas not associated with or in proximity to water sources.
Moderate potential	Artefacts are known to occur in comparable landforms in detectable densities (~1artefact/m^2) and there is an unknown possibility for detection.	Landforms with an environmental focus which may have seen seasonal visitation.
High potential	Artefacts are consistently found in comparable landforms or similar environmental contexts and thus will certainly be found in any ground breaking works.	Landforms with known environmental focus encouraging repeat visitation to specific locale, i.e. margins of swamp or near high order creeks.

Archaeological site formation is a complex combination of factors, such as bioturbation and environmental conditions like erosion or the burial of sites through soil movement. Once discarded on the grounds surface, artefacts are often readily incorporated into the topsoil horizons through the process of bioturbation. It is common for dense artefact deposits to exist hidden beneath the grounds surface (cf. Wandsnider and Camilli 1992). Archaeological assessments that do not employ appropriate methods for prediction cannot reliably define an area's archaeological content.

Frequently, only the eroded component of a larger subsurface deposit is detected and recorded as a site. Where soils are soft, sandy or in boggy conditions, artefacts can occur at greater depths below surface level. Therefore, it is crucial that the nature of an area's soils, sands and geomorphology are defined correctly in an archaeological assessment and the resulting archaeological implications identified. An understanding of these factors, linked further to the notions of site integrity and condition, results in an understanding of an area or site's archaeological potential.

The knowledge gained from examining landforms, geology, regional archaeological patterns, and prior archaeological reports have enabled a set of parameters to be established to predict the potential location of Aboriginal sites within the PA. The topographical nature, geology, flora and fauna of the PA would have provided shelter from the elements and a range of subsistence and lithic resources to Aboriginal people. The PA's proximity to a permanent water source, the Dumaresq River and its numerous associated tributaries that run through the PA would have made it a prime source of water and food resources for Aboriginal groups in the area. In line with this and the archaeological context as discussed above, the PA is likely to contain low density stone artefact scatters across all of its landform units. Although the upper layers of soil horizons across the PA have likely been disturbed by non-Aboriginal agricultural activities such as ploughing, *in situ* archaeological deposits may be present within deeper stratigraphic layers. It is also likely that stone artefacts have not been moved far from their original depositional position by ploughing.

5.4.1 Predictive Model

Based on the background studies and comparative analysis, the following predictions are made for Aboriginal cultural heritage within the PA:

- Aboriginal sites are most likely to be stone artefact sites;
- stone artefact sites are most likely to occur within 400 m of a permanent water course, although smaller creek margins may display scatters of stone artefacts, particularly if near to larger water courses;
- surface expressions of artefacts are most likely to be found on flat or gently sloping terrain;
- surface expressions of artefacts are most likely to be found within proximity of water, or within elevated landforms such as ridge crests or spur line crests, or within proximity of open drainage depressions;
- high density open camp sites will likely be representative of a permanent or seasonal occupational camp, and will likely be located within flat raised terrain that is defensible and sheltered from the elements and has access to resources (water, food, wood and potentially stone);
- lower density sites or isolated finds are likely to contain a 'background scatter' and be representative of a more transient movement throughout the landscape, or intermittent activities (hunting, food procurement, etc.);
- elevated areas that afford views of the surrounding landscape are likely to contain stone artefact sites;
- cultural modifications or scars may occur on mature trees with the PA;
- areas of subsurface stone artefact deposits (with or without a display of surface level stone artefacts) may be present in the PA. Such sites are likely to be located at depths of between 0 and 30 cm below ground surface level;
- human burials are rare, and are not likely to be present in the PA, but if present would most likely be in the alluvial soils that make up the PA's flood plain, creek and river terraces or found in crests and hill tops;
- ceremonial sites (bora grounds) may be present on hill tops in the PA, though are very unlikely due to their rarity and previous disturbances across the landscape; and
- the most common stone materials used for the manufacturing of artefacts within the local region of the PA are likely to be silcrete, chert and quartz (with some quartzite and volcanic material).

Much of the material used by Aboriginal people to produce survival equipment (such as wood, bone, shell and fibre material) is highly perishable and does not often survive in the archaeological record. Material culture that has survived, often found in locations where Aboriginal people camped, are generally stone artefacts and scarred trees. Stone artefacts, and to a lesser extent scarred trees, are the most likely artefact types to be located within the PA. Aboriginal archaeological sites within the PA are likely to have been impacted upon (disturbed) due to past European farming practices, the development of transport infrastructure (such as road constructions) and trenching for utility services.

6. HISTORICAL CONTEXT

This chapter considers the potential non-Aboriginal heritage values for the PA. It includes a review of primary and secondary resources including available heritage assessments, reports, publications, historical maps and aerial imagery for the local area. This material will be used to help the PA's history and development over time. The following databases were also searched to determine whether known non-Aboriginal ('historic') heritage sites are located within the PA:

- Commonwealth Heritage List (CHL);
- NSW State Heritage Register and Inventory;
- Inverell Local Environmental Plan (LEP) 2012; and
- The National Trust of Australia.

6.1 Historical Overview

The New England region and Inverell district's first European explorers were Allan Cunningham (1827) and John Oxley (1818), who entered the area on separate expeditions (OzArk 2011). Squatters then moved into the Inverell area around 1835, some establishing large holdings throughout the area, including Campbell in 1837, a significant landholder in Inverell (OzArk 2011; Inverell Shire Council 2018). Campbell, having arrived in Australia from Scotland in 1824 and named the area "Inv" a meeting place and "Ell" meaning swans, as a large amount of these birds were in the area at the time (Inverell Shire Council 2018).

In June 1838 the Myall Creek massacre occurred 35 km from Inverell, becoming a famous case in Australia as the first time that Europeans were hanged for killing Aborigines (Inverell Shire Council 2018). Unfortunately it was not the only massacre in the region at this time, however subsequent massacres and violent episodes went unreported or punished (Inverell Shire Council 2018).

The town of Inverell was incorporated as a municipality in 1872 and tin mining in the region ensured the town's economic growth and remained an important industry in the area for the next century (Inverell Shire Council 2018). The Closer Settlements Acts introduced in NSW between 1901 and 1909 helped to create new small towns in the area in an effort to break large landholding squatter's dominance in country areas (Inverell Shire Council 2018).

6.1.1 Township of Bonshaw

It is not clear when the small township of Bonshaw was formed, however it was built to support local agricultural holdings. The earliest cattle station is thought to have been established in the Bonshaw area in the early 1840s and a track from Bonshaw to Ashford developed in the 1850s (Main Roads 1968). A hotel was constructed at Bonshaw prior to 1867, in time for the bushranger, Captain Thunderbolt (Fred Ward) to rob it in May that year (The Armidale Express 1867). Other community buildings were also built in the town including a church, school, and memorial hall (refer to *Photographs 6.1* and *6.2*). In 1878 £750 was provided for the construction of a track from Tenterfield to Bonshaw (Main Roads 1968). Further roads from Bonshaw to other large towns in the area were established and upgraded over the following decades, including to Ashford, Texas, and Inverell, leading to the formation of State Highway No. 16 in 1938 which became NSW's most northern highway from the coast to the Queensland border at Goondiwindi, it was later renamed Bruxner Highway in 1959 (Main Roads 1968).

Photograph 6.1 School at Maidenhead Station, Bonshaw, c. 1880s (Trove Item #48117813)

Photograph 6.2 Memorial Hall, Bonshaw (Trove Item #252402940)

6.1.2 The Project Area

While little is known about the history of the PA, historical parish maps dating from at least 1909 show that the land was used for pastoral purposes. In 1909, a Charles Strathley Jr was the landholder (refer to *Figure 6.1*). No further detail is included on the map (or any later parish maps) to indicate that any buildings or dwellings were present on the site. Strathley is shown to hold a number of titles within this parish and it is possible that he resided elsewhere and used the land purely for grazing purposes. Strathley is listed as a grazier in several historical sources including the Sydney Stock and Station Journal (5 April 1918). According to later parish maps Strathley was still the landholder in 1939. By 1967 a B.F. Hartley held the land title and continued to do so until at least 1979 (NSWLRS 1965; 1979).

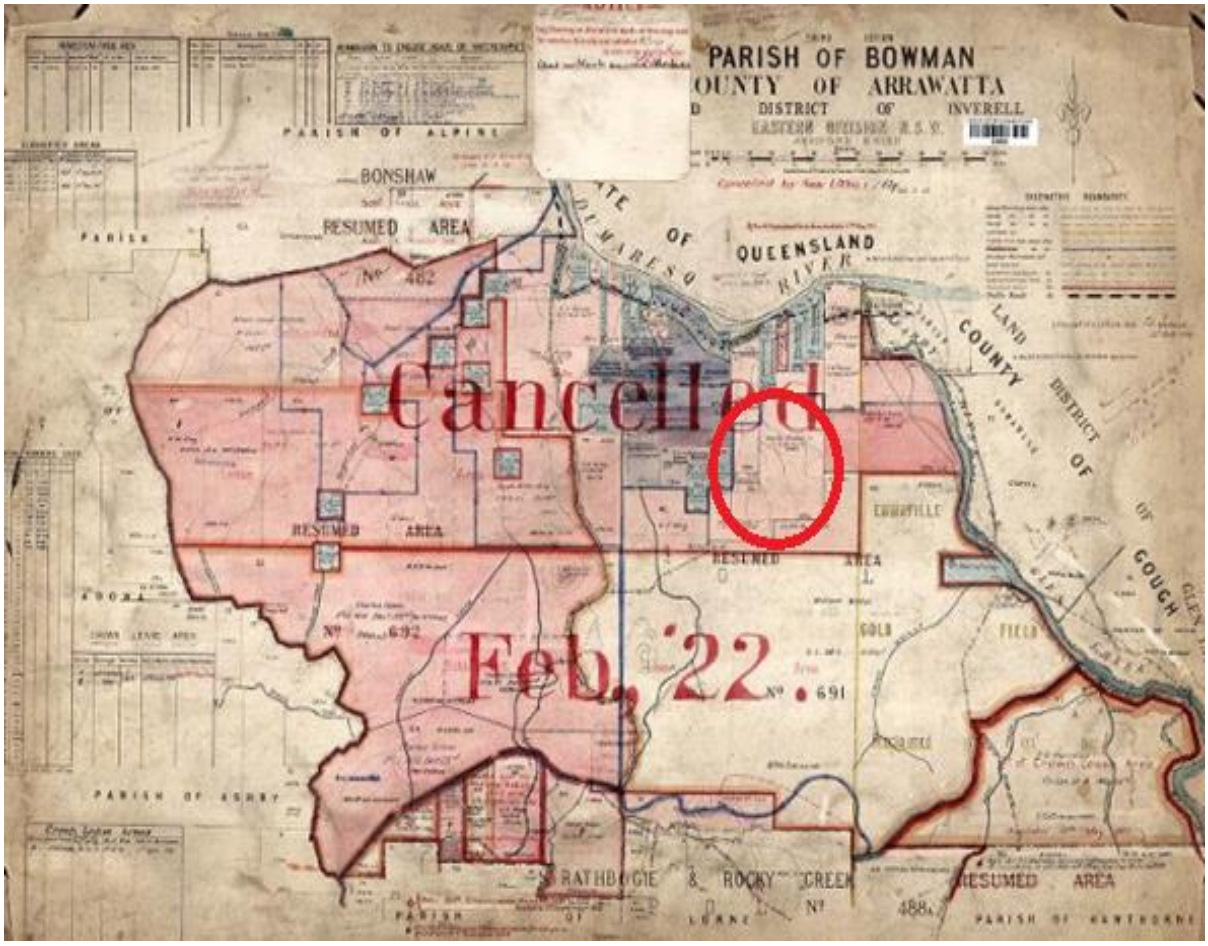


Figure 6.1 1909 Parish of Bowman map, PA is indicated in red (NSWLRS 1909)

6.2 Historical Heritage Database Searches

A search of heritage databases was undertaken in August 2018 and again on 27 February 2019 to determine whether any historical heritage items have previously been recorded within the Project Area. The results are outlined below.

6.2.1 Commonwealth Heritage List

There are no places listed on the CHL within or near the Project Area.

6.2.2 State Heritage Register

A search of the State Heritage Inventory (SHI) indicated that there are no places listed under the NSW Heritage Act (NSW State Heritage Register) within or near the Project Area.

6.2.3 Local Environmental Plan

There are hundreds of places of heritage significance items located within the Inverell Council area that are listed on the LEP Schedule 5: Part 1 Heritage Items. In Bonshaw itself, three places are listed, all of which are located in Bonshaw village approximately 16 km NNW of the PA, and these are:

- Bonshaw Cemetery, Spark Street (Item #I019);
- Church, 10986 Bruxner Highway (Item #I018); and
- Memorial Hall, Miller Street (Item #I021).

No items of local historic heritage are located within or near the general Project Area.

6.3 Historical Heritage Predictive Model

There are no registered or known significant historic heritage sites in or near the PA. There may be evidence of early agricultural activities, timber harvesting, domestic dwellings and domestic remains in the PA. However, the historical background suggests that the PA was used as grazing land. Given the long term pastoral grazing and ongoing site disturbance associated with the installation of and maintenance of the transmission line through the southern section of the PA, it is unlikely that there will be substantial historical remains identified within the AP.

7. SURVEY METHODOLOGY AND RESULTS

This chapter provides an overview of the archaeological surveys of the PA that were undertaken between the 11 and 13 September 2018.

7.1 Field Survey Methodology

The September 2018 field survey was conducted according to the survey methodology developed and sent to RAPs on 9 August 2018 (*Appendix B*). The archaeological survey aimed to assess the ground surface of the PA and targeted all soil exposures and zones with low vegetation such as areas of erosion and any tracks or paths.

Where Aboriginal cultural heritage sites were identified, these were mapped and recorded by the survey team for content, GPS location, landscape features and digitally photographed. Notes were made of soil conditions, evidence of ground disturbance and possible spatial extent of sites.

Visibility refers to the amount of ground upon which artefacts could be seen. The presence of vegetation, leaf litter and other variables can obscure visibility, which is expressed as a percentage. An exposure is defined as an area in which ground surface disturbance (usually in the form of erosion) results in the removal of ground cover and soils and permits the detection of archaeological material that was formerly contained within a surface or subsurface context. The level of exposure is determined as a percentage. As a descriptive tool, *Table 7.1* has been devised which indicates the level of ground surface visibility. It is a subjective method of assessment, but provides a useful tool when attempting to describe the level of ground surface visible during field surveys or inspection.

Table 7.1 Ground Surface Visibility Rating

	Description	GSV Rating %
Very Poor	Heavy vegetation, scrub foliage or debris cover, dense tree of scrub cover. Soil surface of the ground very difficult to see.	0-9%
Poor	Moderate level of vegetation, scrub, and / or tree cover. Some small patches of soil surface visible in the form of animal tracks, erosion, scalds, blow outs etc., in isolated patches. Soil surface visible in random patches.	10-29%
Fair	Moderate levels of vegetation, scrub and / or tree cover. Moderate sized patches of soil surface visible, possibly associated with animal, stock tracks, unsealed walking tracks, erosion, blow outs, etc. Soil surface visible as moderate to small patches across a larger section of the PA.	30-49%
Good	Moderate to low level of vegetation, tree or scrub cover. Greater amount of areas of soil surface visible in the form of erosion, scalds, blow outs, recent ploughing, grading or clearing.	50-59%
Very Good	Low levels of vegetation / scrub cover. Higher incidence of soil surface visible due to recent or past land-use practices such as ploughing, grading, mining, etc.	60-79%
Excellent	Very low to non-existent levels of vegetation/scrub cover. High incidence of soil surface visible due to past or recent land use practices, such as ploughing, grading, mining, etc.	80-100%

Each of the different landforms identified in the PA were surveyed, which included slopes, upper flats, crests and plains (refer to *Table 7.3*). Creek lines, mature trees, erosion scours, and vehicle and animal access tracks were all inspected. In order to ensure the highest likelihood of finding Aboriginal sites, the field survey focussed on areas of highest ground visibility although it is noted that the ground surface visibility was poor (10-29%) to fair (30-49%) across the majority of the survey area.

7.2 Field Survey Results

The PA was surveyed over three days in September 2018 by Katherine Deverson and representatives of the RAPs as outlined in *Table 7.2.* The field survey methodology was adopted to pursue the discovery of new archaeological sites, ensure the accurate recording of such sites and provide sufficient information to provide an assessment of the PA's cultural significance. Discussion also included Aboriginal intangible values and the importance of Aboriginal sites to the local community.

Table 7.2 Field Survey Attendees

Name	Organisation
Vicky Duncan	Aboriginal Cultural Sites Services
Samantha Duncan	Edgerton Kwiambal
Darren Daley	Moombahlene LALC

7.2.1 Description of the Project Area

The PA generally consisted of grazing paddocks with dense grass traversing gently undulating terrain, plains, and crest landforms (refer to *Table 7.3* and *Photographs 7.1* and *7.2*). There was generally a low level of ground surface visibility with some ground exposures under trees, in areas of soil erosion and along tracks. Disturbances observed include the development of fencing, farm dams and vegetation clearance. Several woodland areas, along with a number of small unnamed creeks were also located in the PA (*Photograph 7.3*). Exposures associated with tracks, dams, woodland areas and other disturbances were examined for artefacts.

Soils across the PA range from alluvial soils adjacent to watercourses with thin sandy-silty Aeolian soil in colours of deep orange and red, to a light yellow/brown and dark brown. Disturbance to the soil profile has occurred during past episodes of vegetation clearance.

