Government of **Western Australia**
Development Assessment Panels

LG Ref: TP2115
DAP Ref: DAP/19/01667
Enquiries: (08) 6551 9919

Mr Baifulaqi Du
SE Waroona Development Pty Ltd
Level 27
150 Lonsdale Street
MELBOURNE VIC 3000

Dear Mr Du

MID-WEST/WHEATBELT JDAP - SHIRE OF WAROONA - DAP APPLICATION - TP2115 - DETERMINATION

Property Location:	Lot 24 & Lot 25 (981) Buller Road, Waroona
Application Details:	Construction and operation of a 165 MW Solar Farm

Thank you for your Form 1 Development Assessment Panel (DAP) application and plans submitted to the Shire of Waroona on 19 September 2019 for the above-mentioned development.

This application was considered by the Mid-West/Wheatbelt JDAP at its meeting held on 15 November 2019, where in accordance with the provisions of the Shire of Waroona District Planning Scheme No. 7, it was resolved to **approve** the application as per the attached notice of determination.

Should the applicant not be satisfied by this decision, an application may be made to amend or cancel this planning approval in accordance with regulation 17 and 17A of the *Planning and Development (Development Assessment Panels) Regulations 2011*.

Please also be advised that there is a right of review by the State Administrative Tribunal in accordance with Part 14 of the *Planning and Development Act 2005*. Such an application must be made within 28 days of the determination, in accordance with the *State Administrative Tribunal Act 2004*.

Should you have any queries with respect to the conditions of approval, please contact Mr Leonard Long on behalf of the Shire of Waroona on 9733 7800.

Yours sincerely,

DAP Secretariat

19 November 2019

Encl. DAP Determination Notice
Approved Plans

Cc: Mr Leonard Long
Shire of Waroona

Government of **Western Australia**
Development Assessment Panels

Planning and Development Act 2005

Shire of Waroona District Planning Scheme No. 7

Mid-West/Wheatbelt Joint Development Assessment Panel

Determination on Development Assessment Panel Application for Planning Approval

Property Location: Lot 24 & Lot 25 (981) Buller Road, Waroona
Application Details: Construction and operation of a 165 MW Solar Farm

In accordance with regulation 8 of the *Planning and Development (Development Assessment Panels) Regulations 2011*, the above application for planning approval was **granted** on 15 November 2019, subject to the following:

Accept that the solar farm is in accordance with clause 3.3 (4)(b) of Local Planning Scheme 7 and is appropriate for consideration as a use not listed;

Approve DAP Application reference DAP/19/01667 and accompanying plans attached as Attachment 1 - 10 in accordance with Clause 68 of Schedule 2 (Deemed Provisions) of the Planning and Development (Local Planning Schemes) Regulations 2015, and the provisions of the clause 3.13.1 of the Shire of Waroona Local Planning Scheme No. 7, subject to the following conditions

Conditions:

1. The Development / Land Use shall be in accordance with the attached approved plan(s) and subject to any modification required as a consequence of any condition(s) of this approval. The endorsed plans shall not be modified or altered without the prior written approval of the local government.

2. No signs or hoardings shall be erected on the lot without the prior written approval of the local government.

3. Prior to commencement of works the applicant shall provide an amended site plan showing the following:

    a. a minimum buffer distance of 50m from the high water mark of the 'Conservation Category Wetland (CCW) (Harvey River Main Drain).
    b. minimum setbacks from the 'Resource Enhancement' wetland required by the Department of Biosecurity, Conservation and Attractions.

4. Prior to commencement of works the applicant shall enter into an agreement with the local government, prepared at the applicants cost, by which the operator agrees to financially contribute to the following:

    a. repair and maintenance of the local road (Landwehr Road) during the construction phase to the satisfaction of the local government.

5. Prior to commencement of works the applicant shall submit and have approved by the local government, and thereafter implement to the satisfaction of the local government, a 'Construction Management Plan' addressing the following matters:

    a. construction traffic,
    b. signage,
    c. dust management; and
    d. construction operating hours.

6. Prior to commencement of works the applicant shall submit and have approved by the local government, and thereafter implement to the satisfaction of the local government, an 'Environmental Management Plan' addressing the following matters:

    a. remnant vegetation,
    b. foreshore management demonstrating the mitigation of risks to the CCW,
    c. contamination,
    d. stormwater and drainage,
    e. fire management,
    f. stock management, and
    g. rehabilitation plan.

7. Prior to commencement of works the applicant shall submit and have approved by the local government, and thereafter implemented to the satisfaction of the local government, an 'Ecological Assessment / Management Plan'.

8. The applicant is required to give at least 3 months' notice to the local government if the proposed development is to cease operations and all solar panels and infrastructure must be decommissioned and removed within the 1 year of giving this notice, unless the local government agrees otherwise.

9. Prior to commencement of works a landscaping plan to be submitted to the local government for approval, which includes implementation and maintenance.

10. This decision constitutes planning approval and is valid for a period of four (4) years from the date of approval. If the subject development is not substantially commenced within the four (4) year period, the approval shall lapse and be of no further effect.

Advice Notes

1. The proponent is advised that all other government agencies approvals (where required) are to be complied with i.e. clearing permits.

2. The proponent is advised that they should consult with the Department Primary Industries and Regional Development on the appropriate stocking levels for the grazing of sheep within the development area.

3. The proponent is encouraged to enter into a financial contribution program towards the development of community projects within the local government area.

Where an approval has so lapsed, no development shall be carried out without further approval having first been sought and obtained, unless the applicant has applied and obtained Development Assessment Panel approval to extend the approval term under regulation 17(1)(a) of the *Planning and Development (Development Assessment Panels) Regulations 2011*.

DEVELOPMENT
ASSESSMENT PANEL

APPROVED
15-Nov-2019

ATTACHMENT 1

Table 3 Typical single-axis tracking system specifications

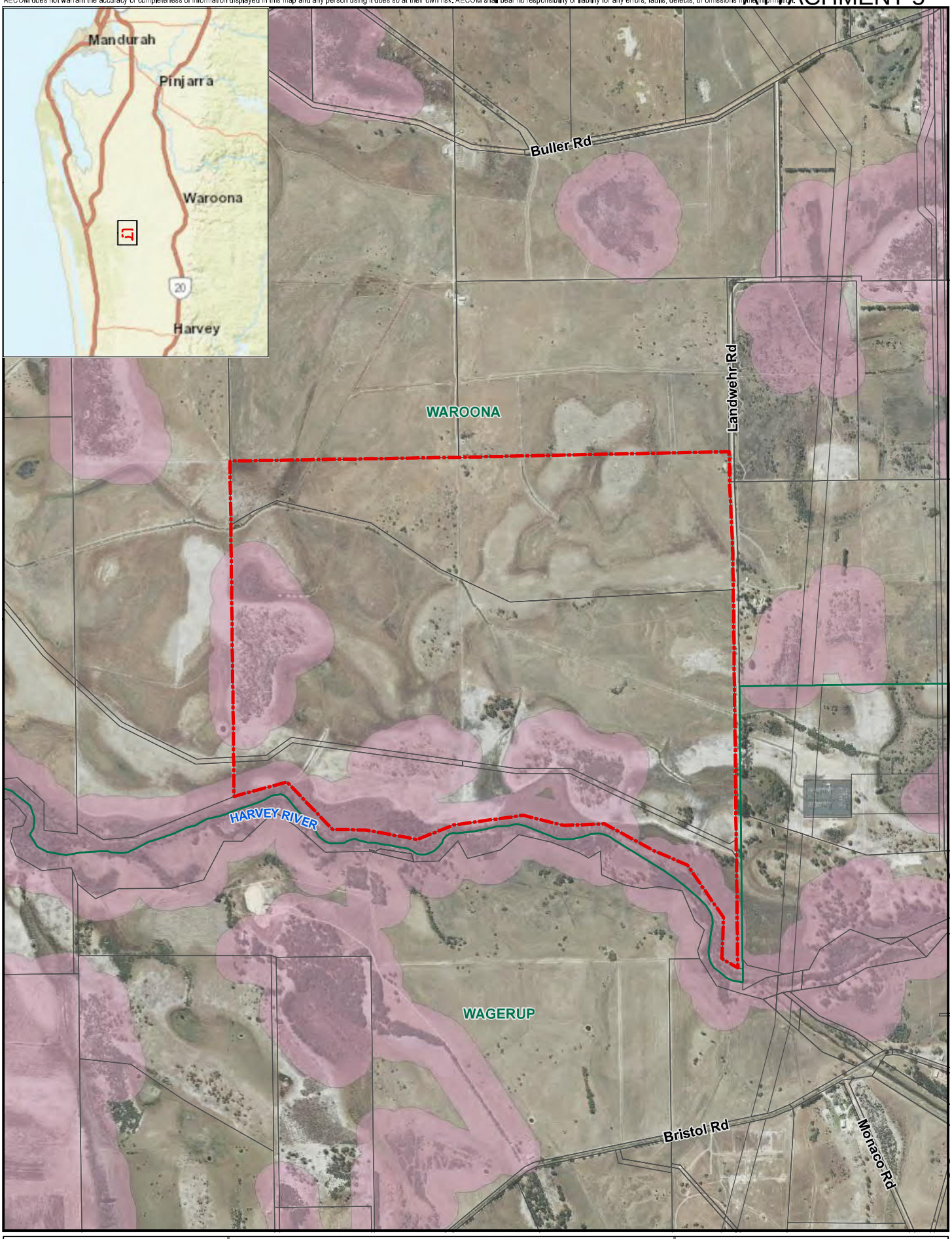
Item	Single-axis tracking system
Mounting Structure Configuration	
Row Alignment	North-south (tracking east-west)
Tracker Rotation Range	Tracker range -60˚to +60˚
Row spacing (centre to centre)	8 m
PV Module Mounting Configuration	104 PV modules with 4 modules in height in landscape
Electrical Configuration	
Quantity of Tables	9,400
Quantity of Strings	18,800
Quantity of Modules	488,800
String Configuration	26 modules per string