Table 7.3 Landform Summary

Landform	% of landform effectively surveyed	Number of Sites
Slope	1.5%	6
Upper Flat/Crest	1.75%	1
Plain/Open Depression	2.88%	28

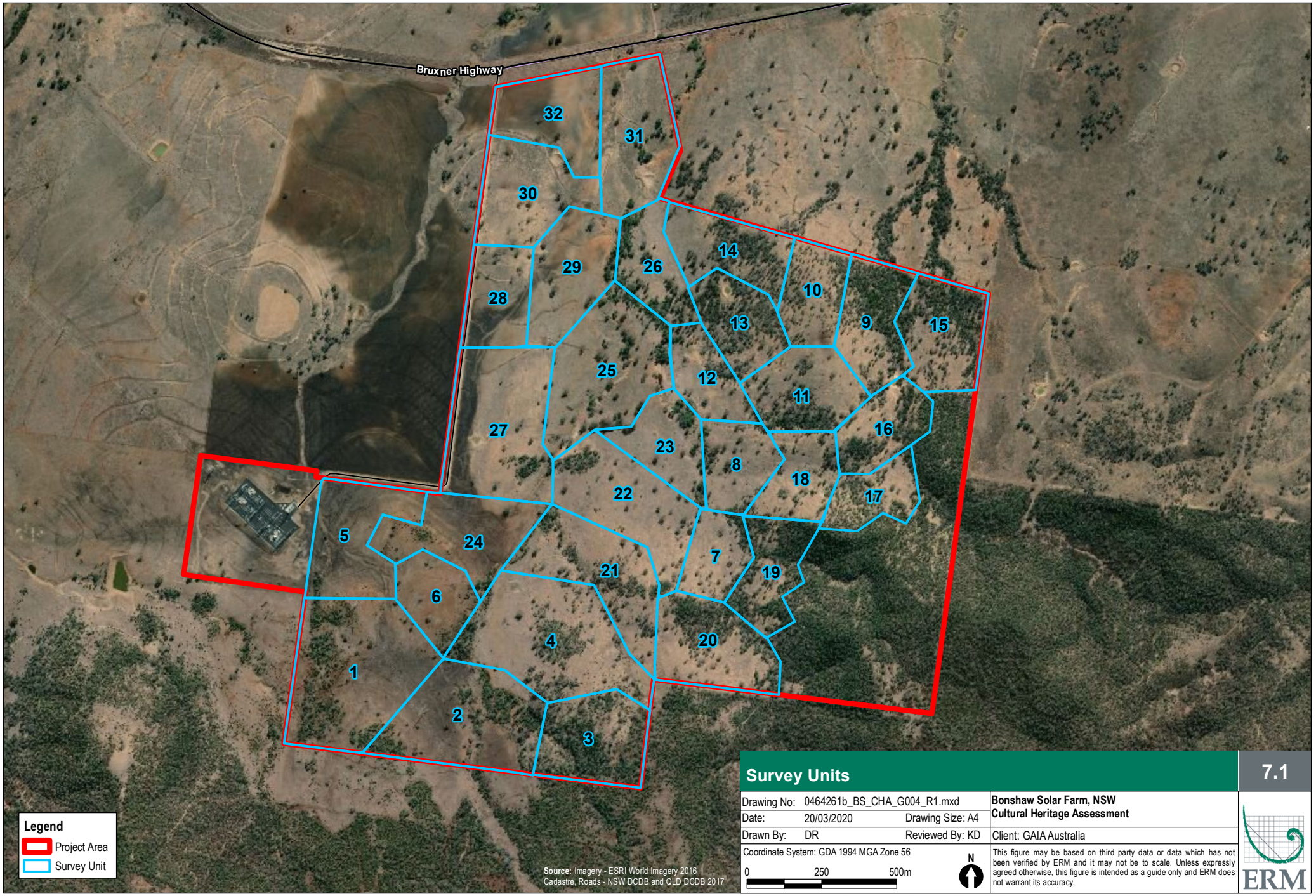
Photograph 7.1 Densely grassed paddock in PA, view to creek line (ERM 2018)

Photograph 7.2 Area of exposure along creek to the left, view to south of PA (ERM 2018)

Photograph 7.3 View to north, along unnamed creek (ERM 2018)

7.2.2 Survey Coverage

The PA was examined in 32 survey units, based on fenced paddocks/areas throughout the PA for ease of recording and analysis. These survey units are identified as Survey Unit (SU) 1 to SU32. The location of these survey units is shown in *Figure 7.1* and detailed in *Table 7.4.*


Bruxner Highway
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4
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1
2
3
Legend
Project Area
Survey Unit
Source: Imagery - ESRI World Imagery 2016
Cadastre, Roads - NSW DCDB and QLD DCDB 2017
Survey Units
7.1
Drawing No: 0464261b_BS_CHA_G004_R1.mxd
Date: 20/03/2020
Drawing Size: A4
Drawn By: DR
Reviewed By: KD
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Cultural Heritage Assessment
Client: GAIA Australia
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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Table 7.4 Survey Coverage

Survey Unit	Landform	Visibility %	Exposure %	Effective Coverage %	Number of Sites
SU1	Plain	Poor 10%	10%	1%	2
SU2	Plain/Mid Slope	Poor 15%	10%	1.5%	2
SU3	Upper Slope/Crest	Poor 10%	10%	1%	0
SU4	Plain/Open Depression	Poor 20%	10%	2%	2
SU5	Plain/Mid Slope	Poor 10%	10%	1%	2
SU6	Plain/Mid Slope	Poor 10%	10%	1%	0
SU7	Plain	Poor 20%	10%	2%	1
SU8	Plain	Poor 15%	10%	1.5%	1
SU9	Upper Slope/Crest	Poor 25%	10%	2.5%	0
SU10	Mid Slope	Poor 10%	10%	1%	0
SU11	Mid Slope	Poor 10%	10%	1%	0
SU12	Plain	Poor 20%	10%	2%	0
SU13	Plain	Poor 10%	10%	1%	0
SU14	Plain	Poor 10%	10%	1%	2
SU15	Plain	Poor 10%	10%	1%	1
SU16	Plain/Mid Slope	Poor 15%	10%	1.5%	1
SU17	Mid Slope	Poor 10%	10%	1%	0
SU18	Plain	Poor 10%	10%	1%	0
SU19	Plain/Mid Slope	Poor 10%	10%	1%	0
SU20	Plain/Open Depression/Mid Slope	Poor 15%	10%	1.5%	0
SU21	Plain	Poor 15%	10%	1.5%	1
SU22	Plain	Poor 10%	10%	1%	2
SU23	Mid Slope	Poor 10%	10%	1%	1
SU24	Plain/Slope/Upper Flat	Good 50%	30%	15%	4
SU25	Plain	Fair 30%	10%	3%	2
SU26	Plain	Poor 10%	10%	1%	1
SU27	Plain	Fair 40%	30%	12%	1
SU28	Plain/Mid Slope	Poor 20%	15%	3%	1
SU29	Plain	Fair 40%	20%	8%	4
SU30	Mid/Upper Slope	Fair 30%	15%	4.5%	2
SU31	Plain	Poor 25%	15%	3.75%	2
SU32	Plain	Poor 25%	15%	3.75%	1

7.2.3 Survey Results

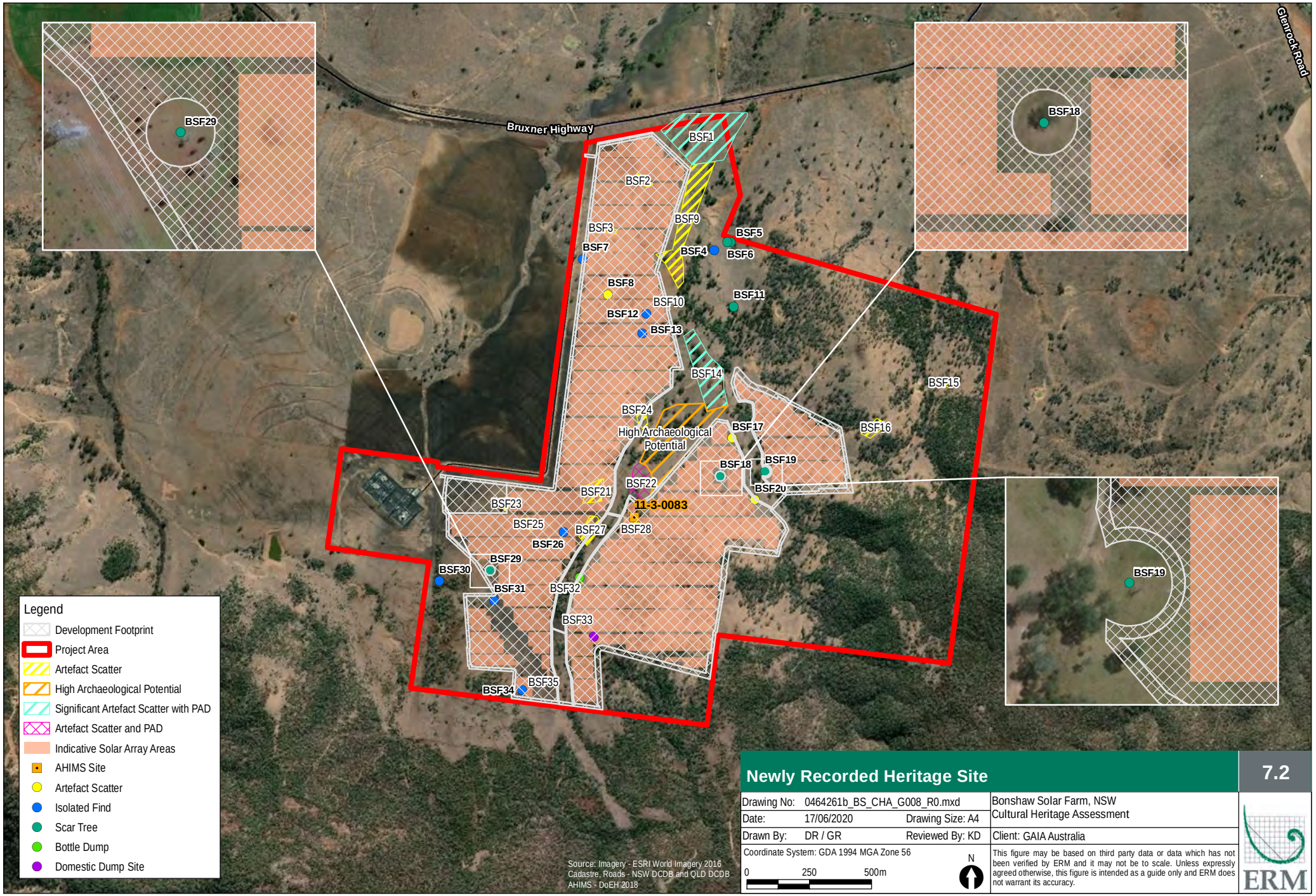
7.2.3.1 Aboriginal Heritage

During the field survey 35 previously unidentified Aboriginal heritage sites were recorded. The sites were located within 3 km of the Dumaresq River to the north, often along small creek lines (*Figure 7.2*. 29 of these sites were stone artefacts including isolated finds and stone artefact scatters. Seven scarred trees were also identified, one of the scarred trees was identified as part of an artefact scatter site. The proximity to water sources and prevalence of artefact scatters or open sites is in line with the predictive model developed in *Section 5.4* and are representative of previously recorded sites in the area. It should be noted that while early studies suggest that sites in the region are less likely to occur along creek lines, this is not the case here and many artefact scatters were located along creeks, rather than in elevated areas or on ridgelines. These sites are described below in *Table 7.5.* Previously unrecorded Aboriginal cultural heritage sites located during the survey were recorded and artefacts and features identified were left *in situ*.

AHIMS Site #11-3-0083

AHIMS Site #11-3-0083 was identified within the PA in 2011 during surveys for the Dumaresq to Lismore 330kV Transmission Line. The 2018 survey conducted by ERM attempted to relocate site #11-3-008; however, this attempt was not successful which comprises of discrete artefact scatters and a scar tree. During the 2018 survey, the AHIMS site was attempted to be relocated. However, the scar tree, which was seen as a key identifier of AHIMS #11-3-0083 (as shown on to *Figure 5.2*) was unable to be relocated. In regards to the artefact scatters that also comprise AHIMS #11-3-0083, it is noted in *Table 7.4* above the ground surface visibility across the PA was generally poor, averaging 10-15% visibility and 1-3% effective survey coverage.

Additionally, as the site complex was recorded as a large series of artefact scatters (measuring 100 m by 80 m, high likelihood that sites located in the general area (between 50-100 m from the edges of the recording may form part of the same greater site. Therefore it was originally thought, during the EIS preparation process, that BSF27, BSF28 and BSF32 may form part of AHIMS #11-3-0083. However, through the assessment process of the SSD project, the Biodiversity and Conservation Division undertook a technical assessment of all the information recorded regarding AHIMS #11-3-0083. The result of this assessment suggests that a technical error in the recording of coordinates has resulted in a misunderstanding about the location of AHIMS #11-3-0038. Having projected the original coordinates, the Biodiversity and Conservation Division has determined that the area was identified during the 2018 survey and given a new site identifier. *Appendix D* provides further detail of the coordinate error and supporting Figures of the originally mapped AHIMS location and of the reprojected location.



Newly Recorded Heritage Site

7.2

Drawing No:	0464261b_BS_CHA_G008_R0.mxd		Bonshaw Solar Farm, NSW Cultural Heritage Assessment
Date:	17/06/2020	Drawing Size: A4	
Drawn By:	DR / GR	Reviewed By: KD	Client: GAIA Australia
Coordinate System: GDA 1994 MGA Zone 56			This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

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Table 7.5 Aboriginal Cultural Heritage Field Survey Results

Site	Survey Unit	Landform	Description		Associated PAD
BSF1	SU31	Plain	**Large Artefact Scatter / Open Camp** This site comprises a high number of stone artefacts. It is not likely that all surface artefacts were identified and recorded at this site, however more than 50 artefacts were noted, across an area of approximately 350 m (east to west) by 200 m (north to south). The site is located at northern boundary of property along small creek line and vehicle access track. The site is located on a plain set in a wider landscape context of rolling hills. BSF1 is considered to have a moderate potential for further archaeological deposits due to the number of artefacts found with a corresponding low ground surface visibility, as well as its landscape setting and association with the nearby water course. Artefacts located included chert, tuff, basalt and quartz material, a silcrete retouched axe head and quartz round grindstone. Given its location on the creek that (to the south) contains a site also considered to be an occupation site (BSF14) indicating extended or repeated use, and its subsurface potential, it is considered likely that BSF1 may be part of a complex of occupation sites along the creek beginning at BSF1 and continuing south through BSF14 to BSF22.	 	Yes
BSF2	SU32	Plain	**Artefact Scatter** This small artefact scatter of approximately six stone artefacts, including silcrete and basalt flakes and cores, and potentially a quartzite grindstone is located across an area of approximately 75 m (east to west) by 25 m (north to south). The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.		No

Site	Survey Unit	Landform	Description		Associated PAD
			The site may have been formed as a result of wash down from the nearby hill to the south.		
BSF3	SU30	Upper Slope	**Artefact Scatter** This small artefact scatter of four stone artefacts, including dilite/diorite flakes was identified by RAPS on a slope near the hillcrest on a track. It is located across an area of approximately 75 m (east to west) by 25 m (north to south). The site is located on an upper slope set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified. The site may have been formed as a result of wash down from the nearby hill top.		No
BSF4	SU31	Plain	**Isolated Find** Broken Granite manuport artefact. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.		No
BSF5	SU14	Plain	**Scarred Tree** During the survey RAPs identified a felled scarred tree located within proximity to another standing but dead scarred tree (BSF6). The oval shaped scar was approximately 1.4 m in length and 40 cm wide. The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.		No

Site	Survey Unit	Landform	Description		Associated PAD
BSF6	SU14	Plain	**Scarred Tree** During the survey RAPs identified a standing (but dead) scarred tree, with an oval shaped scar. Within proximity to another felled scarred tree (BSF5). The oval shaped scar was approximately 1.2 m in length and 25 cm wide. The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.		No
BSF7	SU30	Mid Slope	**Isolated Find** Silcrete core located on slope set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.		No
BSF8	SU28	Mid Slope	**Artefact Scatter** Small artefact scatter consisting of at least seven blue chert flakes scattered within a 3 m x 5 m area may have been formed as the result of a single knapping event. The site is located on a slope set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.		No

Site	Survey Unit	Landform	Description		Associated PAD
BSF9	SU29	Plain	**Large Artefact Scatter / Open Camp** This site comprises a widespread surface artefact scatter evident along a track and yard across an area of approximately 500 m (north to south) by 100 m (east to west), the site also contains an associated scar tree. There is no evidence for subsurface material and it is possible that the site could have been caused by wash down from the nearby hill to the west of from the nearby occupation sites at BSF1 and BSF14. It is located near creek line and on a vehicle access track. The site is located on a plain set in a wider landscape context of rolling hills. The site contains more than 40 artefacts which are mostly flakes including silcrete, chert, and quartz, flakes; basalt and tuff artefacts were also identified. The site associated with a scar tree identified by RAPs during survey which has been recorded as part of the site. Given its location near the creek that (to the north and south) contains a sites that are considered to be occupation sites (BSF1 and BSF14), it is considered likely that BSF9 may form part of an area of wider occupation sites at BSF1 and continuing south through BSF 9, BSF14, and BSF22.	 	No

Site	Survey Unit	Landform	Description		Associated PAD
BSF10	SU29	Plain	**Artefact Scatter** Small artefact scatter, comprising 2 x basalt hammerstones. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.	 	No

Site	Survey Unit	Landform	Description		Associated PAD
BSF11	SU26	Plain	**Scarred Tree** During the survey RAPs identified a standing, live, scarred tree. The roughly oval shaped scar was approximately 1 m in length, 40 cm wide, and very close to the ground. The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.		No
BSF12	SU29	Plain	**Isolated Find** Silcrete core located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.		No