Plate 1 Typical single-axis tracking system

Plate 3 Typical Single Inverter PCU

Plate 4 Typical double inverter PCU

Plate 6 Typical battery storage



PROJECT ID 60605068
CREATED BY RNM
APPROVED BY M.Morel
LAST MODIFIED 20 AUG 2019

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N

DATUM GDA 1994 MGA Zone 50

1:20,000 (when printed at A4)

0 100 200 300 400
Meters

Data sources: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land

LEGEND
- Project Property Boundary
- Cadastral Boundary
- Locality Boundary
- Bushfire Prone Areas

DEVELOPMENT ASSESSMENT PANEL
APPROVED
15-Nov-2019

Bushfire Prone Areas

SE WAROONA DEVELOPMENT PTY LTD

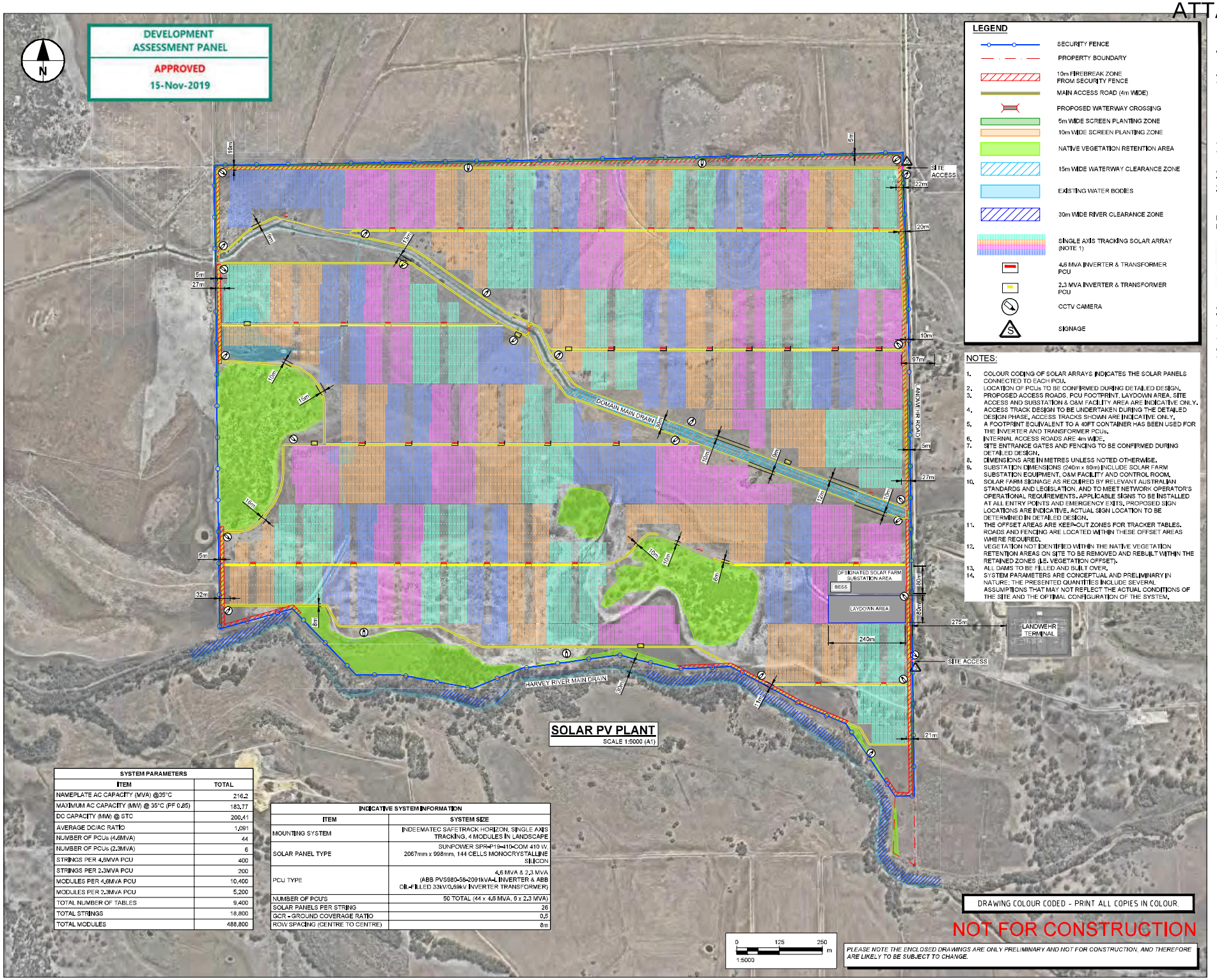
WAROONA SOLAR FARM DEVELOPMENT APPLICATION

Figure 4

Map Document: \\aupert1gis01\geo\GIS_Projects\WaroonaSolarFarm\02_MXDs\06_60605068_DevApp\G60605068_Fig4_BushFireProneAreas_A4P.mxd (WyattK2)

A4 size

ATTACHMENT 6



SYSTEM PARAMETERS	
ITEM	TOTAL
NAMEPLATE AC CAPACITY (MVA) @35°C	216.2
MAXIMUM AC CAPACITY (MW) @ 35°C (PF 0.85)	183.77
DC CAPACITY (MW) @ STC	200.41
AVERAGE DC/AC RATIO	1.091
NUMBER OF PCUs (4.6MVA)	44
NUMBER OF PCUs (2.3MVA)	6
STRINGS PER 4.6MVA PCU	400
STRINGS PER 2.3MVA PCU	200
MODULES PER 4.6MVA PCU	10,400
MODULES PER 2.3MVA PCU	5,200
TOTAL NUMBER OF TABLES	9,400
TOTAL STRINGS	18,800
TOTAL MODULES	488,800

INDICATIVE SYSTEM INFORMATION	
ITEM	SYSTEM SIZE
MOUNTING SYSTEM	INDEEMATEC SAFETRACK HORIZON, SINGLE AXIS TRACKING, 4 MODULES IN LANDSCAPE
SOLAR PANEL TYPE	SUNPOWER SPR-P19-410-COM 410 W, 2067mm x 998mm, 144 CELLS MONOCRYSTALLINE SILICON
PCU TYPE	4.6 MVA & 2.3 MVA (ABB PVS980-58-2091kVA-L INVERTER & ABB OIL-FILLED 33kV/0.69kV INVERTER TRANSFORMER)
NUMBER OF PCU'S	50 TOTAL (44 x 4.6 MVA, 6 x 2.3 MVA)
SOLAR PANELS PER STRING	26
GCR - GROUND COVERAGE RATIO	0.5
ROW SPACING (CENTRE TO CENTRE)	8m

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PLEASE NOTE THE ENCLOSED DRAWINGS ARE ONLY PRELIMINARY AND NOT FOR CONSTRUCTION, AND THEREFORE ARE LIKELY TO BE SUBJECT TO CHANGE.

AECOM

PROJECT

WAROONA
SOLAR FARM
CONCEPT DESIGN

WAROONA
Western Australia

CLIENT

SE WAROONA
Development Pty Ltd
Level 27, 150 Lonsdale Street
Melbourne, VIC 3000

South Energy

CONSULTANT

AECOM
COLLINS SQUARE, LEVEL 10, TOWER TWO
727 COLLINS STREET, MELBOURNE, VIC 3008
613 9653 1234 tel 613 9654 7117 fax
www.aecom.com

ISSUE/REVISION

I/R	DATE	DESCRIPTION
1	22.08.2019	FINAL ISSUE
0	22.08.2019	DRAFT

PROJECT NUMBER

60605068

SHEET TITLE

WAROONA
SOLAR FARM
CONCEPT LAYOUT

SHEET NUMBER

60605068-DWG-EL-0004

ISO A1 594mm x 841mm Approved: LJ Checked: CJO Designer: JJC Project Management Initials:

Last saved by: CACERES,J (2019-08-22) Last Plotted: 2019-08-22
Filename: P:\605X\60605059\90_CAD_GIS\01_CAD\20_SHEETS\60605059_DWG-EL-0004.DWG

ATTACHMENT 7

AECOM Imagine it Delivered

Waroona Solar Farm
SE Waroona Development Pty Ltd
08-Jul-2019

DEVELOPMENT ASSESSMENT PANEL
APPROVED
15-Nov-2019

Landscape and Visual Impact Assessment

Waroona Solar Farm

Landscape and Visual Impact Assessment

Waroona Solar Farm

Client: SE Waroona Development Pty Ltd

ABN: 627 427 169

Prepared by

AECOM Australia Pty Ltd
3 Forrest Place, Perth WA 6000, GPO Box B59, Perth WA 6849, Australia
T +61 8 6208 0000 F +61 8 6208 0999 www.aecom.com
ABN 20 093 846 925