Site	Survey Unit	Landform	Description		Associated PAD
BSF13	SU29	Plain	**Isolated Find** Silcrete core located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.		No
BSF14	SU25	Plain	**Large Artefact Scatter / Open Camp** This site comprises a high number of stone artefacts. It is not likely that all surface artefacts were identified and recorded at this site, however more than 50 artefacts were noted, across an area of approximately 110 m (east to west) by 330 m (north to south). Located along and extending between two small creek lines and vehicle access track. The site is located on a plain set in a wider landscape context of rolling hills. The site is considered to have a high potential for further archaeological deposits due to the number of artefacts found with a corresponding low ground surface visibility, as well as its landscape setting and association with the nearby water course. Sub-surface artefacts were visible in the soil profile along eroded creek line at southern end of site. Artefacts located included chert, granite, basalt and quartz material. Given its location on the creek that (to the south) contains a site also considered to be an occupation site (BSF14) indicating extended or repeated use, and its subsurface potential, it is considered likely that BSF1 may be part of a complex of occupation sites along the creek beginning at BSF1 and continuing south through BSF14 to BSF22. It is not likely that all surface artefacts were identified and recorded at this site, however more than 50 artefacts were noted, across an		Yes

Site	Survey Unit	Landform	Description		Associated PAD
			area of approximately 350 m (east to west) by 200 m (north to south).		
BSF15	SU15	Plain	**Artefact Scatter** This site comprises1 x silcrete flake and 1 x broken silcrete hammerstone. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.	 	No
BSF16	SU16	Plain	**Artefact Scatter** This site comprises1 x silcrete flake and 1 x silcrete hammerstone. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.		No

Site	Survey Unit	Landform	Description		Associated PAD
BSF17	SU23	Mid Slope	**Artefact scatter** This site comprises approximately eight stone artefact including blue chert flakes, silcrete flakes and one core, across an area of approximately 80 m (NW to SE) by 30 m (SW to NE). The site is located on a slope set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified. The site may have been formed as a result of wash down from BSF14 which is nearby to the north.		No
BSF18	SU22	Plain	**Scarred Tree** During the survey RAPs identified a standing, live, scarred tree. The oval shaped scar was approximately 1.7 m in length, 40 cm wide, and had significant overgrowth. The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.		No

Site	Survey Unit	Landform	Description		Associated PAD
BSF19	SU8	Plain	**Scarred Tree** During the survey RAPs identified a standing, live, scarred tree with a 1.5 m (length) narrow scar that was approximately 40 cm from the ground and showed significant overgrowth. The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.		No
BSF20	SU7	Plain	**Artefact Scatter** This site comprises a three chert flakes. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified. The site may have been formed as a result of wash down from larger sites, such as BSF14 which is along the same creek line to the north.		No

Site	Survey Unit	Landform	Description		Associated PAD
BSF21	SU24 & SU 27	Plain	**Artefact Scatter** This site comprises five stone artefacts, including a quartz flake, a large coarse grained flake with evidence for retouch, a large blue/grey coarse grained flake, a chert flake displaying at least 50% cortex, and a basalt axe. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified. The site may have been formed as a result of wash down from nearby sites along the creek to the north (such as BSF14) or from a small lightly wooded rise immediately to its north, although no artefacts were identified on the rise.		No
BSF22	SU22	Plain	**Artefact Scatter** This site comprises a small artefact scatter with approximately 20 artefacts across a ground surface area on approximately 50 m (NW to SE) by 30 m (SW to NE). The site contains mostly basalt flakes and cores, and at least one chert flake. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified. The site is considered to have potential for further archaeological deposits due to noted evidence for sub-surface artefacts in the soil profile in the eroded creek line along the western edge of site. The presence of the site on the high bank of a creek that (further to the north) contains occupation sites indicating extended or repeated use, and its noted subsurface potential means that it may also be an occupation site and a southern extension of what may be a complex of occupation sites along the creek beginning at BSF1 and continuing south through BSF14 to BSF22.	 	Yes

Site	Survey Unit	Landform	Description		Associated PAD
BSF23	SU5	Crest/Upper Flat	**Artefact Scatter** This site comprises two artefacts a smooth grained modified stone artefact and a granite hammerstone. The site is located on a rocky upper flat set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.		No
BSF24	SU25	Plain	**Artefact Scatter** This site comprises a small artefact scatter of four fine grained (possibly chert) flakes across an area 75 m 40 m. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified. The site may have been formed as a result of wash down from nearby sites along the creek to the north (such as BSF14).		No
BSF25	SU24	Mid Slope	**Artefact Scatter** This site comprises two artefacts, 1 x basalt hammerstone and 1 x granite axe. The site is located on a slope set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified. The site may have been formed as a result of wash down from nearby sites and terraced landforms to the west.		No

Site	Survey Unit	Landform	Description		Associated PAD
BSF26	SU24	Plain	**Isolated Find** This site comprises a silcrete flake. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.		No
BSF27	SU24	Plain	**Artefact Scatter** This site comprises a small artefact scatter of eight stone artefacts including five chert flakes, two basalt flakes and a hammerstone granite. The site is located in a ploughed field across an area of approximately 25 m (SW to NE) by 50 m (NW to SE), on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.		No
BSF28	SU21	Plain	**Artefact Scatter** This site comprises a small artefact scatter of three artefacts with a chert, and quartz flakes identified and a quartzite core, across an area of approximately 110 m (SW to NE) by 50 m (NW to SE). The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified. The site may have been formed as a result of wash down from nearby sites along the creek to the north (such as BSF14).		No

Site	Survey Unit	Landform	Description		Associated PAD
BSF29	SU5	Plain	**Scarred Tree** During the survey RAPs identified a standing, but dead, scarred tree. The long oval shaped scar was approximately 2 m in length and 40 cm wide. The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.		No
BSF30	SU1	Plain	**Isolated Find** This site comprises a granite artefact. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.		No

Site	Survey Unit	Landform	Description		Associated PAD
BSF31	SU1	Plain	**Isolated Find** This site comprises a grindstone. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.		No
BSF32	SU4	Plain	**Artefact scatter –** This site comprises a small artefact scatter, 1 x basalt scraper and 1 x basalt flake. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.		No
BSF33	SU4	Plain	**Artefact scatter** – This site comprises a small artefact scatter, 1 x fine-grained core and 1 x basalt core. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.		No

Site	Survey Unit	Landform	Description		Associated PAD
BSF34	SU2	Mid Slope	**Isolated Find** This site comprises a grindstone. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.		No
BSF35	SU2	Plain	**Artefact scatter** This site comprises a small artefact scatter comprising 3 x blue chert flakes identified in ploughed field located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.		No

7.2.3.2 Historic Heritage

Two areas with historical items were observed during the field survey:

- A surface scatter of several miscellaneous historical items; and
- A smaller surface scatter of glass bottles to the north of the first surface scatter.

The surface scatter of historical items (refer to *Photographs 7.4* to *7.7*) included three small ceramic fragments, car parts, bottle fragments, and other metal domestic items. The items were sparsely strewn across an area of approximately 25 m x 20 m on the high bank side of an unnamed small creek. Items appeared to approximately date from (after) the 1940s, which is evidenced by the presence of bottles labelled as property of the Australasian Pickle Company Ltd. There was no evidence of any previous structure at the site nor any indication of a PAD.

Photograph 7.4 Domestic dump site (ERM2018)

Photograph 7.5 Ceramic fragments at domestic dump site (ERM 2018)

Photograph 7.6 Car parts at domestic dump site (ERM 2018)

Photograph 7.7 Discarded bottle, inscriptions says "This bottle always remains the property of the Australasian Pickle Company Ltd" (ERM 2018)

The separate surface scatter of bottles, located approximately 230 m NNW of the domestic dump, consists of five complete bottles sitting on the ground surface (refer to *Photograph 7.8*). The bottles include:

- one brown glass long necked beer bottle;
- one clear cylindrical bottle labelled "Pick-me-up (regd trade mark)" "this bottle is the property of Pick-Me-Up Condiment Co. Ltd Sydney 1946"; and
- three oblong shaped clear bottles, one of which is labelled as "Clements Tonic" (refer to *Photograph 7.9*).

Given the date on the cylindrical bottle it is likely that this smaller bottle dump dates to a similar period as the domestic dump to the south (from/after the late 1940s). Frederick Moore Clements began manufacturing Clements Tonic in Newtown, Sydney in c.1886 and was commercially successful (Haines 1981). The product is still available today (though very likely uses a different formula than the original. The bottles were laying directly on top of the ground surface with no indication of further sub-surface items.

Photograph 7.8 Small bottle dump (ERM 2018)

Photograph 7.9 Clements Tonic bottle (ERM 2018)

8. SIGNIFICANCE ASSESSMENT

The heritage values significance assessment for the PA has been assessed in accordance with the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011), the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010) and the *Aboriginal cultural heritage consultation requirements for proponents* (DECCW 2010). This assessment encompasses the four values outlined in the *Burra Charter* (social, historical, scientific and aesthetic) (Australia ICOMOS 2013), as shown in *Figure 8.1*.

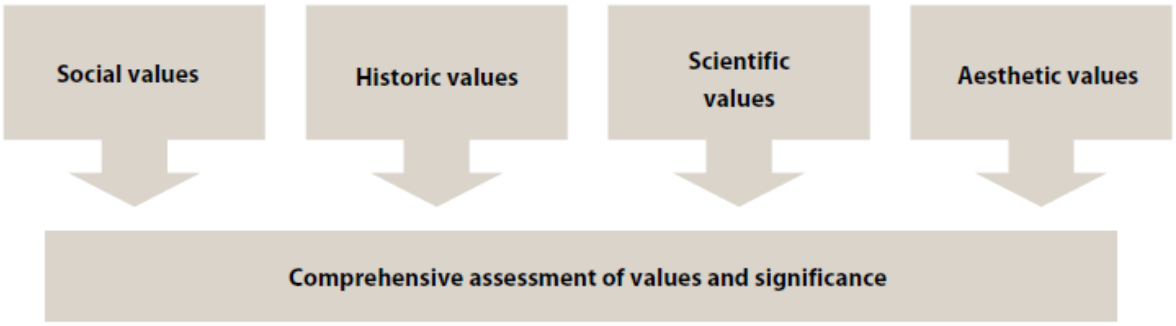


Figure 8.1 Diagrammatic Presentation of the Significance Assessment Process (OEH 2011)

8.1 Assessment of Aboriginal Cultural Significance

Aboriginal heritage sites, objects and places hold value for communities in many different ways. The nature of those heritage values is an important consideration when deciding how to manage a heritage site, object or place and balance competing land use options. Assessing the cultural significance of a place means identifying the reasons why a place is culturally important.

The OEH *Guideline for investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW* (2011) states that analysing cultural heritage significance involves two main steps:

- identifying the range of values present, including social, historic, scientific and aesthetic values; and
- assessing why they are important.

The Australia ICOMOS Burra Charter provides seven key criteria against which significance can be assessed, providing information about why sites are significant for the community. These criteria are identified as:

- *Rarity*: whether any or all aspects of a site (type, location, integrity, content and archaeological potential) can be considered common or rare within a local, regional or national context;
- *Representativeness*: the comparative rarity of the site when considered and contrasted against other similar sites conserved at the local and/or regional level;
- *Archaeological landscapes*: the study of the cultural sites relating to Aboriginal peoples within the context of their interactions in the wider social and natural environment they inhabited. Landscapes can be large or small depending upon specific contexts (i.e. local or regional conditions); they may also may be influenced by Aboriginal social and demographic factors (which may no longer be apparent);

- *Connectedness*: whether the site can be connected to other sites at the local or regional level through aspects such as type, chronology, content (i.e. materials present, manufacturing processes), spatial patterning or ethno-historical information;

- *Integrity & condition*: integrity refers to the level of modification a site has been subject to (the cultural and natural formation process) and whether the site could yield intact archaeological deposits, which could be spatially meaningful. Condition takes into account the state of the material, which is especially relevant for organic materials;

- *Complexity*: the demonstrated or potential ability of a site to yield a complex assemblage (stone, bone and/or shell) and/or features (hearths, fire pits, activity areas); and

- *Archaeological potential*: the potential to yield information (from sub-surface materials which retain integrity, stratigraphical or not) that will contribute to an understanding of contemporary archaeological interest, or which could be saved for future research potential.

The significance assessment presented in *this Section* and summarised in *Table 8.1* utilises these criteria.

8.1.1 Social Significance

Cultural/social significance concerns the value/s of a place, feature or site to a particular community group/s, in this case the local Aboriginal communities. Aspects of cultural or social significance are relevant to sites, objects and landscapes that are important or have become important to local Aboriginal communities. This importance involves both traditional links with specific areas as well as an overall concern by Aboriginal people for sites and their continued protection. As such, Aboriginal cultural significance can only be determined by the Aboriginal community.

During the field survey component of this assessment and in accordance with the relevant Aboriginal consultation guidelines, Aboriginal representatives were queried about the cultural significance (to individuals and the community more broadly) of the PA generally, specific locations within it and at identified sites. It was indicated by all RAP representatives that the PA holds a high level of cultural significance to Aboriginal people as it is situated within areas that were used for hunting, gathering and camping by past Aboriginal groups and therefore represents Aboriginal occupation of the region, a past way of life and a direct link to their ancestors. The wider landscape, particularly the flora, fauna and water courses associated with the PA are significant as they formed part of an economic resource environment.

The large and somewhat dense artefact scatters BSF1, BSF9, and BSF14 close to and extending along creek lines are thought by RAPs to represent large camping sites or meeting places.

8.1.2 Historic Significance

The PA has not demonstrated historic values of significance to the local Aboriginal community, as identified through consultation. Although the PA has been identified as holding cultural/social significance for the local Aboriginal community, the PA cannot be linked to specific historical events which are significant to the community.

8.1.3 Scientific Significance

The majority of areas of archaeological interest occurring in the PA are common site types within the region. Stone artefact sites including open camp sites (or artefact scatters) and isolated finds are the most common regional sites types, and that is reflected in the results of the field survey undertaken for the Project. The description of the low density scatters do not place them as of exceptionally high standard in terms of condition or content. They are therefore assessed as having a low archaeological significance.

The three largest artefact scatter / open camp sites are fairly artefact dense sites that all extend along and near creek lines and could represent extended or repeated occupation of the area. The sites may also be closely related and possible represent one large occupation site. BSF1 and BSF14 are associated with Potential Archaeological Deposits (PADs) and are particularly dense and contain stone artefacts that are not only the by-product of stone tool making and tool use but also several tools themselves, including hammerstones and a retouched axe head found at BSF1. BSF1 and BSF14 are therefore assessed as having moderate significance.

Scarred trees, while less common, are known to be found in the area. Seven scarred trees were identified by RAPs (during the surveys) (refer to *Figure 7.2* and *Table 7.5)*, however they do not present high scientific value due to the apparent age of the trees and relative commonness of the site type, and are assessed as having a low archaeological significance.

8.1.4 Aesthetic Significance

The stone artefact scatters identified within the PA do not reach the threshold of aesthetic significance and do not contribute to the aesthetic value of the broader landscape. The scarred trees identified have a moderate aesthetic value, as visual representations of cultural heritage practices of the local Aboriginal people.

8.2 Aboriginal Heritage Statement of Significance

The PA contains 36 Aboriginal sites and three associated PADs (35 recorded as part of this assessment). The majority of these sites are stone artefact sites including open camp sites and isolated finds. The sites recorded during this study have been assigned scientific significance in terms of rarity, representativeness, archaeological landscape, connectedness, integrity and condition, complexity, and archaeological sensitivity.

The significance rating of the identified stone artefact sites is higher or lower based on the presence of particular stone artefact types, formal tool types, diverse or unusual raw stone materials and the potential for stratified subsurface deposits. The sites identified within the PA are common site types at a local and regional level. Stone artefact sites are the main site type represented in the region and those located within the PA have not demonstrated a significantly greater diversity or complexity in comparison to other known sites within the region. Scarred tree sites have also been identified as part of this assessment.

It is for this reason that all but two sites (BSF1 and BSF14) located within the PA have been assessed as having low archaeological significance (separate to cultural significance). Additionally, AHIMS Site #11-3-0083 (within the development footprint) was previously assessed as having moderate to low archaeological significance.

BSF1, BSF14, BSF22 and AHIMS #11-3-0083 are all within close proximity to watercourses and located within flat terrain with relative shelter from the elements (areas of known Aboriginal occupation) were identified as having moderate potential for subsurface archaeological deposits based on observations of possible subsurface artefacts in soil profiles. These areas incorporate prominent landscape types within the PA (i.e. flat terrain and slightly sloping areas near a water source). Such areas are likely to contain as yet unrecorded Aboriginal sites and/or objects. Careful detailed design of the solar farm following initial heritage survey results has successfully avoided these two sites, however BSF22 and AHIMS #11-3-0083 may still be impacted by the Project. Given the BSF22's proximity to other significant sites (BSF1 and BSF14) thought to indicate extended or repeated occupation on the banks of the same creek as BSF22 to the north, it is possible that though the surface expression of artefacts at BSF22 is less dense than at sites to the north (BSF1, BSF9, and BSF14), it may also be an occupation site and a southern extension of what may be a complex of occupation sites along the creek.