08-Jul-2019

Job No.: 60605068

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Quality Information

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Date	08-Jul-2019
Prepared by	P Faustino
Reviewed by	F Mengler

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	8-July-2019	For Internal Review	Linda Kirchner Team Lead - IAP	
B	29-Jul-2019	Final Report (Revised)	Linda Kirchner Team Lead - IAP	
O	05-Aug-2019	For Planning Submission (Final Report)	Linda Kirchner Team Lead - IAP	
01	14-Aug-2019	For Planning Submission (Revised Masterplan)	Linda Kirchner Team Lead - IAP	

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Glossary

Term	Definition
Amenity	The pleasantness of a place as conveyed by desirable attributes including views, noise, odour etc.
Character	A distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another, and often conveys a distinctive 'sense of place'.
DEM	Digital Elevation Model – a computer simulation of topography.
Effect	The landscape or visual outcome of a proposed change. It may be the combined result of sensitivity together with the magnitude of the change.
GIS	Geographic Information System
Impact	The categorisation of effects. Surrounding context should be considered in defining 'impacts' and their significance.
Landscape	Landscape is an all-encompassing term that refers to areas of the earth's surface at various scales. It includes those landscapes that are: urban, peri-urban, rural, and natural; combining bio-physical elements with the cultural overlay of human use and values.
Landscape Character Zones (LCZ)	These are distinct zones of the landscape that are relatively homogeneous in character. They are generic in nature in that they may occur in different areas, but wherever they occur they share broadly similar combinations of geology, topography, drainage patterns, vegetation and historical land use and settlement pattern, and perceptual and aesthetic attributes.
Photomontage	A visual representation of a proposal from a particular receptor viewpoint, on a photographic base.
Magnitude of change	The extent of change that will be experienced by receptors. This change may be adverse or beneficial. Factors that could be considered in assessing magnitude are: the proportion of the view / landscape affected; extent of the area over which the change occurs; the size and scale of the change; the rate and duration of the change; the level of contrast and compatibility.
Mitigation	Measures to avoid, reduce and manage identified potential adverse impacts.
Receptor	A place, route, viewer audience or interest group which may receive an effect and require assessment.
Scenic amenity	A measure of the relative contribution of each place to the collective appreciation of the landscape. The term scenic amenity has a specific meaning and application in GIS mapping (a combination of visual exposure and scenic preference)
Sensitivity	Capacity of a landscape or view to accommodate change without losing valued attributes. Includes the value placed on a landscape or view by the community through planning scheme protection.
Values	Any aspect of landscape or views considered to be important. Landscape and visual values may be reflected in planning regulations, other published documents or be established through community consultation and engagement, or as professionally assessed.
View	Any sight, prospect or field of vision as seen from a place.
Viewpoint	The specific location of a view, typically used for assessment purposes.

Executive Summary

Background

Client	SE Waroona Development Pty Ltd
Property Address	Lot 24 on Plan 59266 (Land ID 3800596) and Lot 25 on Plan 59266 (Land ID 3800597)
Formal Property Description	Pastoral land in Waroona, approximately 8 km west of Wagerup
Total Site Area	303.52 hectares
Council	Shire of Waroona

Relevant planning provisions

Planning Policy Framework	State Planning Framework 2017
Local Planning Policy Framework	Peel Region Scheme (PRS) and Shire of Waroona District Planning Scheme No.7
Zone	Rural 1 – General Farming
Area of Aboriginal Cultural Heritage Sensitivity	None

Summary
This report provides an overview of the potential Landscape and Visual Impacts and required mitigation associated with the development of the Waroona Solar Farm.

Potential landscape impacts
The report findings generally show that the proposed Waroona Solar Farm has the potential to result in:

- **Moderate to low** direct impacts to the open rural landscape character of the Pinjarra System of the Swan Coastal Plain character type within which the Project is located
- **Low** to negligible direct impacts to the bushland rural character type to which the Project is adjacent
- **Moderate** direct impacts to the farmhouse rural character type to which the Project is adjacent.

Potential visual impacts
Potential visual impacts of the proposed Waroona Solar Farm have been assessed from 14 representative public viewpoint locations ranging from **Low** impact through to **High-moderate** impact. The visual impact ratings for each viewpoint are based on a consideration of the sensitivity of the visual receptors and the magnitude of expected visual change. The greatest levels of impact are expected from the viewpoints closest to the Project, where the solar panels themselves will form discernible elements within a given view.

Mitigation measures
The following mitigation is recommended to minimise impacts on the landscape and visual character:

- Further refine the design and layout during detailed design to reduce bulk and height of proposed structures.
- Review materials and colour finishes for selected components including the use of non-reflective finishes to structures where possible.
- Avoid or minimise impacts to the native vegetation including the isolated trees in paddock and riparian vegetation; minimise tree removal and rehabilitate disturbed areas.
- Carry out the proposed mitigations as described the in the Landscape Concept Plan.

- Continuously maintain and repair the constructed elements to maintain the visual appearance of the Project.
- Provide long term maintenance (and replacement as necessary) of screen planting within the Project to maintain visual filtering and screening of external views where appropriate.

1.0 Introduction

1.1 Overview

SE Waroona Development Pty Ltd (the Client) is considering development of a solar farm at a site near Waroona, approximately 100 km south of Perth in Western Australia (Figure 1) (Waroona Solar Farm, or the Project). This site is located within a 303.52 ha parcel of pastoral land identified as Lot 24 on Plan 59266 (Land ID 3800596) and Lot 25 on Plan 59266 (Land ID 3800597) (Project Area). The land is currently zoned as Rural 1 – General Farming. AECOM Australia Pty Ltd (AECOM) was engaged to prepare this Landscape and Visual Impact Assessment (LVIA) for the Client as part of the planning phase for the proposed solar farm development.

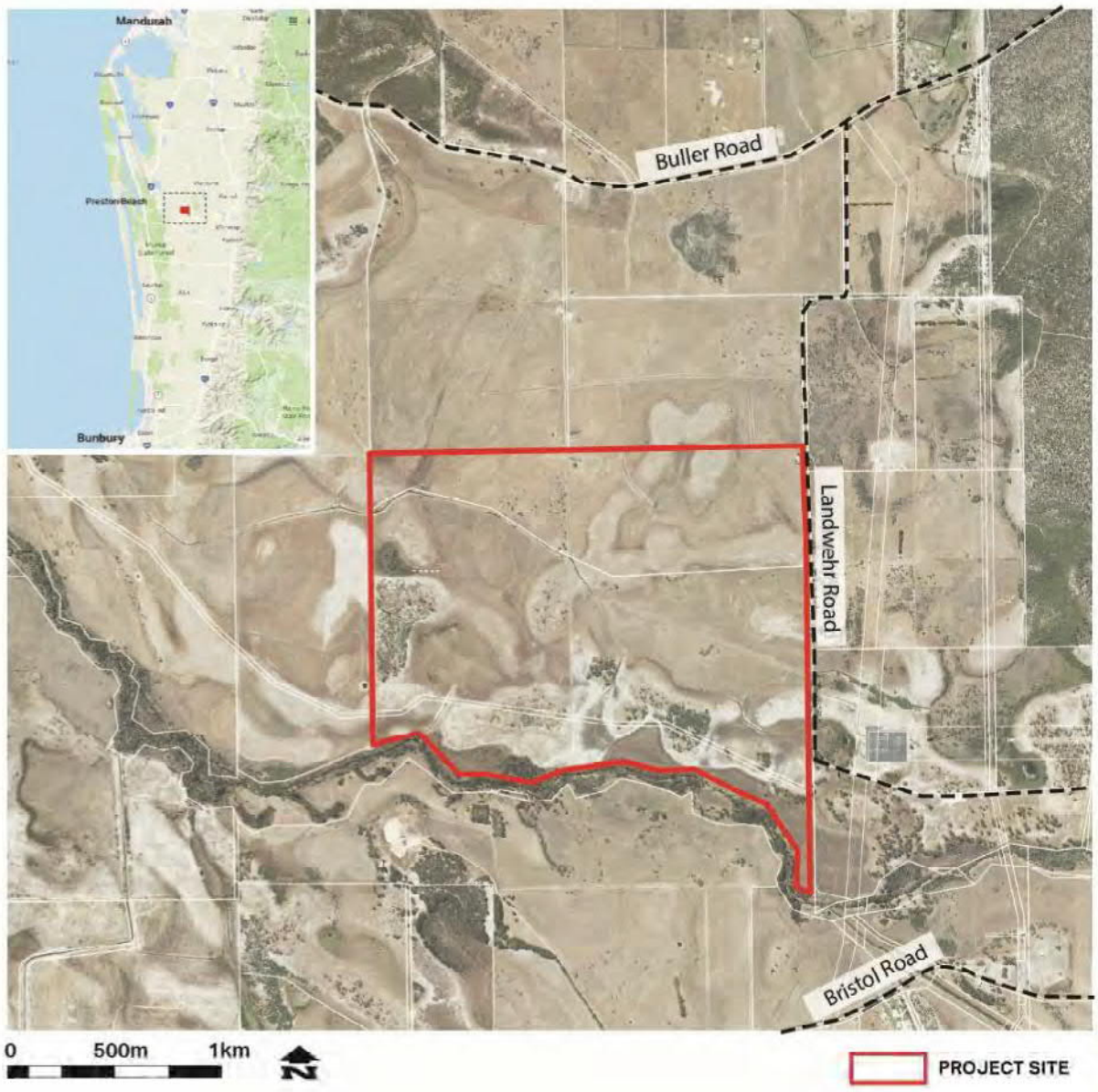


Figure 1 Project Location.