Table 8.1 Summary Significance of Aboriginal Heritage Sites

Site ID	Social Significance	Historical Significance	Scientific Significance	Aesthetic Significance	Overall Significance Level
BSF1	It is considered that all Aboriginal sites are significant to the local Aboriginal community. No specific comments have been received regarding the social significance of this site. **Significance: High**	BSF1 **does not** meet the threshold for significance under this criterion.	BSF1 is a large artefact scatter containing formal tool types and has been assessed as having potential to contain subsurface archaeological material, and therefore may have some research value. It has been identified in proximity two other large scatters long a creek line indicating it may be part of a larger complex. **Significance: Moderate**	BSF1 **does not** meet the threshold for significance under this criterion.	**Moderate**
BSF2	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF2 **does not** meet the threshold for significance under this criterion.	BSF2 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF2 **does not** meet the threshold for significance under this criterion.	**Low**
BSF3	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF3 **does not** meet the threshold for significance under this criterion.	BSF3 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF3 **does not** meet the threshold for significance under this criterion.	**Low**
BSF4	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF4 **does not** meet the threshold for significance under this criterion.	BSF4 consists of a single manuport stone, transported in the landscape by human action. **Significance: Low**	BSF4 **does not** meet the threshold for significance under this criterion.	**Low**

Site ID	Social Significance	Historical Significance	Scientific Significance	Aesthetic Significance	Overall Significance Level
BSF5	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF5 **does not** meet the threshold for significance under this criterion.	BSF5 is a felled scarred tree identified by RAPs. The site type is relatively common in the region. **Significance: Low**	BSF5 is a visual representation of cultural heritage practices of the local Aboriginal people. **Significance: Moderate**	**Moderate**
BSF6	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF6 **does not** meet the threshold for significance under this criterion.	BSF6 is a scarred tree identified by RAPs. The site type is relatively common in the region. **Significance: Low**	BSF6 is a visual representation of cultural heritage practices of the local Aboriginal people. **Significance: Moderate**.	**Moderate**
BSF7	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF7 **does not** meet the threshold for significance under this criterion.	BSF7 consists of an isolated stone artefact, which holds very little research potential and is unlikely to assist in demonstrating depositional processes or land usage. **Significance: Low**	BSF7 **does not** meet the threshold for significance under this criterion.	**Low**
BSF8	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF8 **does not** meet the threshold for significance under this criterion.	BSF8 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF8 **does not** meet the threshold for significance under this criterion.	**Low**
BSF9	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF9 **does not** meet the threshold for significance under this criterion.	BSF9 is a large artefact that has been identified in proximity (between) two other large scatters near a creek line indicating it may be part of a larger complex. **Significance: Low**	The scarred tree at BSF9 is a visual representation of cultural heritage practices of the local Aboriginal people. **Significance: Moderate**	**Moderate**

Site ID	Social Significance	Historical Significance	Scientific Significance	Aesthetic Significance	Overall Significance Level
BSF10	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF10 **does not** meet the threshold for significance under this criterion.	BSF10 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF10 **does not** meet the threshold for significance under this criterion.	**Low**
BSF11	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF11 **does not** meet the threshold for significance under this criterion.	BSF11 is a scarred tree identified by RAPs. The site type is relatively common in the region. **Significance: Low**	BSF **11** is a visual representation of cultural heritage practices of the local Aboriginal people. **Significance: Moderate**	**Moderate**
BSF12	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF12 **does not** meet the threshold for significance under this criterion.	BSF12 consists of an isolated stone artefact, which holds very little research potential and is unlikely to assist in demonstrating depositional processes or land usage. **Significance: Low**	BSF12 **does not** meet the threshold for significance under this criterion.	**Low**
BSF13	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF13 **does not** meet the threshold for significance under this criterion.	BSF13 consists of an isolated stone artefact, which holds very little research potential and is unlikely to assist in demonstrating depositional processes or land usage. **Significance: Low**	BSF13 **does not** meet the threshold for significance under this criterion.	**Low**
BSF14	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF14 **does not** meet the threshold for significance under this criterion.	BSF14 is a large artefact scatter containing formal tool types and has been assessed as having potential to contain subsurface archaeological material, and therefore may have some research value. It has been identified in proximity two other large scatters long a creek line indicating it may be part of a larger complex. **Significance: Moderate**	BSF14 **does not** meet the threshold for significance under this criterion.	**Moderate**

Site ID	Social Significance	Historical Significance	Scientific Significance	Aesthetic Significance	Overall Significance Level
BSF15	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF15 **does not** meet the threshold for significance under this criterion.	BSF15 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF15 **does not** meet the threshold for significance under this criterion.	**Low**
BSF16	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF16 **does not** meet the threshold for significance under this criterion.	BSF16 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF16 **does not** meet the threshold for significance under this criterion.	**Low**
BSF17	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF17 **does not** meet the threshold for significance under this criterion.	BSF17 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF17 **does not** meet the threshold for significance under this criterion.	**Low**
BSF18	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF18 **does not** meet the threshold for significance under this criterion.	BSF18 is a scarred tree identified by RAPs. The site type is relatively common in the region. **Significance: Low**	BSF18 is a visual representation of cultural heritage practices of the local Aboriginal people. **Significance: Moderate**	**Moderate**
BSF19	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF19 **does not** meet the threshold for significance under this criterion.	BSF19 is a scarred tree identified by RAPs. The site type is relatively common in the region. **Significance: Low**	BSF19 is a visual representation of cultural heritage practices of the local Aboriginal people. **Significance: Moderate**	**Moderate**

Site ID	Social Significance	Historical Significance	Scientific Significance	Aesthetic Significance	Overall Significance Level
BSF20	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF20 **does not** meet the threshold for significance under this criterion.	BSF20 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF20 **does not** meet the threshold for significance under this criterion.	**Low**
BSF21	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF21 **does not** meet the threshold for significance under this criterion.	BSF21 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF21 **does not** meet the threshold for significance under this criterion.	**Low**
BSF22	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF22 **does not** meet the threshold for significance under this criterion.	BSF22 presents a common low density scatter which has low potential to contribute to archaeological research in the region, however it has been assessed as having potential to contain subsurface archaeological material, and therefore may have some research value. **Significance: Moderate - Low**	BSF22 **does not** meet the threshold for significance under this criterion.	**Moderate to Low**
BSF23	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF23 **does not** meet the threshold for significance under this criterion.	BSF23 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF23 **does not** meet the threshold for significance under this criterion.	**Low**
BSF24	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF24 **does not** meet the threshold for significance under this criterion.	BSF24 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF24 **does not** meet the threshold for significance under this criterion.	**Low**

Site ID	Social Significance	Historical Significance	Scientific Significance	Aesthetic Significance	Overall Significance Level
BSF25	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF25 **does not** meet the threshold for significance under this criterion.	BSF25 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF25 **does not** meet the threshold for significance under this criterion.	**Low**
BSF26	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF26 **does not** meet the threshold for significance under this criterion.	BSF26 consists of an isolated stone artefact, which holds very little research potential and is unlikely to assist in demonstrating depositional processes or land usage. **Significance: Low**	BSF26 **does not** meet the threshold for significance under this criterion.	**Low**
BSF27	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF27 **does not** meet the threshold for significance under this criterion.	BSF27 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF27 **does not** meet the threshold for significance under this criterion.	**Low**
BSF28	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF28 **does not** meet the threshold for significance under this criterion.	BSF28 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF28 **does not** meet the threshold for significance under this criterion.	**Low**
BSF29	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF29 **does not** meet the threshold for significance under this criterion.	BSF29 is a scarred tree identified by RAPs. The site type is relatively common in the region. **Significance: Low**	BSF29 is a visual representation of cultural heritage practices of the local Aboriginal people. **Significance: Moderate**.	**Moderate**

Site ID	Social Significance	Historical Significance	Scientific Significance	Aesthetic Significance	Overall Significance Level
BSF30	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF30 **does not** meet the threshold for significance under this criterion.	BSF30 consists of an isolated stone artefact, which holds very little research potential and is unlikely to assist in demonstrating depositional processes or land usage. **Significance: Low**	BSF30 **does not** meet the threshold for significance under this criterion.	**Low**
BSF31	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF31 **does not** meet the threshold for significance under this criterion.	BSF31 consists of an isolated stone artefact, which holds very little research potential and is unlikely to assist in demonstrating depositional processes or land usage. **Significance: Low**	BSF31 **does not** meet the threshold for significance under this criterion.	**Low**
BSF32	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF32 **does not** meet the threshold for significance under this criterion.	BSF32 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF32 **does not** meet the threshold for significance under this criterion.	**Low**
BSF33	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF33 **does not** meet the threshold for significance under this criterion.	BSF33 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF33 **does not** meet the threshold for significance under this criterion.	**Low**
BSF34	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF34 **does not** meet the threshold for significance under this criterion.	BSF34 consists of an isolated stone artefact, which holds very little research potential and is unlikely to assist in demonstrating depositional processes or land usage. **Significance: Low**	BSF34 **does not** meet the threshold for significance under this criterion.	**Low**

Site ID	Social Significance	Historical Significance	Scientific Significance	Aesthetic Significance	Overall Significance Level
BSF35	It is considered that all Aboriginal sites are significant to the local Aboriginal community. **Significance: High**	BSF35 **does not** meet the threshold for significance under this criterion.	BSF35 presents a common low density scatter which has low potential to contribute to archaeological research in the region. **Significance: Low**	BSF35 **does not** meet the threshold for significance under this criterion.	**Low**
AHIMS Site #11-3-0083	It is considered that all Aboriginal sites are significant to the local Aboriginal community. The 2011 report (OzArk EHM) assessed this site as being of moderate to high cultural significance. **Significance: Moderate - High**	11-3-0083 **does not** meet the threshold for significance under this criterion.	The 2011 report (OzArk EHM) assessed this site as being of low to moderate scientific cultural significance. **Significance: Moderate - Low**	11-3-0083 **does not** meet the threshold for significance under this criterion.	**Moderate**

8.3 Assessment of Historic Heritage Significance

Two surface scatters of historical items were identified during the 2018 surveys, however no research into these sites has been undertaken. As these sites are fairly sparse scatter with limited historic artefacts and no evidence for structures or subsurface expressions were noted during the survey, it is considered that these are dumpsites that were utilised once (or twice) by a local household sometime in the last 70 years. No items identified are considered rare or representative, or of containing any value for further research. It is considered likely that other properties in the area contain similar sites. Although the identification of five complete historic glass bottles is interesting, these sites are not considered to reach the threshold for local historic heritage significance.

9. IMPACT ASSESSMENT

The proposed works involve the following actions that have the potential to impact on Aboriginal heritage sites and values:

- site establishment including the provision of access and construction compounds and laydown areas/material storage facilities;
- topsoil stripping and stockpiling in windrows along the edge of the trench;
- trench excavation and stockpiling of the spoil on the opposite side to the topsoil;
- installation of a sand bed layer;
- laying of conductor and earth cables, incorporating direct bury of cable joints (located approximately every 500 m to 1000 m) and marking of those with electronic marker devises; and
- trench reinstatement consisting of placement of sand coverage of cables, installation of a hard cover, then backfilling/compaction of spoil and respread of topsoil;
- the grading of roads and upgrading of existing access roads;
- vehicle movement across eroded tracks;
- the development of new access roads;
- clearance of vegetation;
- the construction of hardstands and laydown areas; and
- on-site equipment storage areas for the construction period.

36 Aboriginal heritage sites (and three associated PADs) have been recorded within the PA. 30 of these sites were stone artefacts including isolated finds and stone artefact scatters. Seven scarred trees were also identified, one of the scarred trees was identified as part of an artefact scatter site. Careful detailed design of the Project footprint has successfully avoided several of these sites, including BSF1 and BSF14 which are considered to have moderate archaeological significance (refer to *Table 9.1* and *Figure 9.1*).

As the Project is still at concept design phase, and no detailed positioning of solar arrays has been developed, there remains some uncertainty around impact to a number of identified Aboriginal heritage sites. It is evident that these sites are within the Project footprint; however, careful avoidance measures applied and integrated at detailed design phase could avoid smaller artefact scatters or isolated finds. In order to facilitate this process, a detailed methodology for avoidance and procedures for surface collection, test excavation and archaeological salvage will be written into the Cultural Heritage Management Plan. Where impact to sites is possible, but has not been confirmed, these sites have been identified as 'Potentially Impacted'.

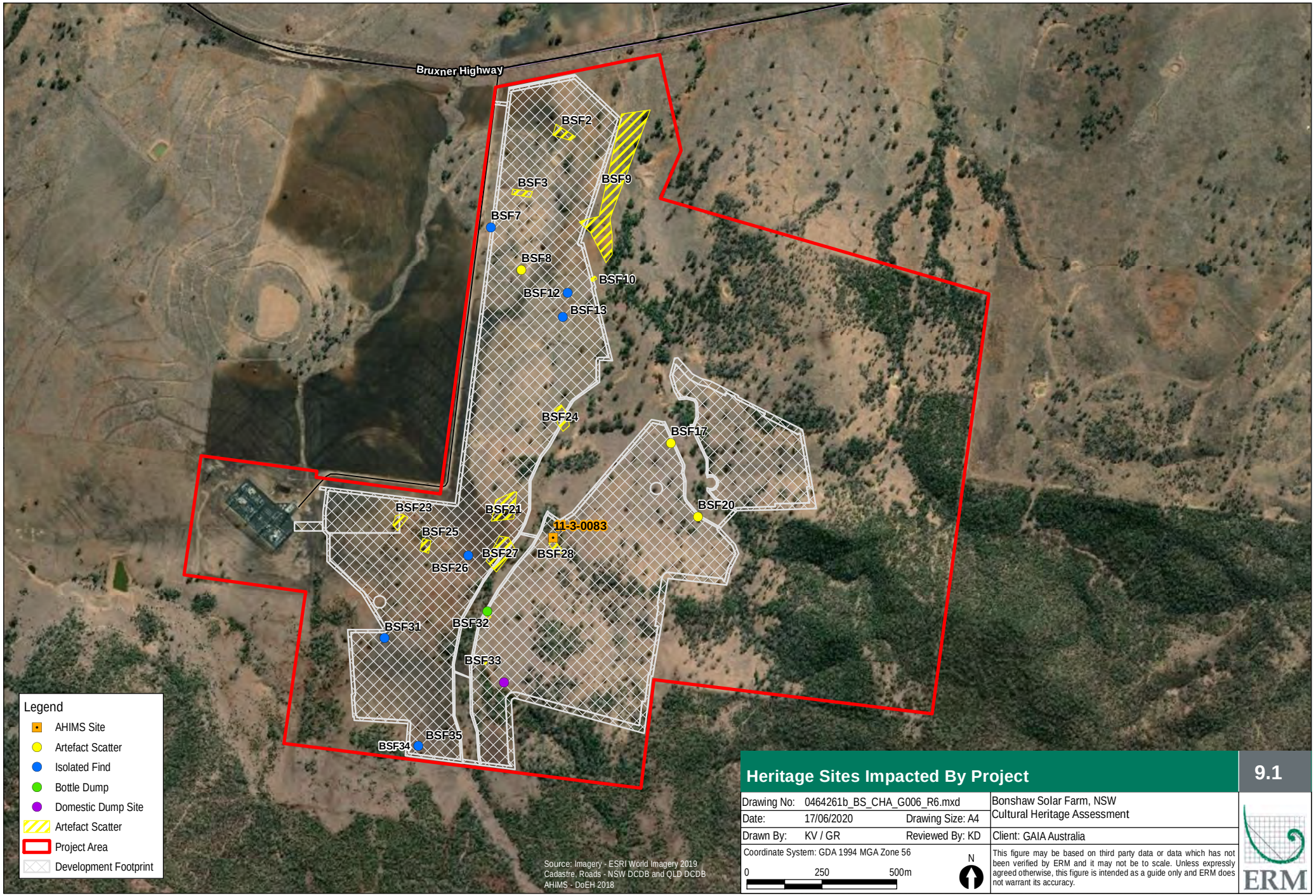
All scarred trees within the Project footprint will be avoided during detailed design phase and no harm will result from proposed works.

Table 9.1 Summary Impact Assessment of Aboriginal Heritage Sites

Site ID	AHIMS	Overall Significance Level	Assessment of Potential Impact
BSF1	TBD	Moderate	No Impact Careful detailed design of the development footprint has successfully avoided this site and PAD
BSF2	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF3	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF4	TBD	Low	No Impact Careful detailed design of the development footprint has successfully avoided this site
BSF5	TBD	Moderate	No Impact Careful detailed design of the development footprint has successfully avoided this scarred tree
BSF6	TBD	Moderate	No Impact Careful detailed design of the development footprint has successfully avoided this scarred tree
BSF7	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF8	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF9	TBD	Moderate	Partial Impact Careful detailed design of the development footprint has successfully avoided most of this site, however a small section of the site may be impacted
BSF10	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF11	TBD	Moderate	No Impact Careful detailed design of the development footprint has successfully avoided this scarred tree
BSF12	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF13	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF14	TBD	Moderate	No Impact Careful detailed design of the development footprint has successfully avoided this site and PAD
BSF15	TBD	Low	No Impact Careful detailed design of the development footprint has successfully avoided this site
BSF16	TBD	Low	No Impact Careful detailed design of the development footprint has successfully avoided this site

Site ID	AHIMS	Overall Significance Level	Assessment of Potential Impact
BSF17	TBD	Low	Partial Impact Careful detailed design of the development footprint has successfully avoided most of this site, however a small section of the site may be impacted
BSF18	TBD	Moderate	No Impact Careful detailed design of the development footprint has successfully avoided this scarred tree
BSF19	TBD	Moderate	No Impact Careful detailed design of the development footprint has successfully avoided this scarred tree
BSF20	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF21	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF22	TBD	Low	No Impact Careful detailed design of the development footprint has successfully avoided this site
BSF23	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF24	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF25	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF26	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF27	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF28	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF29	TBD	Moderate	No Impact Careful detailed design of the development footprint has successfully avoided this scarred tree
BSF30	TBD	Low	No Impact Careful detailed design of the development footprint has successfully avoided this site
BSF31	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF32	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF33	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.

Site ID	AHIMS	Overall Significance Level	Assessment of Potential Impact
BSF34	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF35	TBD	Low	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
Tenterfield-Dumaresq OS14	11-3-0083	Moderate	Potential Impact Artefact scatter may be impacted by project works. Avoidance measures have been recommended.



Heritage Sites Impacted By Project

9.1

Drawing No:	0464261b_BS_CHA_G006_R6.mxd		Bonshaw Solar Farm, NSW Cultural Heritage Assessment
Date:	17/06/2020	Drawing Size: A4	
Drawn By:	KV / GR	Reviewed By: KD	Client: GAIA Australia

Coordinate System: GDA 1994 MGA Zone 56

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

10. CONCLUSIONS AND RECOMMENDATIONS

10.1 Conclusions

36 Aboriginal heritage sites and three associated PADs have been recorded within the PA. 30 of these sites were stone artefacts including isolated finds and stone artefact scatters. Seven scarred trees were also identified, one of the scarred trees was identified as part of an artefact scatter site. Careful detailed design of the Project footprint has successfully avoided nine of these sites, including BSF1 and BSF14 which are considered to have moderate archaeological significance.

10.2 Recommendations

The following recommendations are made to assist in ongoing management of identified heritage sites. The management recommendation statements are made in light of:

- the results of background desktop investigation as outlined in this report;
- predictive modelling;
- results of the field survey;
- a heritage significance assessment;
- legislative requirements as outlined in this report; and
- consultation with the relevant Aboriginal organisations.

10.2.1 Aboriginal Heritage

Based on the information presented in this report, specific recommendations for each identified Aboriginal site is detailed in *Table 10.1* and the following general recommendations have been developed:

- personnel involved with ground breaking activities in the PA should undertake cultural awareness training in line with the recommendations below;
- during works, the location of all recorded Aboriginal heritage sites should be clearly marked on all construction plans for the PA, physically and visibly demarcated on the ground, and site foremen informed of their presence and the need to avoid disturbance;
- if suspected Aboriginal heritage objects are found during works, the Unexpected Find Procedure outlined below should be followed and applies to the entire PA;
- continuing Aboriginal involvement in the Bonshaw Solar Farm project. Ongoing consultation with the Aboriginal community and registered Aboriginal stakeholders for the Project should occur during the construction of the Project. The triggers for consultation with the community during construction may include:
- Additional heritage assessments for any changes in Project scope;
- The implementation of the Unexpected Finds Procedure;
- Preparation of a Cultural Heritage Management Plan (CHMP) for implementation during construction;
- Endorsement by RAPs of the heritage information to be contained in the Project induction material;
- a copy of this report should be provided to each of the Aboriginal organisations who expressed an interest in the Project; and
- a copy of this report should be provided to the relevant OEH regional branch.

10.2.1.1 Cultural Awareness Training

In order to comply with best practice principles, it is recommended that any personnel involved with ground breaking activities in the PA undertake basic cultural awareness training. This training should be carried out in the form of a pre-work workshop by a qualified heritage specialist in consultation with a Aboriginal Stakeholders, or by a relevant Aboriginal Stakeholder. The heritage induction material, including an unexpected finds procedure should be developed by an appropriately qualified heritage specialist. This training should:

- include information on the Aboriginal archaeological and cultural heritage values of the PA;
- legal responsibilities and statutory obligations for heritage under the NPW Act and the Heritage Act;
- outline the location and type of archaeological sites within the PA including significant landforms and give instructions not to disturb these sites;
- outline the procedures for the discovery of previously unrecorded Aboriginal objects, through the chance finds procedure; and
- only information endorsed for sharing by the registered Aboriginal stakeholders should be included within the induction package for all workers.

10.2.1.2 Unexpected Finds Procedure

If any heritage objects and/or relics, as protected under NSW legislation, are uncovered during the Project, then the following steps should be followed:

- all activity in the immediate area should cease;
- an area of 2 m surrounding the find should be cordoned off with hazard tape to avoid further disturbance;
- an appropriately qualified archaeologist should be consulted;
- OEH should be immediately contacted;
- If the find consists of Aboriginal cultural heritage, the local Aboriginal stakeholder groups should be notified; and
- an appropriately qualified archaeologist should record the location and attributes of the site and determine the significance of the find.

Additional unexpected finds protocols relating to Historical Heritage finds are detailed in *Section 10.2.2*.

In the event of the discovery of human skeletal material (or suspected human skeletal material) during project activities in the PA the following steps should be followed:

- all activities and/or works in the immediate area must cease;
- the NSW Police must be contacted along with the OEH; and
- any sand/soils removed from the near vicinity of the find must be identified and set aside for assessment by the investigating authorities.

10.2.1.3 Aboriginal Community Endorsement and Recommendations

A draft copy of the CHA report was provided to all Aboriginal parties who registered an interest in the project on 9 May 2019, for the purposes of receiving written or oral general comments and more specific comments on the cultural significance of the PA and the identified sites and the recommended management and mitigation measures in the ACHA. Feedback was received from two of the RAPs (also refer to *Section 3.4* and *Appendix A*).

10.2.1.4 Cultural Heritage Management Plan

In addition to the cultural heritage induction for contractors, ERM recommends that a Cultural Heritage Management Plan (CHMP) be prepared prior to construction commencing. The CHMP would respond to statutory requirements and Conditions of Consent to ensure appropriate management of cultural heritage during the course of construction and operation of the Project. The CHMP would include protocol for surface collection and salvage, test or salvage excavations, and construction monitoring (as required). The CHMP would also provide a methodology for physical demarcation of sites prior to construction commencing, allowing for RAP participation in this process to ensure all significant cultural heritage sites are appropriately managed.

The CHMP should be prepared in consultation with the RAPs and should be endorsed by all RAP groups prior to finalisation.

10.2.1.5 Dissemination of Information

It is recommended that a copy of the final report be provided to each of the Aboriginal organisations who participated in the project. A copy of this report is to be provided to OEH upon finalisation.

10.2.1.6 Identified Aboriginal Heritage Sites

Direct harm to some sites listed in *Table 10.1* is considered unavoidable. A large number of individual artefacts were identified in the sites listed in *Table 10.1*. It is considered that the cumulative impacts resulting from harm to the sites has the potential to significantly and negatively impact on the Aboriginal cultural heritage values of the area. Therefore, it is considered essential to develop management strategies to minimise this impact as far as possible.

The management measures proposed in *Table 10.1* were formulated during discussions on site with Aboriginal representatives. The recommended mitigation of these direct impacts is to facilitate salvage of artefacts prior to harm occurring, followed by reburial (return to country) outside of impact areas, as close to original location as possible. This management strategy has been formulated with consideration of principles of Ecologically Sustainable Development (ESD), in particular intergenerational equity that holds that various aspects of the environment (including cultural heritage) are available for the benefit of future generations.

If impact to BSF22 is unavoidable it is recommended that subsurface testing be carried out to identify the nature and extent of sub-surface Aboriginal objects at the site in accordance with the *Code of Practice*. The presence of the site on the high bank of a creek that (further to the north) contains occupation sites indicating extended or repeated use, and its noted subsurface potential means that it may also be an occupation site and a southern extension of what may be a complex of occupation sites along the creek beginning at BSF1 and continuing south through BSF14 to BSF22. Test excavations at this site may contribute to the understanding of site characteristics and local and regional prehistory. It may also be used to better inform mitigation measures within the PA.

Where there is a time lapse between collection of artefacts and associated reburial, it is proposed that the Project archaeologist undertaking the artefact collection retain any collected artefacts until such time as they can be reburied.

Note that management measures would be carried out in accordance with the SEARS, and any requirements of the RAPs and the OEH, and therefore the specifics may differ from that presented below.

Table 10.1 Management Measures for identified Aboriginal Heritage Sites

Site ID	Overall Significance Level	Potential Impact?	Management Measure
BSF1	Moderate	No	**Avoidance.** Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF2	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF3	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF4	Low	No	**Avoidance.** Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF5	Moderate	No	**Avoidance.** Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF6	Moderate	No	**Avoidance.** Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF7	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF8	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF9	Moderate	Partial	**Avoidance.** Prior to construction commencing, exclusion fencing and exclusion signage should be erected, around the section of the site that will not be impacted by project works and the scarred tree, by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed. It is recommended that if proposed project works cannot avoid the entire site that surface collection/salvage of the section of the site that will be impacted be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.

Site ID	Overall Significance Level	Potential Impact?	Management Measure
BSF10	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF11	Moderate	No	**Avoidance.** Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF12	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF13	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF14	Moderate	No	**Avoidance.** Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF15	Low	No	**Avoidance.** Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF16	Low	No	**Avoidance.** Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF17	Low	Partial	**Avoidance.** Prior to construction commencing, exclusion fencing and exclusion signage should be erected, around the section of the site that will not be impacted by project works and by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed. It is recommended that if proposed project works cannot avoid the entire site that collection/salvage of the section of the site that will be impacted be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.

Site ID	Overall Significance Level	Potential Impact?	Management Measure
BSF18	Moderate	No	**Avoidance.** Prior to construction commencing, exclusion fencing and exclusion signage should be erected around the scarred tree by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF19	Moderate	No	**Avoidance.** Prior to construction commencing, exclusion fencing and exclusion signage should be erected around the scarred tree by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF20	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF21	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF22	Moderate to Low	No	**Avoidance.** Prior to construction commencing, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed. It is recommended if proposed project works cannot avoid the entire site that subsurface testing be carried out to identify the nature and extent of subsurface Aboriginal objects at the site. Further to this, surface collection/salvage of the section of the site that will be impacted should be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF23	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF24	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF25	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF26	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF27	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF28	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.

Site ID	Overall Significance Level	Potential Impact?	Management Measure
BSF29	Moderate	No	**Avoidance.** Prior to construction commencing, exclusion fencing and exclusion signage should be erected around the scarred tree by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF30	Low	No	**Avoidance.** Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF31	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF32	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF33	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF34	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF35	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
11-3-0083	Moderate	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.

10.2.2 Historic Heritage

While the historic items identified during the this assessment have been assessed as not meeting the threshold for local historic heritage significance, the items at these sites should be carefully collected and offered to a local heritage museum or organisation prior to commencement of project works.

10.2.2.1 Unexpected Historic Heritage Finds Procedure

If any heritage objects and/or relics, as protected under NSW legislation, are uncovered during the Project, then the following steps should be followed:

- all activity in the immediate area should cease;
- and an appropriately qualified heritage professional should be consulted;
- OEH should be immediately contacted; and
- an appropriately qualified heritage professional should record the location and attributes of the site and determine the significance of the find.

In the event of the discovery of human skeletal material (or suspected human skeletal material) during project activities in the PA the following steps should be followed:

- all activities and/or works in the immediate area must cease;
- the NSW Police must be contacted along with the OEH; and
- any sand/soils removed from the near vicinity of the find must be identified and set aside for assessment by the investigating authorities.

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Unknown, (n.d).(Photograph)**Bonshaw Memorial Hall** url=https://trove.nla.gov.au/work/229575195 | accessdate=27 February 2019

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APPENDIX A ABORIGINAL STAKEHOLDER CONSULTATION LOG

AGENCIES CONTACTED

Body/Group	Contact Details	Date Sent	Response	Date
OEH Branch : Coffs Harbour	NSW Office of Environment and Heritage Federation House, 24 Moonee Street, Coffs Harbour NSW 2450 info@environment.nsw.gov.au	3/7/18 Via email and post	Refers ERM to contact Mr Craig Archibald and Mr Aaron Broad	11th July Via post
The Registrar, *Aboriginal Lands Right Act*	Office of the Registrar, Aboriginal Land Rights Act PO Box 112 Glebe NSW 2037 adminofficer@oralra.nsw.gov.au	3/7/18 Via email and post	No Registered Aboriginal Owners within project Area on the Register of Aboriginal Owners. Refers ERM to contact Toomelah Local Aboriginal Land Council	11th July Via email
National Native Title Tribunal (NNTT)	enquiries@nntt.gov.au	3/7/18 Via email and post	Overlap report	5/7/18 Via email
Native Title Services Corporation (NTS Corp)	Native Title Services Corporation PO Box 2105 Strawberry Hills NSW 2012 information@ntscorp.com.au	3/7/18 Via email and post		
Inverell Shire Council	Inverell Shire Council Administration Centre 144 Otho Street PO Box 138 Inverell NSW 2360	3/7/18 Via email and post	Referred to LALCs in the Inverell LGA	17th July 2018 Via post

Body/Group	Contact Details	Date Sent	Response	Date
Tenterfield Shire Council		3/7/18 Via email and post	Links to councils Aboriginal Heritage Study lists and relevant groups. Refers ERM to Moombahlene LALC	4/7/18 Via email
Local Land Services – Northern Tablelands	Local Land Services Northern Tablelands 15 Vivian Street PO Box 411 Inverell NSW harry.white@lls.nsw.gov.au	3/7/18 Via email and post	Refers ERM to Toomelah Local Aboriginal Land Council (in their region) Interested in providing quote to conduct detailed assessment.	4th July Via post
Moombahlene Local Aboriginal Land Council	299 Rouse St, Tenterfield NSW 2372 moombahlenelalc1@bigpond.com	3/7/18 Via email and post	Helen Duroux (CEO) Interested in taking part in the cultural assessments.	4/7/18 Email response

NEWSPAPER ADVERTISMENT

Newspaper	Contact	Date Sent	Date Published
Inverell Times	The Inverell Times t 0267 200 100 classifieds.invtimes@fairfaxmedia.com.au 166 Byron Street, Inverell, NSW 2360	03/07/2018	06/07/2018
Tenterfield Star	The Tenterfield Star t 02 6776 0501 classifieds.tentstar@fairfaxmedia.com.au	03/07/2018	11/07/2018

Newspaper	Contact	Date Sent	Date Published
	115 Faulkner Street, Armidale, NSW 2350 www.tenterfieldstar.com.au		

LIST OF STAKEHOLDERS GROUPS IDENTIFIED & PROJECT NOTIFICATION SENT

Organisation/Person	Contact Provided	Date Sent	Comment
Mr Craig Archibald	27 Margaret Street Teralba NSW 2284	24 July 2018	No Response – Letter returned 30/08/2018 marked as "RTS no longer as this address"
Aaron Broad	1 Waratah Ave Albion Park Rail NSW 2527 minnamunnung@gmail.com	24 July 2018	No Response
Toomelah Local Aboriginal Land Council	Toomelah LALC 0746762348 toomelahlandcouncil@gmail.com	Phone call and follow up email 7 August 2018	Correspondence from the LLS has suggested that the site is located within the Toomelah LALC boundaries. Our review of the boundaries places the site within Moombahlene LALC. Request was sent to confirm that it is not in Toomelah region.

REGISTERED ABORIGINAL PARTIES

Organisation/Person	Contact	Date Registered	How the registration was received & any comments
Aboriginal cultural sites services	Vicky Duncan Diane MARLOW acsworknsw@gmail.com	8 July 2018	Email response registering an interest in being consulted

Edgerton Kwiambal	Samantha Duncan and Liza Talbot. PH: 0422098648 6 Bala st, Ashford N.S.W 2361 duncans528@gmail.com	9 July 2018	Email response registering an interest in being consulted
Helen Duroux (CEO)	Moombahlene LALC PO Box 70 Tenterfield ,2372 Ph : 0267363219 Fax : 0267361486 Helen Duroux moombahlenelalc1@bigpond.com	4 July 2018 and 17 July 2018	Email response registering an interest in being consulted

Presentation of information about the proposed project

Presentation of proposed project information

Aboriginal Organisation/Person	Date Sent	Date Reply	Comments, outcomes and/or issues	Notes
Aboriginal cultural sites services	09/08/2018	10/08/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology and invitation to survey included in letter.	VD & DM responded via email accepting invitation to the survey, no comments on methodology or known cultural heritage values in email.
Edgerton Kwiambal	09/08/2018	13/08/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology and invitation to survey included in letter.	SD responded via email accepting invitation to the survey, no

Aboriginal Organisation/Person	Date Sent	Date Reply	Comments, outcomes and/or issues	Notes
				comments on methodology or known cultural heritage values in email.
Moombahlene LALC	09/08/2018	03/09/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology and invitation to survey included in letter.	ERM called on 30/08/18 to enquire if LALC was available for fieldwork on these dates or had any feedback on methodology and project information. No answer, left message. Followed up with email stating the same. HD responded via email 03/09/2018.

The record of agreed outcomes and/or contentious issues should be supplied to all registered Aboriginal parties.

Provision of the proposed assessment methodology to the RAP

Aboriginal Organisation/Person	Date Sent	Date Reply	Comment and details of how input has been considered	Notes
Aboriginal cultural sites services	09/08/2018	10/08/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology, cultural heritage assessment workshop and invitation to survey included in letter.	VD & DM responded via email accepting invitation to the survey, no

Aboriginal Organisation/Person	Date Sent	Date Reply	Comment and details of how input has been considered	Notes
				comments on methodology or known cultural heritage values in email.
Edgerton Kwiambal	09/08/2018	13/08/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology, cultural heritage assessment workshop and invitation to survey included in letter.	SD responded via email accepting invitation to the survey, no comments on methodology or known cultural heritage values in email.
Moombahlene LALC	09/08/2018	03/09/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology, cultural heritage assessment workshop details included in letter.	ERM called on 30/08/18 to enquire if LALC was available for fieldwork on these dates or had any feedback on methodology and project information. No answer, left message. Followed up with email stating the same. HD responded via email 03/09/2018, stating that they were interested in the methodology

Aboriginal Organisation/Person	Date Sent	Date Reply	Comment and details of how input has been considered	Notes
				and looking forward to fieldwork.