(Source: Nearmap © 2019)

1.2 Purpose

The purpose of this LVIA is to identify sensitive visual receptors and illustrate through visualisations the visual impacts from the construction and operation of the proposed solar farm. A secondary purpose is to identify mitigation required to minimise landscape and visual impact.

1.3 Report structure

The LVIA includes the following sections:

Table 1 Report structure

Report Section	Description
1.0 Introduction	This section provides an introductory overview that describes the purpose and structure of the LVIA.
2.0 Methodology	This section describes the method employed to assess the potential impacts of the Project.
3.0 Legislation, Policy and Guidelines	This section outlines the legislation, policies and planning guidelines relevant to the Project.
4.0 Project Location and Description	This section describes the site locality and key components of the Waroona Solar Farm.
5.0 Landscape Character Impact Assessment	This section identifies the variations in the character of the landscape within and surrounding the Project and determines the sensitivity and magnitude of the landscape to the proposed change.
6.0 Visual Impact Assessment	This section describes and determines the potential visual impact of the Project from key visual receptor locations.
7.0 Mitigation Measures	This section considers the application of mitigation measures to minimise potential visual impact.
8.0 Conclusion	Conclusions are made on the overall impact of the Project.

2.0 Methodology

2.1 Overview

The following method to assess landscape character and visual amenity impacts arising from the Project has been derived from an analysis of a preliminary concept design plan. The method:

- analyses the existing landscape character and visual environment
- determines the extent and nature of potential landscape and visual impacts of the Project on surrounding areas
- identifies measures to mitigate and minimise potential landscape and visual impacts.

2.2 Objectives

The Department of Planning, Lands and Heritage (DPLH) "Visual Landscape Planning in Western Australia: A manual for evaluation*, assessment, siting and design"* and Landscape Institute and the Institute for Environmental Management (United Kingdom) (2013) "Guidelines for Landscape and Visual Impact Assessment" (GLVIA3), have been used to develop the landscape and visual impact assessment methodology. The principal objectives to conduct the evaluation and assessment include:

1. Describe the existing visual landscape character.
2. Describe the proposed development.
3. Describe and evaluate the potential visual impacts.
4. Develop visual management measures.
5. Provide recommendations.

These objectives are considered to be in line with the approach outlined in (DPLH) 'Visual Landscape Planning in Western Australia: A manual for evaluation, *assessment, siting and design'* and (GLVIA3).

2.3 Desktop assessment and fieldwork

Key information was reviewed during the desktop assessment. This included review of topographic maps and aerial photography of the Project site and surrounding landscape. The topographic maps and aerial photography were used to identify the locations of potential receptor locations.

The desktop assessment also outlined the visual character of the surrounding landscape including features such as landform, elevation, water courses, vegetation cover, residential properties and the location of public roads. A one day site visit was undertaken on the 5th June 2019, and attended by two landscape architects. Fieldwork was conducted to determine and confirm the potential extent and visibility of the Project.

2.4 Assessment of landscape character impacts

Assessment of landscape character deals with the impact of a visible change on the landscape and development on: the elements that make up the landscape; the aesthetic and perceptual aspects of the landscape; and, its distinctive character. The assessment comprises the combination of the following assessments:

2.4.1 Sensitivity of landscape to visual change

The identification of the sensitivity of the landscape to a specific change encompasses the following components:

Susceptibility to change

The existing landscape receptor is assessed to understand the capacity to accommodate the Project; without adverse impact on existing landscape character, e.g. based on landform, land use, pattern or scale; and the capacity to achieve landscape planning policy and strategy objectives.

Value of the landscape

This assesses whether the value of the landscape would be affected based on existing landscape character designations (e.g. state, regionally or locally recognised landscapes), and the value of particular landscape elements or notable aesthetic, perceptual or experiential qualities.

These individual criteria are combined to achieve a landscape sensitivity rating that is defined in Table 2.

Table 2 Landscape sensitivity rating

High	Landscapes of international designation and/or landscapes that have high sensitivity to the type of development proposed which could have a detrimental impact on the landscape character or value. Mitigation measures will be unlikely to reduce all of the impacts of the change.
Moderate	Landscapes of regional designation or valued more locally and tolerant of moderate levels of change. Any change would be unlikely to have a significant adverse impact on the landscape character or value and mitigation would neutralise some of the impacts.
Low	Landscapes of local designation that are more commonplace and potentially tolerant of noticeable change or are undergoing substantial development themselves, with mitigation measures likely to neutralise or improve the landscape character.
Negligible	Landscapes of local designation and/or with low sensitivity to the type of change proposed with mitigation likely to completely neutralise any impacts or not required at all.

2.4.2 Magnitude of landscape impact

The magnitude of landscape impacts comprises the following components:

Size or scale of change

An assessment of size or scale of change in the landscape likely to be experienced as a result of the Project which may include the extent of loss of existing landscape elements, the degree of alteration to aesthetic or perceptual aspects of the landscape or change to key characteristics of the landscape.

Geographical extent of impacts

This considers the geographical extent over which the landscape impacts will be felt and is distinct from the size or scale of the change. This is influenced by site levels, the immediate setting of the site, and landscape character types in the vicinity.

Duration and reversibility of the impacts

Duration is judged on a scale of short term (zero to five years), medium term (five to ten years) and long term (ten to thirty years).

Reversibility is a judgement about the prospects of the impact being reversed, for example, a project such as a mine might have a limited life and then be rehabilitated for a new or pre-existing purpose.

These individual criteria are combined to achieve a magnitude of landscape impact that is defined in Table 3.

Table 3 Magnitude of landscape impact

High	A substantial/obvious change to the landscape due to total loss of, or change to, elements, features or characteristics of the landscape. Change would cause a landscape to be permanently changed and its quality diminished.
Moderate	Discernible changes in the landscape due to partial loss of, or change to key elements, features or characteristics of the landscape which may be partly mitigated. The change would be out of scale with the landscape, at odds with the local character, and would leave an adverse impact on the landscape. The change would partially obstruct or change a view.
Low	Minor loss or alteration to one or more key landscape features or characteristics, or the introduction of elements that may be visible but may not be uncharacteristic within the existing landscape.
Negligible	Almost imperceptible or no change in the landscape or views as there is little or no loss of, or change to the elements, features or characteristics of the landscape.

2.4.3 Overall significance of landscape character impacts

Once the sensitivity of the landscape to visual change and the magnitude of the landscape impact is determined, a rating matrix is used to determine an overall rating of landscape impacts, and rated on the level of significance of the impact, described as being Negligible, Low, Moderate - Low, Moderate, High - Moderate or High, as set out in in Table 4. Ratings of High and High - Moderate are considered to be significant.

Table 4 Overall significance of landscape character impacts

		Magnitude of impact			
		High*	**Moderate**	**Low**	**Negligible**
Sensitivity	**High**	High	High - Moderate	Moderate	Negligible
	Moderate	High - Moderate	Moderate	Moderate - Low	Negligible
	Low	Moderate	Moderate - Low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

2.5 Assessment of visual impacts

Assessment of visual impacts deals with the impact of changes to the landscapes perceived by individuals or groups of people. This identifies the change or loss of existing elements of the visual landscape and/or introduction of new elements to relevant users.

Receptor Types

The viewpoints have been organised into key receptor types, each of which are considered typically to share defined levels of sensitivity to changes in the context and character of views. The receptor types that form this assessment comprise nearby residential properties, public space and road users.

Visual Envelope Mapping

The likely visibility of the proposed elements of the Project at operation from surrounding areas is broadly mapped to define a visual envelope. This map indicates 'worst case' and is indicative only as it does not consider the impacts of existing vegetation cover.

Photomontages

Photography

Photographs of the Project site from nominated receptor locations were used to assist in the analysis process. The photographs were taken during a site visit on 5 June 2019.

Camera

A series of photographs were captured on site using a Nikon D5600 digital camera with a Nikon 18- 55 F3.5-5.6 G Lens. The camera has an APS-C sensor which produces a crop factor of 1.5x relative to 35mm film. Photos were taken with the lens set at 24mm, providing a horizontal Field of View (FoV) of 51.4° and a vertical FoV of 35.6°. Photos were taken using an aperture of F8 to provide a deep depth of field, an ISO of 100 to keep noise to a minimum and shutter speed of 1/125 to 1/500 seconds to create a suitable exposure. The camera was mounted on a tripod to eliminate camera shake or motion blur. Camera positions were recorded using Survey123, an ESRI ARC GIS application providing an accuracy of +/- 3m. Coordinates were recorded using the Universal Transverse Mercator co-ordinate system.