Field Survey or opportunity for RAP to visit the proposed project site

RAP	Representative	Date	Comments
Aboriginal cultural sites services	Vicky Duncan	11/09/2018, 12/09/2018 & 13/09/2018	
Edgerton Kwiambal	Samantha Duncan	11/09/2018, 12/09/2018 & 13/09/2018	
Moombahlene LALC	Darren	11/09/2018, 12/09/2018 & 13/09/2018	

Seek information from RAP on (a) the presence of Aboriginal objects of cultural value and (b) places of cultural value

RAP	Date	Comments	Cultural values identified
Aboriginal cultural sites services	09/08/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology, cultural heritage assessment workshop and a request to be provided with any information on the (a) the presence of	No values identified to heritage consultation

		Aboriginal objects of cultural value and (b) places of cultural value, if known or appropriate to divulge.	
Edgerton Kwiambal	09/08/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology, cultural heritage assessment workshop and a request to be provided with any information on the (a) the presence of Aboriginal objects of cultural value and (b) places of cultural value, if known or appropriate to divulge.	
Moombahlene LALC	09/08/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology, cultural heritage assessment workshop and a request to be provided with any information on the (a) the presence of Aboriginal objects of cultural value and (b) places of cultural value, if known or appropriate to divulge.	

ONGOING CONSULTATION

RAP	Contact Made by	Date	Comments	Notes / Follow up
Aboriginal cultural sites services – Vicky Duncan	ERM – Katherine Deverson	03/09/2018	KD called VD to advise that following further desktop it was believed that further fieldwork days were needed and invited RAP to attend fieldwork one day earlier (Tuesday 11 September) and advised likely that fieldwork would now extend to Friday 14 September. VD	KD sent follow up email to confirm extension of fieldwork.

			confirmed availability to attend.	
Edgerton Kwiambal – Samantha Duncun	ERM – Katherine Deverson	03/09/2018	KD called SD to advise that following further desktop it was believed that further fieldwork days were needed and invited RAP to attend fieldwork one day earlier (Tuesday 11 September) and advised likely that fieldwork would now extend to Friday 14 September. No answer message left	KD sent follow up email to invite Edgerton Kwiambal to two further fieldwork days.
Moombahlene LALC – Helen Duroux	ERM – Katherine Deverson	03/09/2018	KD called VD to advise that following further desktop it was believed that further fieldwork days were needed and invited RAP to attend fieldwork one day earlier (Tuesday 11 September) and advised likely that fieldwork would now extend to Friday 14 September. HD advised she would contact LALC heritage officer and advise ERM of their availability.	KD sent follow up email to confirm extension of fieldwork.
Edgerton Kwiambal – Samantha Duncun	Edgerton Kwiambal – Samantha Duncun	04/09/2018	SD emailed to advise she would attend all fieldwork days from 11/09/2018, and email Insurance information	KD emailed to thank SD for her response.
Aboriginal cultural sites services – Vicky Duncan	ERM – Katherine Deverson	18/09/2018	KD emailed to thank everyone for their	

			participation in fieldwork and advise of invoicing details	
Edgerton Kwiambal – Samantha Duncun	ERM – Katherine Deverson	18/09/2018	KD emailed to thank everyone for their participation in fieldwork and advise of invoicing details	
Moombahlene LALC – Helen Duroux	ERM – Katherine Deverson	18/09/2018	KD emailed to thank everyone for their participation in fieldwork and advise of invoicing details	
Aboriginal cultural sites services – Vicky Duncan	ERM – Katherine Deverson	09/05/2019	KD emailed draft ACHA to RAPs requesting any comments by 07/06/2019.	
Edgerton Kwiambal – Samantha Duncun	ERM – Katherine Deverson	09/05/2019	KD emailed draft ACHA to RAPs requesting any comments by 07/06/2019.	
Moombahlene LALC – Helen Duroux	ERM – Katherine Deverson	09/05/2019	KD emailed draft ACHA to RAPs requesting any comments by 07/06/2019.	
Aboriginal cultural sites services – Vicky Duncan	ERM – Katherine Deverson	12/06/2019	KD emailed checking if VD had any comments on the draft ACHA.	
Edgerton Kwiambal – Samantha Duncun	ERM – Katherine Deverson	12/06/2019	KD emailed checking if SD had any comments on the draft ACHA.	SD emailed endorsement of the ACHA 12/06
Moombahlene LALC – Helen Duroux	ERM – Katherine Deverson	12/06/2019	KD emailed checking if HD had any comments on the draft ACHA.	
Edgerton Kwiambal – Samantha Duncun	Edgerton Kwiambal – Samantha Duncun	12/06/2019	SD replied to KD's email advising 100% endorsement of the ACHA draft	KD emailed reply thanking SD for her response.

Aboriginal cultural sites services – Vicky Duncan	ERM – Katherine Deverson	21/06/2019	KD emailed checking if VD had any comments on the draft ACHA.	VD replied with comment on project recommendations.
Moombahlene LALC – Helen Duroux	ERM – Katherine Deverson	21/06/2019	KD emailed checking if HD had any comments on the draft ACHA.	
Aboriginal cultural sites services – Vicky Duncan	Aboriginal cultural sites services – Vicky Duncan	21/06/2019	VD replied with comment on project recommendations, that sites should be avoided otherwise salvaged, and that the area appeared to be a high occupancy area used by her ancestors.	KD emailed replied thanking VD for her response, advising that comments would be included in the ACHA.
Edgerton Kwiambal – Samantha Duncun	ERM – Katherine Deverson	10/07/2019	KD emailed on behalf of the proponent to advise that three sites (scarred trees) BSF18, BSF19 and BSF29 were currently within the projects impact area and to ask for comment on the possibility of the removal of these trees.	
Aboriginal cultural sites services – Vicky Duncan	ERM – Katherine Deverson	10/07/2019	KD emailed on behalf of the proponent to advise that three sites (scarred trees) BSF18, BSF19 and BSF29 were currently within the projects impact area and to ask for comment on the possibility of the removal of these trees.	VD replied on 13/07/2019, see entry below
Moombahlene LALC – Helen Duroux	ERM – Katherine Deverson	10/07/2019	KD emailed on behalf of the proponent to advise that	HD replied 11/07/2019, see below entry

			three sites (scarred trees) BSF18, BSF19 and BSF29 were currently within the projects impact area and to ask for comment on the possibility of the removal of these trees.	
Moombahlene LALC – Helen Duroux	Moombahlene LALC – Helen Duroux	11/07/2019	HD emailed to advise that LALC did not support the removal of any scarred trees.	KD replied thanking HD for her response.
Edgerton Kwiambal – Samantha Duncun	ERM – Katherine Deverson	12/07/2019	KD emailed to advise that significance of scarred trees sites BSF5, BSF6, BSF9, BSF11, BSF18, BSF9, and BSF29 had been revised from low overall significance to moderate significance as a result of corrections in the draft ACHA to reflect the aesthetic and social/cultural values of the sites. Updated version of ACHA also sent.	
Aboriginal cultural sites services – Vicky Duncan	ERM – Katherine Deverson	12/07/2019	KD emailed to advise that significance of scarred trees sites BSF5, BSF6, BSF9, BSF11, BSF18, BSF9, and BSF29 had been revised from low overall significance to moderate significance as a result of corrections in the draft ACHA to reflect the	

			aesthetic and social/cultural values of the sites. Updated version of ACHA also sent.	
Moombahlene LALC – Helen Duroux	ERM – Katherine Deverson	12/07/2019	KD emailed to advise that significance of scarred trees sites BSF5, BSF6, BSF9, BSF11, BSF18, BSF9, and BSF29 had been revised from low overall significance to moderate significance as a result of corrections in the draft ACHA to reflect the aesthetic and social/cultural values of the sites. Updated version of ACHA also sent.	
Aboriginal cultural sites services – Vicky Duncan	Aboriginal cultural sites services – Vicky Duncan	13/07/2019	VD emailed to advise that ACSS did not support the removal of any live scarred trees and that in the event the removal of dead scarred trees notify Kwiembal Elders Group ,Edgerton Kwiembal environment cultural heritage aboriginal corporation also local land Council must be notified for salvage.	KD replied thanking VD for her response.
Edgerton Kwiambal – Samantha Duncun	ERM – Katherine Deverson	25/07/2019	KD emailed checking if SD had any comments on the email regarding possible removal of scarred trees.	

Edgerton Kwiambal – Samantha Duncun	Edgerton Kwiambal – Samantha Duncun	25/07/2019	SD emailed to advise the EK agreed with comments provided by other RAPs that removal of scarred trees should be avoided, however if removal was to occur that it should be done in consultation with RAPs and with them present for salvage.	KD replied thanking SD for her response.

Elise Caldwell

From: Katherine Deverson
Sent: Friday, 21 June 2019 12:38 PM
To: Helen Duroux
Cc: Amanda Antcliff
Subject: FW: 0464261 - Bonshaw ACHA Draft report for you review
Attachments: 0464261 - Bonshaw SF ACHA Draft.pdf

Hi Helen,
I am just checking in again to see if you had any comments on the Bonshaw Solar Farm draft ACHA that I sent through last month?

It you have had a chance to review it, and are able to email back an endorsement of the report and/or any comments you may have, that would be great!

Kind regards,
Kat

Katherine Deverson
Heritage Consultant

Environmental Resources Management Australia Pty Ltd
15 Tench Street | Kingston | ACT 2604 | Australia
T 02 8584 8813 or 02 6126 5311 | **M** 0466 224 250
E katherine.deverson@erm.com | **W** www.erm.com

ERM *The business of sustainability*

From: Katherine Deverson
Sent: Wednesday, June 12, 2019 1:13 PM
To: Helen Duroux <moombahlenelalc1@bigpond.com>
Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>
Subject: FW: 0464261 - Bonshaw ACHA Draft report for you review

Hi Helen,
I am just checking in to see if you had any comments on the Bonshaw Solar Farm draft ACHA that I sent through last month?

It you have been able to review it, it would be great if you could email back with your endorsement of the report and/or any comments you may have.

Kind regards,
Kat

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E katherine.deverson@erm.com | **W** www.erm.com

From: Katherine Deverson
Sent: Thursday, May 9, 2019 3:15 PM
To: Helen Duroux <moombahlenelalc1@bigpond.com>
Subject: 0464261 - Bonshaw ACHA Draft report for you review

Hi Helen,

Please find attached the Draft Bonshaw Solar Farm ACHA report which was completed following the surveys we carried out in September 2018.

Please review this report and provide any comments by Friday 7 June 2019.

Feel free to contact me anytime if you would like to discuss anything.

Regards,
Kat

Katherine Deverson
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E katherine.deverson@erm.com | **W** www.erm.com

Elise Caldwell

From: Katherine Deverson
Sent: Friday, 21 June 2019 2:23 PM
To: acsworknsw@gmail.com
Cc: Amanda Antcliff
Subject: RE: 0464261 - Bonshaw ACHA Draft report for you review

Hi Vicky,
Thanks so much for your comment, I will include it in the draft ACHA. As a State Significant Development the Bonshaw Wind Farm does not go through the approvals process that requires an AHIP, however this ACHA will inform the governing body during their development application consideration process and it is expected that the recommendations from the ACHA will be incorporated into the approval, so it is similar to an AHIP in the mitigation requirements for the proponents.

For this project we have recommended, as you have suggested, that the project area be moved where possibly to avoid impacting cultural heritage sites, and so far this has successfully occurred in those high occupancy sites along the creek line at sites like BSF1 (which you will probably remember is the one up near the road where we found lots of artefacts including the retouched axe head).

The draft ACHA recommends avoidance of all sites where possible however direct impact of the project to some sites is considered unavoidable. The draft ACHA recommends that;

- prior to construction all sites that are to be avoided by project works should be fenced so that they are not harmed by construction works or any associated traffic or lay down areas etc.;
- that surface collection/salvage be undertaken at those sites that cannot be avoided by the project by Aboriginal stakeholder groups and an appropriately qualified archaeologist;
- that any artefacts removed from site as part of the salvage works are safely stored until they can be reburied/returned to country in a place agreed upon by RAPs; and
- that ongoing consultation occurs with RAPs throughout the project.

Thanks again for your comment, I really appreciate your input. Feel free to call or email me anytime if you have any further comments or would like to discuss anything in the draft ACHA or to do with the project.

Have a great weekend!

Regards,
Kat

Katherine Deverson
Heritage Consultant

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E katherine.deverson@erm.com | **W** www.erm.com

ERM *The business of sustainability*

From: acsworknsw@gmail.com <acsworknsw@gmail.com>
Sent: Friday, June 21, 2019 1:49 PM
To: Katherine Deverson <Katherine.Deverson@erm.com>
Subject: Re: 0464261 - Bonshaw ACHA Draft report for you review

Hi Katherine.
Yes comment on site I recommend that an AHIP BE ON the sites that thay will construct the solor panels.Remove to a safe spot, or find another area for farmas the area is a high occupancy area that was used my my Ancestors.
Kind regards
Vicky Duncan

----- Reply message -----
From: "Katherine Deverson" <Katherine.Deverson@erm.com>
To: "acsworknsw@gmail.com" <acsworknsw@gmail.com>
Cc: "Amanda Antcliff" <Amanda.Antcliff@erm.com>
Subject: 0464261 - Bonshaw ACHA Draft report for you review
Date: Fri., Jun. 21, 2019 12:39 PM

Hi Vicky,
I am just checking in again to see if you had any comments on the Bonshaw Solar Farm draft ACHA that I sent through last month?

It you have had a chance to review it, and are able to email back an endorsement of the report and/or any comments you may have, that would be great!

Kind regards,
Kat

Katherine Deverson
Heritage Consultant

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From: Katherine Deverson
Sent: Wednesday, June 12, 2019 1:15 PM
To: acsworknsw@gmail.com
Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>
Subject: FW: 0464261 - Bonshaw ACHA Draft report for you review

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It you have been able to review it, it would be great if you could email back with your endorsement of the report and/or any comments you may have.

Kind regards,
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From: Katherine Deverson
Sent: Thursday, May 9, 2019 3:17 PM
To: acsworknsw@gmail.com
Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>
Subject: 0464261 - Bonshaw ACHA Draft report for you review

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Please review this report and provide any comments by Friday 7 June 2019.

Feel free to contact me anytime if you would like to discuss anything.

Regards,
Kat

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T 02 8584 8813 or 02 6126 5311 | **M** 0466 224 250
E katherine.deverson@erm.com | **W** www.erm.com

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Elise Caldwell

From: Katherine Deverson
Sent: Wednesday, 12 June 2019 4:41 PM
To: Samantha Duncan
Subject: RE: FW: 0464261 - Bonshaw ACHA Draft report for you review

Hi Samantha

Thanks so much for getting back to me. I really appreciate your input on this project.

Kind regards,
Kat

Katherine Deverson
Heritage Consultant

Environmental Resources Management Australia Pty Ltd
15 Tench Street | Kingston | ACT 2604 | Australia
T 02 8584 8813 or 02 6126 5311 | **M** 0466 224 250
E katherine.deverson@erm.com | **W** www.erm.com

From: Samantha Duncan <duncans528@gmail.com>
Sent: Wednesday, June 12, 2019 3:00 PM
To: Katherine Deverson <Katherine.Deverson@erm.com>
Subject: Re: FW: 0464261 - Bonshaw ACHA Draft report for you review

Hi Katherine. I apologise for the delay.
I have read the report and 100% endorse the draft.
Kind regards,

Samantha Duncan.

On 12 Jun 2019 1:17 PM, "Katherine Deverson" <Katherine.Deverson@erm.com> wrote:

> Hi Sam,
>
> I am just checking in to see if you had any comments on the Bonshaw Solar Farm draft ACHA that I sent through last month?
>
> It you have been able to review it, it would be great if you could email back with your endorsement of the report and/or any comments you may have.

Kind regards,

Kat

Katherine Deverson

Heritage Consultant

Environmental Resources Management Australia Pty Ltd

15 Tench Street | Kingston | ACT 2604 | Australia

T 02 8584 8813 or 02 6126 5311 | **M** 0466 224 250

E katherine.deverson@erm.com | **W** www.erm.com

From: Katherine Deverson
Sent: Thursday, May 9, 2019 3:19 PM
To: Samantha Duncan <duncans528@gmail.com>
Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>
Subject: 0464261 - Bonshaw ACHA Draft report for you review

Hi Sam,

Please find attached the Draft Bonshaw Solar Farm ACHA report which was completed following the surveys we carried out in September 2018.

Please review this report and provide any comments by Friday 7 June 2019.

Feel free to contact me anytime if you would like to discuss anything.

Regards,

Kat

Katherine Deverson

Heritage Consultant

Environmental Resources Management Australia Pty Ltd

15 Tench Street | Kingston | ACT 2604 | Australia

T 02 8584 8813 or 02 6126 5311 | **M** 0466 224 250

E katherine.deverson@erm.com | **W** www.erm.com

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Elise Caldwell

From: Katherine Deverson
Sent: Thursday, 11 July 2019 3:56 PM
To: Helen Duroux
Cc: Amanda Antcliff
Subject: RE: Bonshaw Solar Farm

Hi Helen,
Thank you for your feedback.

I very much appreciate it.

Kind regards,
Katherine

Katherine Deverson
Heritage Consultant

Environmental Resources Management Australia Pty Ltd
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E katherine.deverson@erm.com | **W** www.erm.com

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From: Helen Duroux <moombahlenelalc1@bigpond.com>
Sent: Thursday, July 11, 2019 3:37 PM
To: Katherine Deverson <Katherine.Deverson@erm.com>
Subject: RE: Bonshaw Solar Farm

Hi Katherine,

We don't agree to having the trees removed and would advise against removing them at all costs,

Regards

Helen D

From: Katherine Deverson [mailto:Katherine.Deverson@erm.com]
Sent: Wednesday, 10 July 2019 10:39 AM
To: Helen Duroux
Cc: Amanda Antcliff
Subject: Bonshaw Solar Farm

Hi Helen,
Thank you for your review of the draft ACHA for the Bonshaw Solar Farm.

As you know from our fieldwork and the draft ACHA, numerous sites (including scarred trees and artefact scatters) were located and recorded during our fieldwork.

In considering ecological and heritage constraints within the Project Area the proponent has adjusted the Project's footprint, effectively moving it away from several larger sites located along the creek line to avoid impacting the archaeological record in these areas. However, the Project's proposed footprint currently impacts three scarred trees.

The draft ACHA recommends the following for each of these sites:

> ***Avoidance.***
>
> *Prior to construction commencing, exclusion fencing and exclusion signage should be erected around the scarred tree by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.*

The Proponent would like your comment on the possibility of removing these three scarred trees.

The scarred trees as recorded in the draft ACHA are:

BSF18	**Scarred Tree** **During the survey RAPs identified a standing, live, scarred tree. The oval shaped scar was approximately 1.7 m in length, 40 cm wide, and had significant overgrowth.** **The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.**	
BSF19	**Scarred Tree** During the survey RAPs identified a standing, live, scarred tree with a 1.5 m (length) narrow scar that was approximately 40 cm from the ground and showed significant overgrowth. The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.	
BSF29	Scarred Tree During the survey RAPs identified a standing, but dead, scarred tree. The long oval shaped scar was approximately 2 m in length and 40 cm wide. The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.	

If you could kindly review the above information and provide your comments, it would be greatly appreciated.

Kind regards,
Kat

Katherine Deverson
Heritage Consultant

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E katherine.deverson@erm.com | **W** www.erm.com

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This email has been checked for viruses by Avast antivirus software.
www.avast.com

From: Katherine Deverson
To: acsworknsw@gmail.com
Cc: Amanda Antcliff
Subject: RE: Bonshaw Solar Farm
Date: Monday, 15 July 2019 5:48:00 AM
Attachments: image001.png

HI Vicky,
Thank you for your response and comment. It is greatly appreciated.

Kind regards,
Kat

Katherine Deverson
Heritage Consultant

Environmental Resources Management Australia Pty Ltd
15 Tench Street¦Kingston¦ACT 2604¦Australia
T 02 8584 8813 or 02 6126 5311 ¦ **M** 0466 224 250
E katherine.deverson@erm.com ¦ **W** www.erm.com

From: acsworknsw@gmail.com <acsworknsw@gmail.com>
Sent: Saturday, July 13, 2019 3:34 PM
To: Katherine Deverson <Katherine.Deverson@erm.com>
Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>
Subject: Re: Bonshaw Solar Farm

Hi Kat
Aboriginal cultural site services recommend that live scarred trees stay and notify Kwiembal Elders Group ,Edgerton Kwiembal environment cultural heritage aboriginal corporation also local land Council on dead scare tree to salvage.
Kind regards
Vicky Duncan

----- Reply message -----
From: "Katherine Deverson" <Katherine.Deverson@erm.com>
To: "acsworknsw@gmail.com" <acsworknsw@gmail.com>
Cc: "Amanda Antcliff" <Amanda.Antcliff@erm.com>
Subject: Bonshaw Solar Farm
Date: Fri., Jul. 12, 2019 4:52 PM

Hi Vicky,

We have recently incorporated your comments into the ACHA and prepared a final version, in doing so we have corrected the overall significance of the scarred tree sites from low to moderate significance which takes into consideration their aesthetic and social/cultural significance.

I have attached the latest version of the ACHA with these changes included. No recommendations have changed since the draft ACHA.

Please let me know if you have any further comments or questions.

Have a great weekend,
Kat

Katherine Deverson
Heritage Consultant

Environmental Resources Management Australia Pty Ltd
15 Tench Street¦Kingston¦ACT 2604¦Australia
T 02 8584 8813 or 02 6126 5311 ¦ **M** 0466 224 250
E katherine.deverson@erm.com ¦ **W** www.erm.com

From: Katherine Deverson
Sent: Wednesday, July 10, 2019 1:12 PM
To: acsworknsw@gmail.com
Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>
Subject: RE: Bonshaw Solar Farm

Hi Vicky,
The Draft ACHA is now attached.

Cheers,
Kat

Katherine Deverson
Heritage Consultant

Environmental Resources Management Australia Pty Ltd
15 Tench Street¦Kingston¦ACT 2604¦Australia
T 02 8584 8813 or 02 6126 5311 ¦ **M** 0466 224 250
E katherine.deverson@erm.com ¦ **W** www.erm.com

From: acsworknsw@gmail.com <acsworknsw@gmail.com>
Sent: Wednesday, July 10, 2019 1:07 PM
To: Katherine Deverson <Katherine.Deverson@erm.com>
Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>
Subject: Re: Bonshaw Solar Farm

Hi Kath
Can u send report to me please.

----- Reply message -----
From: "Katherine Deverson" <Katherine.Deverson@erm.com>
To: "acsworknsw@gmail.com" <acsworknsw@gmail.com>
Cc: "Amanda Antcliff" <Amanda.Antcliff@erm.com>
Subject: Bonshaw Solar Farm
Date: Wed., Jul. 10, 2019 12:12 PM

Hi Vicky,
No, I didn't get them. When did you send them through?

Cheers,
Kat

Katherine Deverson
Heritage Consultant

Environmental Resources Management Australia Pty Ltd
15 Tench Street¦Kingston¦ACT 2604¦Australia
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E katherine.deverson@erm.com ¦ **W** www.erm.com

From: acsworknsw@gmail.com <acsworknsw@gmail.com>
Sent: Wednesday, July 10, 2019 12:11 PM
To: Katherine Deverson <Katherine.Deverson@erm.com>
Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>

Subject: Re: Bonshaw Solar Farm

Hi Kath.
Did you get all picks that I took of project area.

----- Reply message -----
From: "Katherine Deverson" <Katherine.Deverson@erm.com>
To: "acsworknsw@gmail.com" <acsworknsw@gmail.com>
Cc: "Amanda Antcliff" <Amanda.Antcliff@erm.com>
Subject: Bonshaw Solar Farm
Date: Wed., Jul. 10, 2019 10:37 AM

Hi Vicky,
Thank you for your review and comment on the draft ACHA for the Bonshaw Solar Farm.

As you know from our fieldwork and the draft ACHA, numerous sites (including scarred trees and artefact scatters) were located and recorded during our fieldwork.

In considering ecological and heritage constraints within the Project Area the proponent has adjusted the Project's footprint, effectively moving it away from several larger sites located along the creek line to avoid impacting the archaeological record in these areas. However, the Project's proposed footprint currently impacts three scarred trees.
The draft ACHA recommends the following for each of these sites:

> ***Avoidance.***
>
> *Prior to construction commencing, exclusion fencing and exclusion signage should be erected around the scarred tree by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.*

The Proponent would like your comment on the possibility of removing these three scarred trees.

The scarred trees as recorded in the draft ACHA are:

BSF18	**Scarred Tree** **During the survey RAPs identified a standing, live, scarred tree. The oval shaped scar was approximately 1.7 m in length, 40 cm wide, and had significant overgrowth.** **The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none**	**Photo3**

	were identified.	
BSF19	**Scarred Tree** During the survey RAPs identified a standing, live, scarred tree with a 1.5 m (length) narrow scar that was approximately 40 cm from the ground and showed significant overgrowth. The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.	Photo1
BSF29	Scarred Tree During the survey RAPs identified a standing, but dead, scarred tree. The long oval shaped scar was approximately 2 m in length and 40 cm wide. The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.	Photo1

If you could kindly review the above information and provide your comments, it would be greatly appreciated.

Kind regards,
Kat

Katherine Deverson
Heritage Consultant

Environmental Resources Management Australia Pty Ltd
15 Tench Street ¦ Kingston ¦ ACT 2604 ¦ Australia
T 02 8584 8813 or 02 6126 5311 ¦ **M** 0466 224 250
E katherine.deverson@erm.com ¦ **W** www.erm.com

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From: Katherine Deverson
To: Samantha Duncan
Subject: RE: Bonshaw Solar Farm
Date: Thursday, 25 July 2019 7:40:00 PM
Attachments: image001.png
image005.jpg
image006.jpg
image007.jpg

Hi Sam,
Thanks so much for sending through your comments, it is greatly appreciated.

Have a great weekend.

Regards,
Kat

Katherine Deverson
Senior Heritage Consultant

Environmental Resources Management Australia Pty Ltd
15 Tench Street ¦ Kingston ¦ ACT 2604 ¦ Australia
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E katherine.deverson@erm.com ¦ **W** www.erm.com

From: Samantha Duncan <duncans528@gmail.com>
Sent: Thursday, July 25, 2019 7:19 PM
To: Katherine Deverson <Katherine.Deverson@erm.com>
Subject: RE: Bonshaw Solar Farm

Hi Kat, sorry for the late reply.
I have read through the attachment and agree with the other parties in relation to the scarred trees. If removal can be avoided that would be great due to cultural and spiritual reasons. However, if it is absolutely necessary that the trees be removed than its vital that T.O's (Traditional Owners) of the boundary areas be present and involved in relocation and the removal process.
Hopefully removal can be avoided as it would be extremely disheartening as an indigenous person with cultural connections to the area and objects within it. After all, our history and our future is all depending on the little historical ARTE facts that remain in every tribal area.
Once again I sincerely apologise for the delay.

Kind regards,

Samantha Duncan..

On 25 Jul 2019 7:08 AM, "Katherine Deverson" <Katherine.Deverson@erm.com> wrote:

> Hi Sam,
> Just checking in to see if you wanted to make a comment about the scarred tree query in the email below. I have received a response from Vicky but wasn't sure if you also wanted to submit any comments?
>
> I have attached the most recent version of the report to this email, although it is the same copy that I sent through to you on 12 July.
>
> I hope you are well.
>
> Kind regards,
> Kat
>
> **Katherine Deverson**
> Senior Heritage Consultant
>
> **Environmental Resources Management Australia Pty Ltd**
> 15 Tench Street¦Kingston¦ACT 2604¦Australia
> **T** 02 8584 8813 or 02 6126 5311 ¦ **M** 0466 224 250
> **E** katherine.deverson@erm.com ¦ **W** www.erm.com
>
>
>
> ---
>
> **From:** Katherine Deverson
> **Sent:** Wednesday, July 10, 2019 10:39 AM
> **To:** Samantha Duncan <duncans528@gmail.com>
> **Cc:** Amanda Antcliff <Amanda.Antcliff@erm.com>
> **Subject:** Bonshaw Solar Farm
>
> Hi Sam,
> Thank you for your review and comment on the draft ACHA for the Bonshaw Solar Farm.
>
> As you know from our fieldwork and the draft ACHA, numerous sites (including scarred trees and artefact scatters) were located and recorded during our fieldwork.
>
> In considering ecological and heritage constraints within the Project Area the proponent has adjusted the Project's footprint, effectively moving it away from several larger sites located along the creek line to avoid impacting the archaeological record in these areas. However, the Project's proposed footprint currently impacts three scarred trees.
> The draft ACHA recommends the following for each of these sites:
>
> ***Avoidance.***
>
> *Prior to construction commencing, exclusion fencing and exclusion signage should be erected around the scarred tree by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.*

The Proponent would like your comment on the possibility of removing these three scarred trees.

The scarred trees as recorded in the draft ACHA are:

BSF18	**Scarred Tree** **During the survey RAPs identified a standing, live, scarred tree. The oval shaped scar was approximately 1.7 m in length, 40 cm wide, and had significant overgrowth.** **The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.**	**Photo3**
BSF19	**Scarred Tree** During the survey RAPs identified a standing, live, scarred tree with a 1.5 m (length) narrow scar that was approximately 40 cm from the ground and showed significant overgrowth. The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.	Photo1
BSF29	Scarred Tree During the survey RAPs identified a standing, but dead, scarred tree. The long oval shaped scar was approximately 2 m in length and 40 cm wide. The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and	Photo1

	surrounding area was checked for stone artefacts, though none were identified.	

If you could kindly review the above information and provide your comments, it would be greatly appreciated.

Kind regards,
Kat

Katherine Deverson
Heritage Consultant

Environmental Resources Management Australia Pty Ltd
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APPENDIX B SURVEY METHODOLOGY SENT TO RAPS AUGUST 2018

November 2018

Environmental Resources Management Australia Pty Ltd

15 Tench Street
Kingston ACT 2604

PO Box 4160
Kingston ACT 2604

Telephone +61 2 6253 6888
Facsimile +61 2 9299 7502

www.erm.com

9 August, 2018

Helen Duroux
Moombahlene LALC
PO Box 70
Tenterfield NSW 2372

moombahlenelalc1@bigpond.com

Our Reference: 0464261_SURVEY METHODOLOGY_LALC.DOCX

Dear Helen Duroux,

RE: SOLAR FARM, BONSHAW NSW

Thank you for registering an interest in being consulted for this project.

In accordance with the NSW Office of Environment and Heritage's (OEH) *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (the Guidelines), and the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW 2010* (Code of Practice), Environmental Resources Management Australia (ERM) is undertaking an Aboriginal cultural heritage assessment (ACHA) associated with the construction and operation of 500 MW capacity solar farm connecting to the existing Dumaresq Substation (*Figure 1).*

This letter provides the relevant information about the proposed project, the current known heritage values of the study area and the proposed archaeological survey methodology.

In accordance with *Section 4.1.6* of the Guidelines, we would also like to provide Moombahlene LALC with a list of the registered groups for this Project:

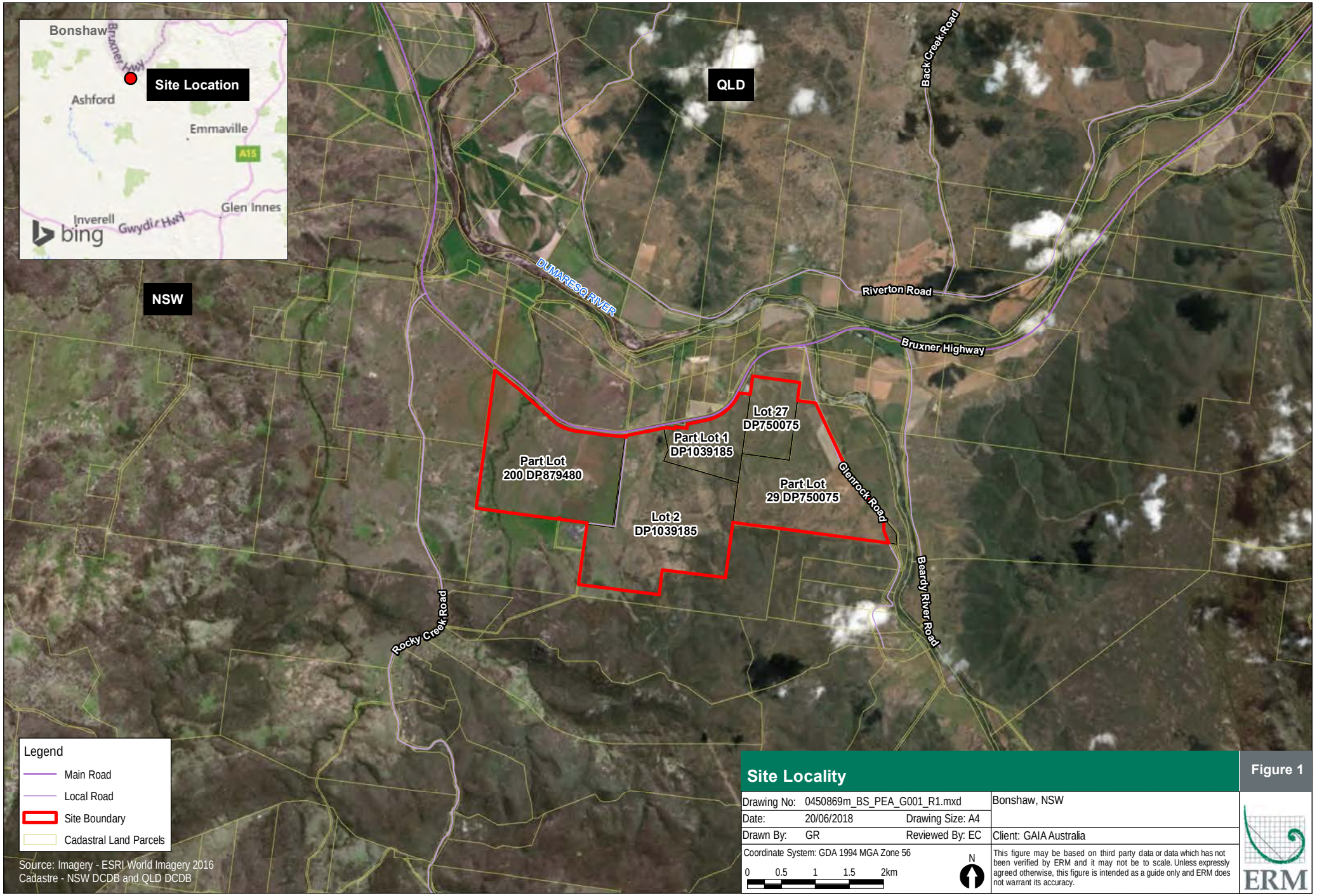
- Aboriginal Cultural Sites Services;
- Edgerton Kwiambal; and
- Moombahlene LALC.

Annex A also includes a copy of the Newspaper advertisement that was placed in the Inverell Times on 6 July 2018 and the Tenterfield Star on 11 July 2018.

1. PROPOSED DEVELOPMENT

The proponent for the proposed works is GAIA Australia Pty Ltd (GAIA).

The proposed Project Area (PA) is approximately 1097 hectares (ha) with a development footprint of approximately 650 ha. The land is privately owned rural land, currently used for grazing.