Photomontage model

The photomontages were created using Adobe Photoshop software. A three dimensional (3D) indicative model of the Project was made using Trimble SketchUp Pro software to represent an indicative arrangement of solar arrays, based on the georeferenced Autodesk Autocad layout. Both the existing terrain (using Landgate topographic data) and the solar farm array model were built as a 3D model. The intent of the model was focussed on viewing the Project in its wider setting, at the view level of a pedestrian at a nominal eye height of 1.85 metres. The materials and finishes used in the photomontages are indicative only and would be further investigated during detailed design.

Virtual camera matching

Photographs were corrected for distortion using specific camera and lens profiles, and camera coordinates were then merged with the 3D model to allow a 'virtual camera' to be set up using these coordinates. Camera matching was undertaken using reference points common to the 3D model and physical features in the photographs. Photos and 3D model were combined using the 'Match Photo' tool within Trimble SketchUp Pro software and then transferred to Adobe Photoshop for rendering.

Rendering

The model was rendered with the photographs and edits to the foreground and background elements made as necessary. AECOM carefully compares site photography, plans, aerial photography and other sources of information such as Google Street View when editing photographic data to ensure that represented views are realistic.

2.5.1 Sensitivity of visual receptors

The sensitivity of visual receptors encompasses the components outlined below.

Susceptibility of visual receptors to change

The susceptibility of different visual receptors to changes in views and visual amenity is mainly a function of the activity of people experiencing the view and the extent to which their attention or interest may therefore be focused on the view.

Visual receptors most susceptible to change are generally residents who are likely to occupy these locations for long periods of time, people engaged in outdoor recreational activity, visitors to attractions where the surroundings are part of the experience, and communities where the landscape setting is an important contributor to the amenity of their environment.

Visual receptors with a moderate susceptibility to change are generally travellers on road and rail transport. Where travel involves recognised scenic routes, the awareness of views may be particularly high.

Visual receptors with less sensitivity to change include people engaged in outdoor sport and people at their place of work where attention is focussed on their activity and the setting is less important to their experience.

Value attached to views

This assessment considers:

- the recognition of the value attached to particular views, either in relation to heritage assets or through planning designations, planning policy or other existing planning or urban design studies.
- indications of the value attached to views, either through inclusion in guidebooks or on tourist maps, or provision of facilities for their enjoyment such as sign boards and interpretive material.

These components are combined to produce a sensitivity assessment that ranges from High to Negligible.

2.5.2 Magnitude of the visual impacts

The magnitude of visual impacts comprises the components outlined below.

Size or scale of the change
This assessment takes account of the scale of change in the view with respect to: the loss or addition of features in the view; the degree of contrast or integration of any new features or changes and characteristics in terms of form, scale and mass, line, height, colour and texture; the nature of the view of the proposal; and, whether views will be full, partial or glimpses.

Geographical extent of impacts
The geographical extent of a visual impact will vary with different viewpoints and is likely to reflect the horizontal angle of the view, the distance of the viewpoint, and the extent of the area over which changes would be visible.

Duration and reversibility of the impacts
Duration is judged on a scale of short term (zero to five years), medium term (five to ten years) and long term (more than ten years). Reversibility is a professional judgement about the prospects of the impact being reversed, with a solar farm having a good potential to revert to farmland.

These components are combined to produce a magnitude of visual impact assessment that ranges from High to Negligible.

2.5.3 Overall significance of visual impacts

Once the sensitivity of the landscape to visual change and the magnitude of the landscape impact is determined, a rating matrix is used to determine an overall rating of visual impacts, and made on the level of significance of the impact, described as being Negligible, Low, Moderate - Low, Moderate, High - Moderate or High, as set out in Table 5.

Table 5 Overall significance of visual impacts

		Magnitude of impact			
Sensitivity		**High***	**Moderate**	**Low**	**Negligible**
	High	High	High - Moderate	Moderate	Negligible
	Moderate	High - Moderate	Moderate	Moderate - Low	Negligible
	Low	Moderate	Moderate - Low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

2.6 Mitigation measures

Following from the assessment of impacts, a set of mitigation measures have been developed to reduce adverse impacts by the Project on sensitive receptors. Mitigation measures typically include appropriate design considerations, materials selection, colour selection and landscape planting.

2.7 Assumptions and limitations

This methodology includes the following assumptions and limitations:

- For assessment purposes, it is assumed that no landscape mitigation is in place.

3.0 Legislation Policy and Guidelines

3.1 Legislative Framework

There is currently no national level guideline document for Landscape and Visual Assessment (LVA) in Australia. Landscape Architects in Australia have instead relied on a number of guidance documents offered by other Landscape Architecture Institutes and Government bodies.

The Landscape Institute and the Institute for Environmental Management (United Kingdom) (2013) "Guidelines for Landscape and Visual Impact Assessment" (GLVIA3), provides the basis for 'best practice' in this field.

The Western Australian Planning Commission's (WAPC) 'State Planning Policy No. 2 Environment and *Natural Resource Policy'* For Western Australia states that the objective for planning is to:

- 'Identify and safeguard landscapes with high geological, geomorphological or ecological values, as well as those of aesthetic, cultural or historic value to the community, and encourage the restoration of those that are degraded.'
- 'Consider the level or capacity of the landscape to absorb new activities and incorporate appropriate planning and building design and siting criteria to ensure that new development is consistent and sensitive to the character and quality of the landscape.'
- 'Consider the need for a landscape, cultural or visual impact assessment for land use or development proposals that may have a significant impact on sensitive landscapes.'

The Department of Planning, Lands and Heritage (DPLH) 'Visual Landscape Planning in Western Australia: A manual for evaluation, assessment, siting and design' has been used to develop the landscape and visual impact assessment methodology. The principal objectives to conduct the evaluation and assessment include:

1. Describe the existing visual landscape character.
2. Describe the proposed development.
3. Describe and evaluate the potential visual impacts.
4. Develop visual management measures.
5. Provide recommendations.

Therefore, this assessment is made with reference to an understanding of planning policy, methodology and techniques set out in the documents above.

4.0 Project location and description

4.1 Regional setting

4.1.1 Swan Coastal Plain

The Project is located within the Swan Coastal Plain, near Waroona in Western Australia. The Swan Coastal Plain is a strip of land approximately 10 kilometres wide that is aligned north-south between the Indian Ocean to the west and the Darling Scarp to the east. Within the district of the Swan Coastal Plain in which the Project Area is located, there is a broad land type identified as Palusplain. The Palusplain is a seasonally waterlogged, flat wetland typical of the duplex and sandy soils found on the Pinjarra Plain to the east of the Swan Coastal Plain (Semeniuk, cited in Hill et al. 1996).

The Palusplain is characterised by a very gently undulating landscape, high winter water tables, sandy and duplex soils, and variable quality groundwater resources. Prior to European settlement, the Palusplain was a slowly moving, interconnected, seasonal wetland system with areas of higher ground, and a rich food source for the local Noongar peoples. Extensive clearing and drainage occurred in the late 1800s through to the mid-1900s to facilitate agriculture (Safstrom and Short, 2012).

4.1.2 Recent Landscape History

Bradby (cited in Environmental Protection Authority, 2008) describes the Swan Coastal Plain in 1829 as being a wetland. Each winter, it and the upstream jarrah forest would be hit by heavy and concentrated rains. Streams and brooks would flow onto the plain, dissipating their energy into a broad, interconnected chain of swamps many kilometres wide. Only the rivers of the largest system, the Murray and the Dandalup, stayed in clear stream beds for all their length, except in larger floods.

The other main rivers, the Serpentine and the Harvey, were well-defined in their upper and lower sections, but their middle reaches were a maze of swamps. Here, the rivers would spread out in winter and join forces with the flow from all the smaller brooks and streams. Some of this water would eventually seep through to the rivers' lower reaches, and flow through the estuary to the sea. The plain would be flooded from the scarp through to the long ridge of tuart-covered Spearwood dunes towards the coast, with only occasional sand hills remaining exposed (Safstrom and Short, 2012).

4.1.3 Vegetation Clearing and Drainage for Agriculture

Prior to European settlement, the land in the district was heavily vegetated with paperbark woodland and jarrah–marri forests to the east. With increased colonisation in the late 1800s came increased clearing for agriculture resulting in groundwater rise which exacerbated the extent of seasonal inundation. Eventually, after landholders lodged numerous complaints relating to lost crops and property damage, the government addressed the problem of inundation by implementing a network of drains. In 1900, the first Drainage Bill was passed by state parliament. Over the next 70 years, trees on the banks of the waterways were removed, lower river reaches were de-snagged, the rivers were straightened and deepened, and systems of interconnecting drains were dug across pastoral lands, resulting in the current landscape setting (Safstrom and Short, 2012).

4.2 Local setting

4.2.1 Soils and Landscape

The Project is located within the Swan Soil-Landscape province and is recognised as described by Purdie et al. (2004) as being part of the following mapped land systems in the area:

- Bassendean System (212Bs) – sand dunes and sandplains with pale deep sand, semi-wet and wet soil. This system covers most of the Project Area.
- Pinjarra System (213Pj) – Poorly drained coastal plain with variable alluvial and aeolian soils. This system presents as the alluvial plain of the Harvey River located along the southern margin of the Project Area, as well as a small depression in the north eastern corner of the Project Area.