Bonshaw
Bruxner Hwy
Site Location
Ashford
Emmaville
A15
Glen Innes
Inverell
Gwydir Hwy
bing
QLD
NSW
Back Creek Road
DUMARESQ RIVER
Riverton Road
Bruxner Highway
Lot 27
DP750075
Part Lot 1
DP1039185
Part Lot
200 DP879480
Part Lot
29 DP750075
Glenrock Road
Lot 2
DP1039185
Rocky Creek Road
Beardy River Road
Legend
Main Road
Local Road
Site Boundary
Cadastral Land Parcels
Source: Imagery - ESRI World Imagery 2016
Cadastre - NSW DCDB and QLD DCDB
Site Locality
Figure 1
Drawing No: 0450869m_BS_PEA_G001_R1.mxd
Bonshaw, NSW
Date: 20/06/2018
Drawing Size: A4
Drawn By: GR
Reviewed By: EC
Client: GAIA Australia
Coordinate System: GDA 1994 MGA Zone 56
0 0.5 1 1.5 2km
N
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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With specific reference to Aboriginal cultural heritage and the assessment of potential impacts to the heritage values of the PA, the project will involve the construction, operation and maintenance of a solar PV generation facility and associated infrastructure with a capacity of up to 500 MW, supplying electricity to the national electricity grid.

The Project would include:

- a network of PV modules in a fixed or tracking arrangement;
- a site office (two proposed options);
- three potential access tracts from Bruxner Highway and one from Glenrock Road;
- underground or overhead cabling for connection between arrays and inverters and transformers;
- parking and internal access tracks;
- perimeter security fencing;
- battery storage; and
- two grid connection options to the 330 kV TransGrid Dumaresq Substation, on the boundary of the PA.

2. HERITAGE BACKGROUND

A preliminary due diligence assessment was undertaken by ERM in June 2018. The assessment included a desktop review of the heritage values which have the potential to impact the PA.

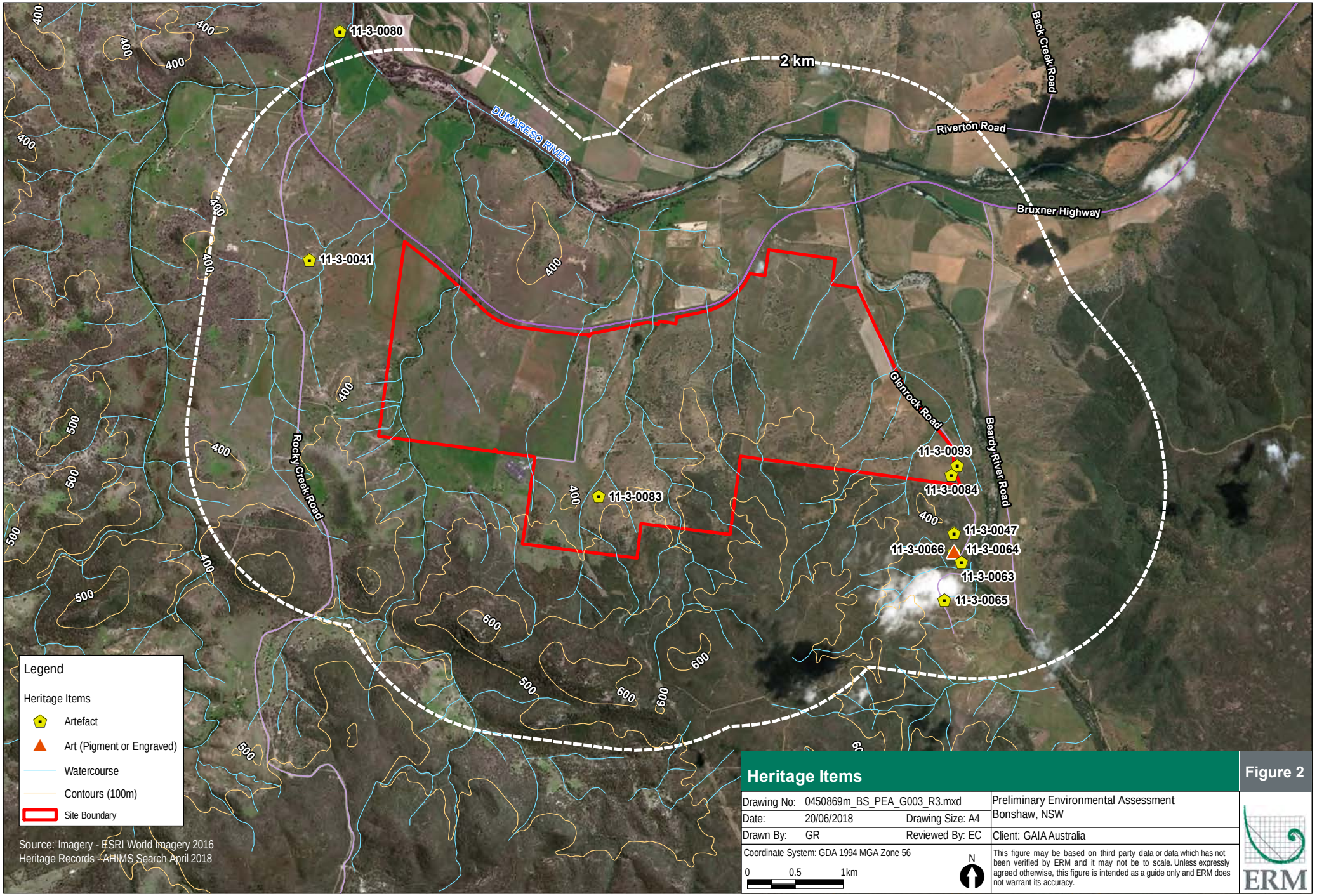
The review was limited to matters identified in the following online resources accessed on Tuesday 6 March 2018:

- Australian Heritage Database register search, including: World Heritage List, National Heritage List, Commonwealth Heritage List, National Trust Register, Register of the National Estate (archive);
- NSW State Heritage Inventory - includes items listed on the State Heritage Register (SHR) and provides a list of places and items of State Significance made under the Heritage Act. Heritage Council approval is required for works proposed to an item on the SHR;
- Inverell LEP 2012 - Schedule 5 and Conservation Areas (Locally listed items);
- Historic Heritage Information Management System (HHIMS) search;

- Aboriginal Heritage Information Management System (AHIMS);
- Schedule 14 of the National Parks and Wildlife Act; and
- Native Title Search.

One active Native Title claim (Comeroi People #NC2011/006) is currently registered within the LGA, and is located on the western side of Rocky Creek Road adjacent to the PA. The PA is not included in this Native Title claim.

An extensive AHIMS register search was conducted for each allotment on 5 March 2018, which identified three previously recorded Aboriginal sites located within the PA. All three of these sites (AHIMS #11-3-0083, #11-3-0084 and #11-3-0093) are reported as artefact scatters, with one potential scar tree also noted at the northern extent of #11-3-0083 (Refer to *Figure 2*). They were recorded as part of the Far North NSW (Dumaresq to Lismore 330kV Transmission Line) Project in 2011 (Ozark, 2011).


11-3-0080
2 km
DUMARESQ RIVER
Back Creek Road
Riverton Road
Bruxner Highway
11-3-0041
Glenrock Road
Beardy River Road
Rocky Creek Road
11-3-0093
11-3-0084
11-3-0083
11-3-0047
11-3-0066
11-3-0064
11-3-0063
11-3-0065
400
500
600
Legend
Heritage Items
Artefact
Art (Pigment or Engraved)
Watercourse
Contours (100m)
Site Boundary
Source: Imagery - ESRI World Imagery 2016
Heritage Records - AHIMS Search April 2018
Heritage Items
Figure 2
Drawing No: 0450869m_BS_PEA_G003_R3.mxd
Date: 20/06/2018
Drawing Size: A4
Drawn By: GR
Reviewed By: EC
Coordinate System: GDA 1994 MGA Zone 56
0 0.5 1km
N
Preliminary Environmental Assessment
Bonshaw, NSW
Client: GAIA Australia
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

3. FIELDWORK METHODOLOGY

Based on the results of the due diligence assessment, the archaeological survey will be undertaken over two days and will aim to identify all Aboriginal sites present within the proposed impact area including the identification of any PADs.

The proposed methodology for the archaeological survey includes:

- the survey will be undertaken on foot where possible with Registered Aboriginal Parties in attendance;
- the survey will consist of all participants traversing the transmission line corridor using walking transects approximately 5 m apart to ensure the entire survey area is covered (subject to surface visibility and accessibility);
- the survey will target each landform in the PA;
- areas of potential such as raised landforms in close proximity to a semi-permanent water source will also be targeted;
- areas of exposure and ground visibility will be targeted;
- any areas of interest to the Registered Aboriginal Parties will be targeted;
- the previously recorded sites will be targeted, re-identified and recorded; and
- any cultural heritage information for the PA held by Aboriginal parties will be recorded during the field survey. Any cultural knowledge provided by Aboriginal Stakeholders will be treated in confidence and the information will be distributed according to their wishes.

ERM propose the dates of **12 and 13 September 2018** to undertake this archaeological survey. One representative from your organisation is invited to attend. Details of the meeting time and location for each day will be provided once we have confirmed attendance.

Each representative is responsible for providing their own Personal Protective Equipment (PPE), including sturdy walking boots, long pants and long sleeve shirts (and wet weather gear, if required). Please ensure that you have sun protection and enough water for the day.

Should you wish to participate, you will need to supply ERM with:

- the name of the individual who will attend as your representative;
- a Certificate of Currency for Public Liability insurance, valid for the period of work; and

- a Certificate of Currency for Workers Compensation insurance, valid for the period of work.

4. FEEDBACK

ERM requests that you respond to this information package and fieldwork methodology prior to **Friday 7 September 2018** with any comments you may have and confirmation of availability for fieldwork.

Please provide feedback to **Katherine Deverson** on the following contact details:

Post: PO Box 4160, Kingston, ACT 2604
Phone: 02 8584 8813 or 02 6126 5311
Email: katherine.deverson@erm.com

If you hold any knowledge of sites within or near the study area or have any specific information concerning the cultural values of the study area, we would be grateful if you could let us know. Our contact details are listed above. Any cultural knowledge provided by Aboriginal Stakeholders will be treated in confidence and the information will be distributed according to their wishes.

Yours faithfully,

for Environmental Resources Management Australia Pty Ltd

Katherine Deverson
ERM Archaeologist

Paul Douglass
ERM Partner

APPENDIX C AHIMS EXTENSIVE SEARCH RESULTS

November 2018

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 0450869

Client Service ID : 331690

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
11-3-0041	S19	AGD	56	335382	6770551	Open site	Valid	Artefact : -	Isolated Find	
	Contact	**Recorders**	Robert Paton					**Permits**		
11-3-0047	EL35	AGD	56	342100	6767700	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Robert Paton					**Permits**		
11-3-0063	EL34	AGD	56	342150	6767550	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Robert Paton					**Permits**		
11-3-0064	EL33	AGD	56	342100	6767500	Open site	Valid	Art (Pigment or Engraved) : -		
	Contact	**Recorders**	Robert Paton					**Permits**		
11-3-0065	EL32	AGD	56	342000	6767000	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Robert Paton					**Permits**		
11-3-0066	EL36	AGD	56	342100	6767500	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Robert Paton					**Permits**		
11-3-0080	TSR Dumaresq River OCS	GDA	56	335700	6772930	Open site	Valid	Artefact : 500		
	Contact Searle	**Recorders**	Miss.Karen Glover					**Permits**		
11-3-0083	Tenterfield-Dumaresq OS14	GDA	56	338395	6768085	Open site	Valid	Artefact : -		
	Contact	**Recorders**	OzArk Environmental and Heritage Management,Mr.Ben Churcher					**Permits**		
11-3-0084	Tenterfield-Dumaresq OS15	GDA	56	342072	6768358	Open site	Valid	Artefact : -		
	Contact	**Recorders**	OzArk Environmental and Heritage Management,Mr.Ben Churcher					**Permits**		
11-3-0093	Tenterfield Dumaresq OS 4 & PAD	GDA	56	342136	6768402	Open site	Valid	Artefact : -		
	Contact	**Recorders**	OzArk Environmental and Heritage Management,Mr.Ben Churcher					**Permits**		

Report generated by AHIMS Web Service on 05/03/2018 for Eliza Collison for the following area at Lat, Long From : -29.2336, 151.2741 - Lat, Long To : -29.1502, 151.4063 with a Buffer of 0 meters. Additional Info : Site Feasibility Report. Number of Aboriginal sites and Aboriginal objects found is 10

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

APPENDIX D BIODIVERSITY AND CONSERVATION DIVISION LETTER JUNE 2020

Our Ref: DOC20/426271
Your Ref: SSD 9438

Director Energy Assessments
Department of Planning, Industry and Environment
Locked Bag 5022
Parramatta NSW 2124

Attention: Mr Iwan Davies

Dear Ms Brewer

RE: Bonshaw Solar Farm – SSD9438 – Outstanding Aboriginal Cultural Heritage Issues

I am writing to provide you advice about the outstanding issues regarding the Aboriginal Cultural Heritage (ACH) assessment process carried out to inform the proposed Bonshaw Solar Farm project (SSD 9438).

The Biodiversity and Conservation Division (BCD) of the Environment, Energy and Science Group in the Department of Planning, Industry and Environment has been involved, in an advisory capacity, in assisting with the determination process for this project.

On 2 December 2019 we provided a letter outlining several recommendations we considered should be addressed prior to the determination of the development application for this project, including that a concerted effort be made to rediscover the previously recorded Aboriginal Heritage Information Management System (AHIMS) site 11-3-0083, which we considered highly important to the contextual understanding of the ACH values of the project area.

The ACH assessment for the project that we had reviewed stated that the consultant archaeologist had been unable to relocate the site in question and that the site had originally been identified as being of high significance. It was recorded as containing an Aboriginal scar tree, surface artefacts and likely subsurface deposits and representative of a much broader occupation complex likely to exist along the entire riparian corridor at this location.

On 21 February 2020 we received an updated Aboriginal Cultural Heritage Assessment Report in response to our submissions. Our review of that report noted that the issues we had raised about AHIMS 11-3-0038 had been overlooked.
On 21 May 2020 we participated in a teleconference with yourself and the Department's Mr Javier Canon, where it was agreed that our recommendation had not been addressed and that further discussions with the project archaeologist may be helpful in understanding the intensity and locations of the survey effort undertaken to relocate the site.

The BCD North East Branch Archaeologist has since made his own technical assessment of all the information recorded to date regarding AHIMS 11-3-0038. The result of his assessment suggests that technical errors on behalf of both the original recording archaeologist in 2011 and the current consultant archaeologists have resulted in a misunderstanding about the location of AHIMS 11-3-0038.

The original recording of the site, carried out in 2011, included coordinates, visual and textual information identifying the site location. After review of this information the BCD has determined the original coordinates of the site were recorded in one projection (AGD) but were mislabelled on the Aboriginal site recording form as another projection (GDA). This error would place the site approximately 210m southeast of its actual location on the ground. The error on the original recording form was translated into the AHIMS register by the Office of Environment and Heritage as per the form submitted.

When the consultant archaeologist for the project carried out their desktop analysis and field assessment, they failed to correlate the coordinates with the other information regarding the site location and therefore failed to identify the correct location of the site.

The BCD has reprojected the original coordinates into the GDA system and determined that the area identified in the 2011 survey and registered as AHIMS 11-3-0038 was identified during the most recent ACH survey and given a new site identifier as it was not recognised as the existing site. Figures 1 and 2 at Attachment 1 to this letter show the recorded location of AHIMS 11-3-0038 as previously understood and the actual location as determined by the BCD. Based on this information, we are confident that the original site, as recorded by OzArk in 2011, has been extensively surveyed as part of the most recent ACH Assessment for the Bonshaw Solar Farm.

However, this also means it now appears that a recorded Aboriginal scar tree may have been removed or destroyed in the last 10 years, which, if true, may constitute an offence under the *National Parks & Wildlife Act 1974*. Accordingly, the matter has been referred to the BCD North East Branch Compliance Team, which has advised that an investigation into the matter has commenced.

The BCD recommends that:

1. the consultant archaeologist must update the ACHAR for the project to reflect the information set out in this letter and include a map showing the re-projected location of AHIMS 11-3-0038.
2. conditions of approval should be included to:
    a. require the preparation of an Aboriginal Cultural Heritage Management Plan in consultation with the project registered Aboriginal parties and the Senior Team Leader Planning, North East Branch, Biodiversity and Conservation Division, to the satisfaction of the Department, before ground-disturbing activities commence on the project.
    b. set out a chance-finds procedure for Aboriginal Cultural Heritage.
    c. require the identification of an appropriate area surrounding the re-projected location of AHIMS 11-3-0038 in consultation with the Senior Team Leader Planning, North East Branch, Biodiversity and Conservation Division, where there will be no impacts or management actions, to enable any compliance investigation considered necessary to proceed. Works can only commence in the identified area after written advice is received from the Biodiversity and Conservation Division to this effect.

The BCD has no further issues to raise about the level of ACH assessment for the project and would support a conditional approval of the development application as set out in our recommendations above. If you have any questions about this advice, please do not hesitate to contact Mr Roger Mehr, Archaeologist, at roger.mehr@environment.nsw.gov.au or 6773 7005.

Yours sincerely

Dimitri Young

11 June 2020

DIMITRI YOUNG
Senior Team Leader Planning, North East Branch
Biodiversity and Conservation

Enclosure: Attachment 1: Figures Demonstrating recorded and actual of AHIMS 11-3-0038

Attachment 1: Figures demonstrating recorded and actual of AHIMS 11-3-0038

Bonshaw Solar Farm
AHIMS 11-3-0038 location
No overlay

Copyright of Department of Planning Industry and Environment.
This map is not guaranteed to be free from error or omission. The Department and its employees disclaim liability for any act done on the information in the map and any consequences of such acts or omissions.

Datum/Projection: GCS GDA 1994

N

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NB: New AHIMS sites recorded by ACH survey for the project are shown in orange hatching – actual tree location is within northern-most survey site

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