Land systems in the Project Area can be further defined into nine sub-systems that form a mosaic of sandplains, low dunes and depressions with varying drainage – in some parts, depressions may form poorly-defined creeks. Where the Pinjarra System is present, clays and duplex soils are more prevalent. These duplex soils support the defined, incised channel and banks of the Harvey River.

More broadly, this area of the Swan Coastal Plain at the interface of the Bassendean and Pinjarra Systems is defined by its gently undulating land surface, extensive areas of poor drainage and palusplain, formed on alluvium originating from the Darling Range. Soils are generally sandy at the surface, tending to loamy duplex soils and clays at depth (Tille et al, 1994). Soil-Landscape mapping within the Project site is shown in Figure 2.

4.2.2 Wetlands

Mapping within the Geomorphic Wetlands, Swan Coastal Plain (DBCA-019) database identifies Multiple Use category wetlands occurring over a substantial portion of the site. The Harvey River is identified as a Conservation Category wetland. A small area of Resource Enhancement wetland is also identified by the DBCA-019 database (Figure 2).

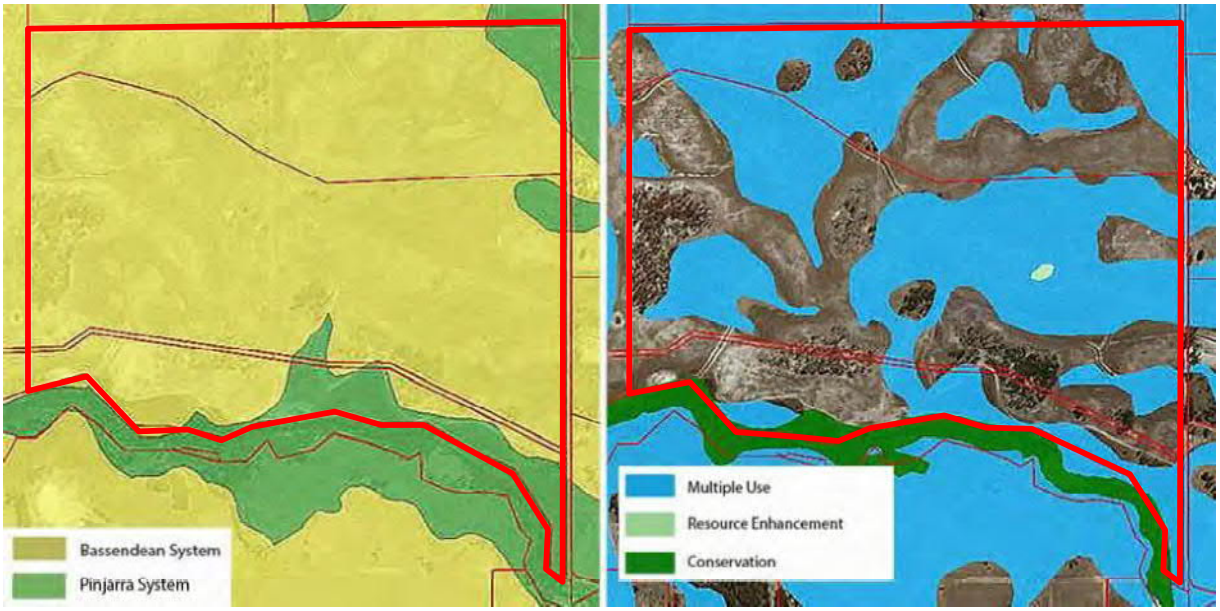


Figure 2 Soil Landscape Systems (Left) & Wetland categories (Right)

4.2.3 Vegetation

Pre-European vegetation mapping has been undertaken by Beard (1974). This mapping shows one vegetation association within the Project Area, described as:

> Association 1000 Low forest or woodland. Mosaic: medium forest; Jarrah-Marri / low woodland; Banksia / Low forest; Teatree (Melaleuca spp.).

Heddle et al. (1980) conducted vegetation complex mapping for the Swan Coastal Plain at a scale of 1:250,000. The mapping shows three vegetation types including Serpentine River, Cannington and Southern River Complex (Figure 3 and Table 6).

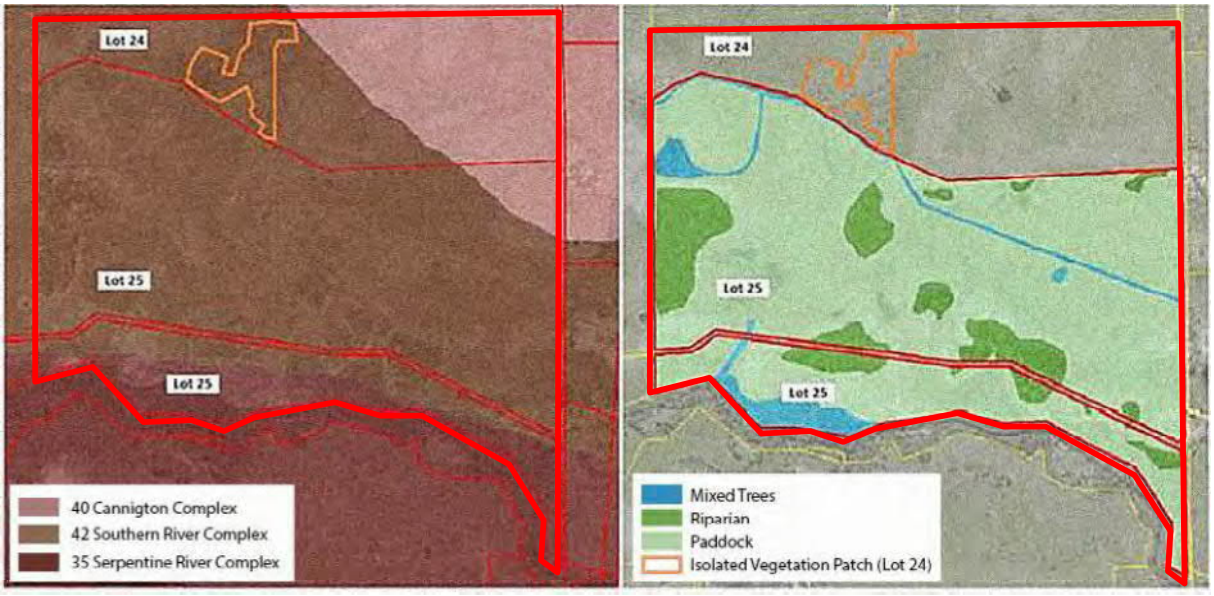


Figure 3 Pre-European vegetation (Left) and AECOM 2019 survey (Right)

Table 6 Vegetation complex mapping in the Project Area by Heddle et al. (1980)

Landform Unit	Complex	Description
Pinjarra Plain	35 Serpentine River Complex	Closed scrub of Melaleuca species and fringing woodland of Eucalyptus rudis (Flooded Gum) - Melaleuca rhaphiophylla (Swamp Paperbark) along streams.
Combination Bassendean Dunes and Pinjarra Plain	40 Cannington Complex	Mosaic of vegetation from adjacent vegetation complexes of Bassendean, Karrakatta, Southern River and Vasse.
	42 Southern River Complex	Open woodland of Corymbia calophylla (Marri) - Eucalyptus marginata (Jarrah) - Banksia species with fringing woodland of Eucalyptus rudis (Flooded Gum) - Melaleuca rhaphiophylla (Swamp Paperbark) along creek beds.

4.2.4 Site Vegetation

AECOM mapped the vegetation within the Project site and reported stands of mixed trees, riparian vegetation and paddock (grasses cultivated for stock feed). Tree death was prominent throughout all areas of native vegetation. Understorey vegetation was generally absent with some evidence of regrowth of herbs following the drying-out of inundated areas.

Degrading factors such as erosion, grazing, potential dieback or alterations in groundwater levels, and weeds are causing considerable decline in the condition of native vegetation within the Project site.

Vegetation descriptions for the main vegetation associations observed in the Project site and typical photographs are provided in Table 7.

Table 7 Vegetation associations including extent and condition

Description	Photograph
Mixed trees Stands of mixed trees including Eucalyptus marginata and Corymbia calophylla with occasional Melaleuca and Banksia spp. Condition: Degraded	
Riparian Eucalyptus rudis subsp. rudis tall overstorey over Melaleuca preissiana low trees over weeds. Density of vegetation varied with degradation. Condition: Degraded to Completely Degraded (man-made drains)	
Paddock Predominantly cleared paddock comprising common pasture weeds. Low-lying areas winter-wet. Scattered Eucalyptus trees. Condition: Completely Degraded	

4.3 Project site

The site is located within the rural area on a 303.52 ha parcel of pastoral land near Waroona, located approximately 40 km south of Mandurah and approximately 100 km south of Perth, in the Shire of Waroona in Western Australia (Figure 4). Project site is identified as Lot 24 on Plan 59266 (Land ID 3800596) and Lot 25 on Plan 59266 (Land ID 3800597), located on flat to gently undulating plains.

Figure 4 Project site
(Source: Nearmap © 2019)

4.4 Site surrounds

Land surrounding the subject site is mostly pastoral land that is currently zoned as Rural 1 - General Farming.

Built environment features include farm houses and residential dwellings, farm-related infrastructure such as out-buildings, sheds, trees, vegetation and waterways.

The immediate surrounds can be described as follows:

- **North:** Northern boundary of Lot 24 on Plan 59266 (Land ID 3800596) and Farmland
- **South:** Harvey River, riparian forest and wetlands
- **East:** Landwehr Road, Landwehr Terminal and Buller Nature Reserve
- **West:** Western boundary of Lot 24 on Plan 59266 (Land ID 3800596) and Lot 25 on Plan 59266 (Land ID 3800597) and Farmland.

4.5 Site characteristics

4.5.1 Land Use

The project is wholly within general Farming Zone of the Local Town Planning Scheme and is on agricultural land that has been heavily cleared for broad acre farming. It is envisaged that throughout the operation of the Project, the site area will continue to be used for the purposes of grazing livestock when not waterlogged.

4.5.2 Landscape

Vegetation present includes native riparian vegetation in the southwest corner and scattered trees throughout the farming paddocks. There are wetland areas throughout the site, which are prone to seasonal waterlogging and inundation. Numerous man-made drains are also present. Buller Nature Reserve is located at approximately 1,000 m east of the site.

4.5.3 Access

The site's main vehicle access point is via Landwehr Road at the south-eastern corner of the site. The site has a frontage to Landwehr Rd along its eastern boundary. The site is surrounded by two main roads – Buller Road approximately 1,250m north of the site and Bristol Road, approximately 1,000m south of the site. The site is bound by the Harvey River to the south and is surrounded by farmland on all the other sides. The main transport corridors in the region include the South Western Highway (east) and Forrest Highway (west), both connecting Perth to Bunbury and all other townships in between (Figure 5).

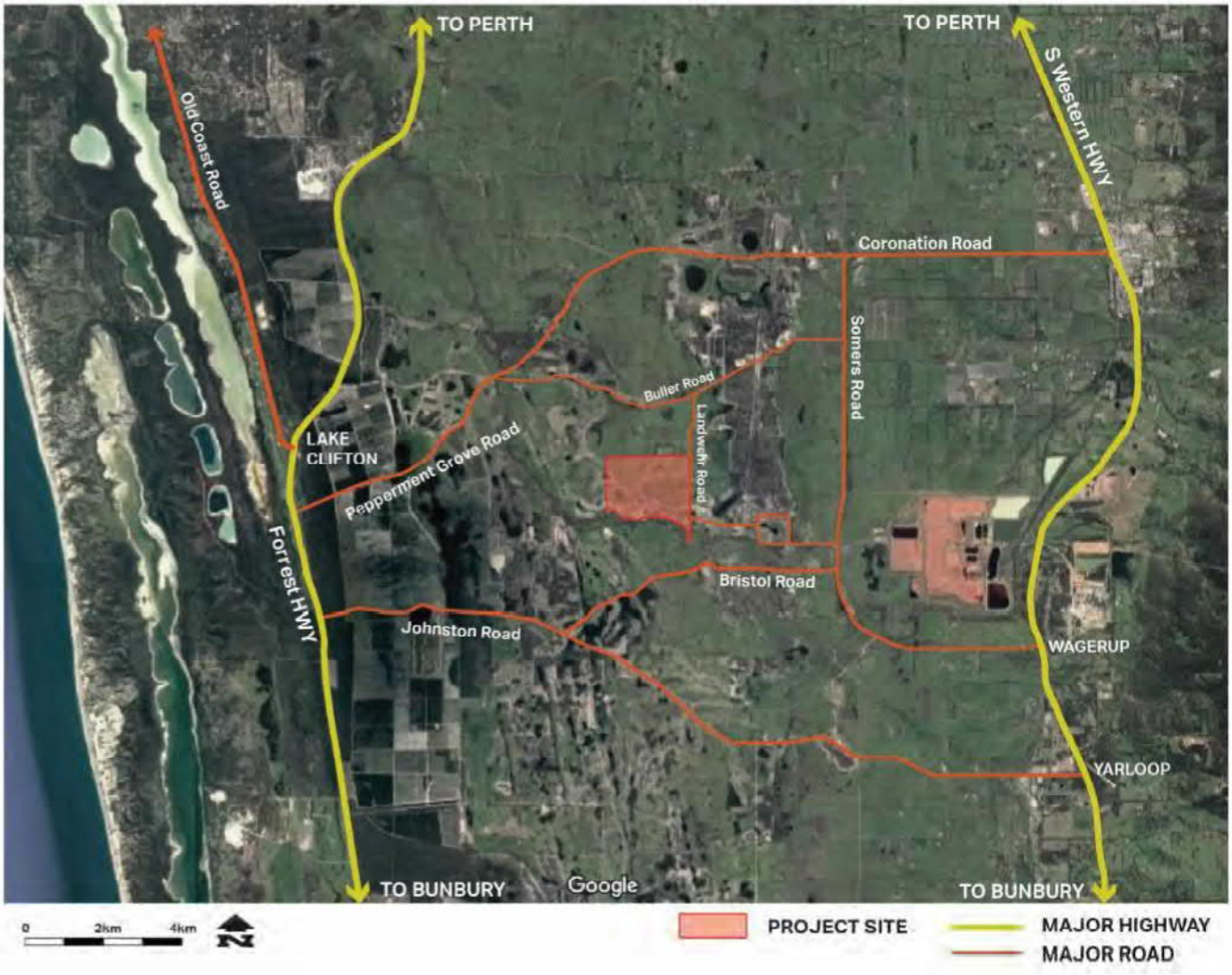


Figure 5 Site Access

(Source: Nearmap © 2019)

4.6 Topography

Based on inferred contours derived from Western Australian Land Information Authority - Landgate, the site elevation ranges between approximately 9 metres Australian Height Datum (mAHD) to 16 mAHD, with several undulating mounds within the site interspersed with low points associated with areas of poor drainage within the site. The majority of the site is at an elevation of 11 mAHD. From the highest area of the landscape located in the southwestern portion of the site, the land generally slopes downwards towards the east and north. The lowest elevations are along the Harvey River (southern boundary). Refer to Figure 6.

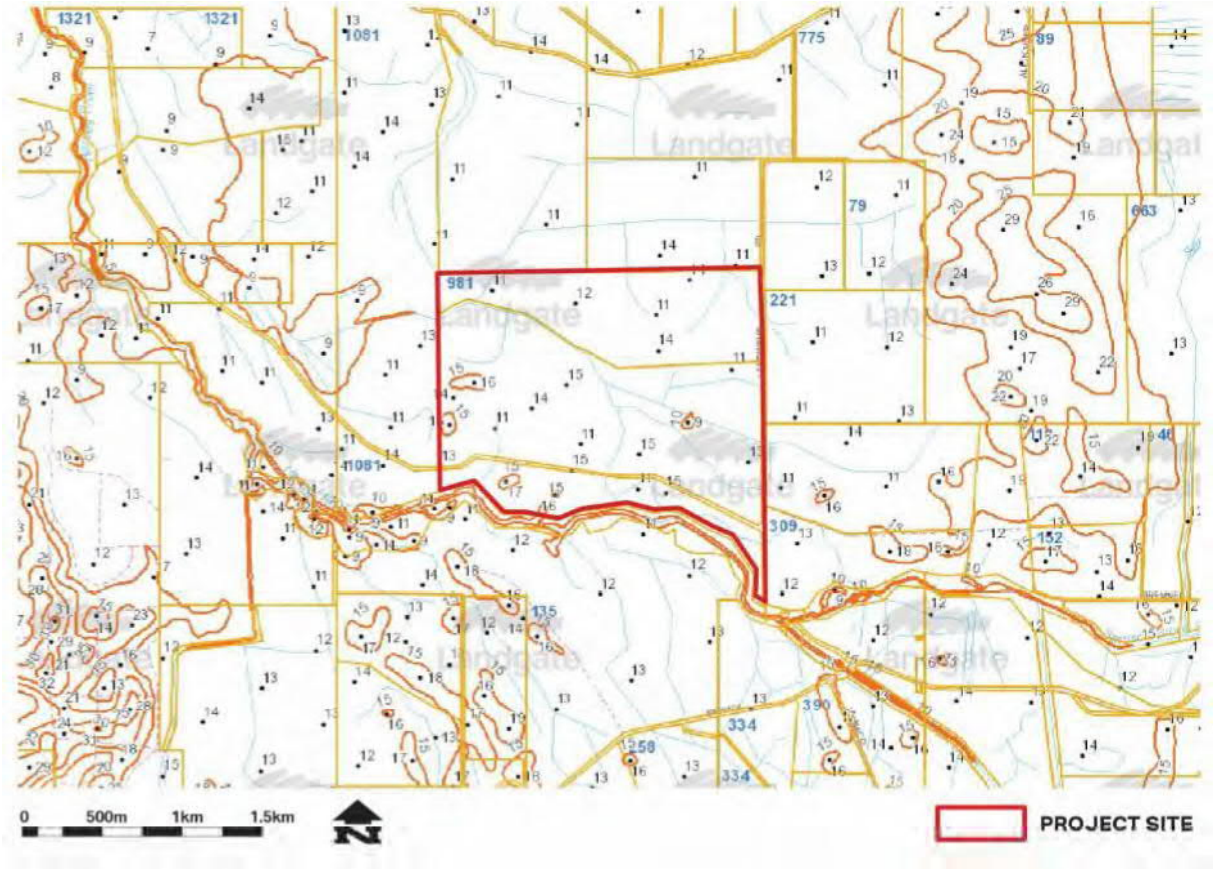


Figure 6 Site Topography and Elevation Points

(Source: Nearmap © 2019)

4.7 Proposed Development

The proposed development is at concept stage and a finalised schematic was not available at the time of preparing this report. Based on previous experience with similar projects, it is assumed the development will comprise:

- Photovoltaic (PV) solar modules mounted on a single-axis tracking system mounted on steel piles
- Solar Farm Substation (including O&M Facility, Control Room, BESS and Western Power Terminal Station equipment)
- Electrical transmission structures
- Power Conversion Unit (PCU)
- Fencing
- Internal all-weather access tracks and associated drainage
- Landscaping.

An indicative site layout is shown below in Figure 7.

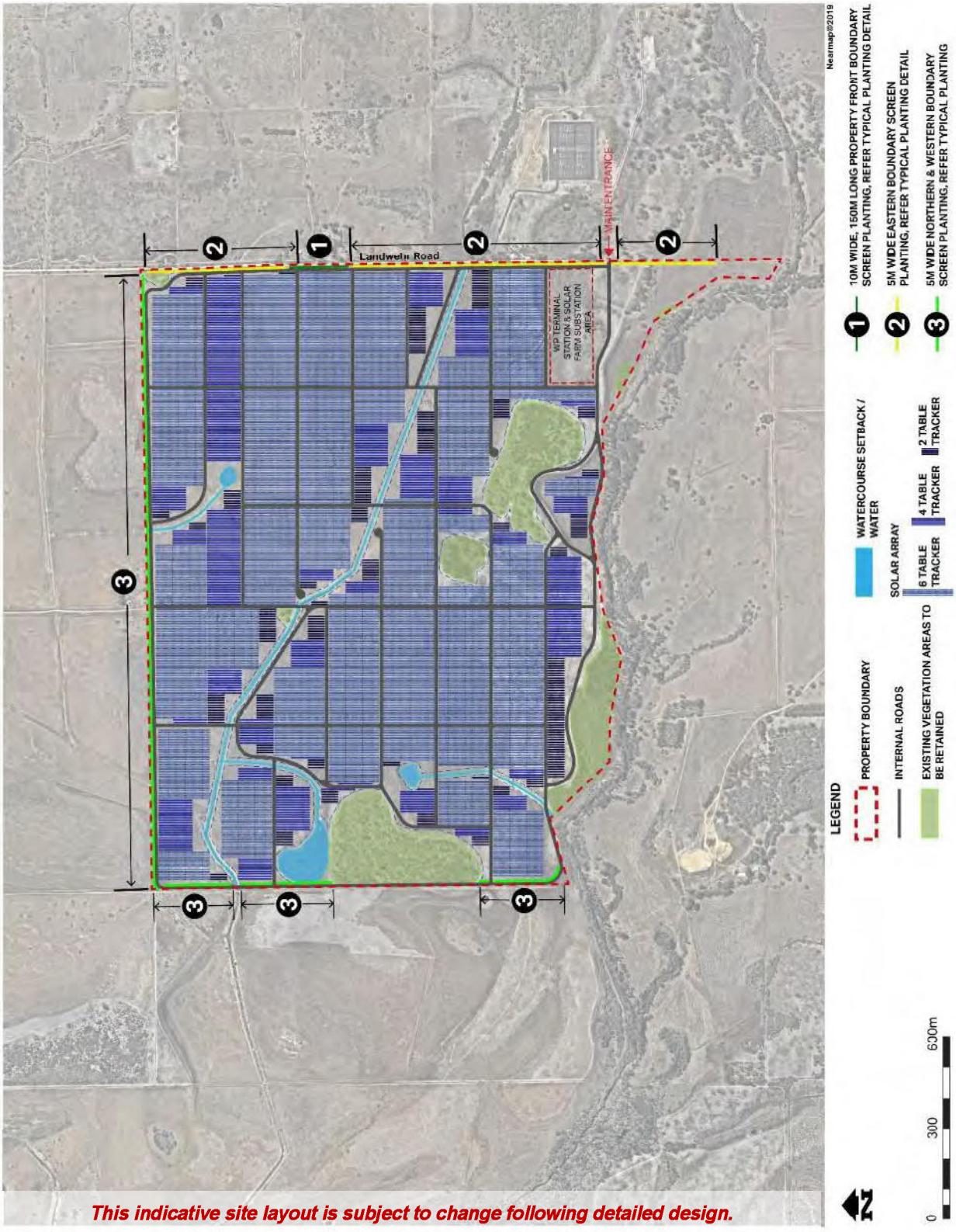


Figure 7 Indicative site layout

(Source: Nearmap © 2019)

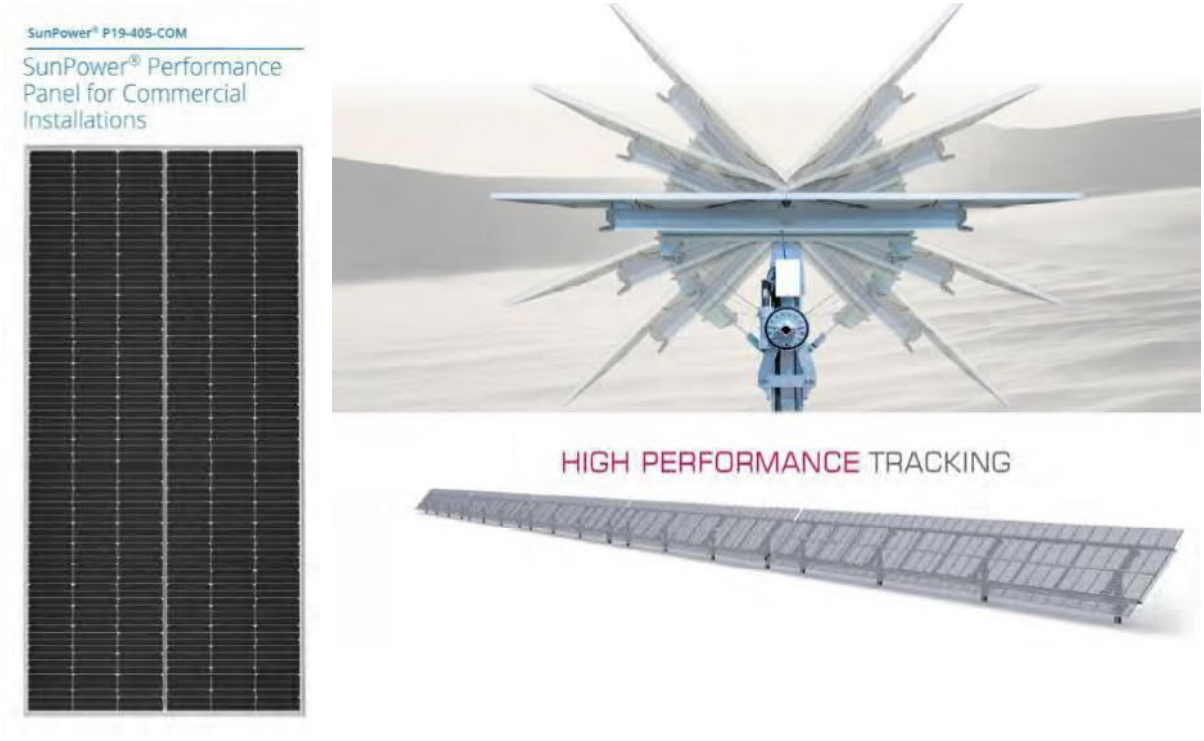
The proposed mounting configuration of the individual PV modules will be a series of modules on tracking structures. PV modules will be mounted on tracker arms in landscape arrangement, with the tracking angle ranging from +55 to -55 degrees to the horizontal each day. The modules will be oriented to face east for first light in the morning and will track to follow the position of the sun throughout the course of the day. At solar noon, the position of the modules will be zero degrees (parallel to the ground) and they will finish facing west in the late afternoon.

In order to maximise electricity production, it is assumed that the PV modules will be arranged on a single tracking system that rotates about a north-south aligned axis to follow the sun +/- 55^{o} from the horizontal, with the panels being oriented as close as perpendicular to the incoming sun as possible.

The tracking structures will be arranged in rows, mounted on piles, which will be screwed, or pile driven depending on final geotechnical analysis. This eliminates the need for concrete and foundations which significantly reduces the impact of construction. In turn, this enables the retention of native grasslands and habitats under the array.

This construction methodology keeps ground disturbance to a minimum and allows the final site design to follow the existing lie of the land. It is expected that the site will be maintained by livestock grazing as much as possible.

The PV module and tracking structures used for this analysis are shown in Figure 8. The actual module and tracking structures may differ once a construction partner has been appointed and detailed design progresses.



PV module **Tracking structure**

Figure 8 Typical example of a PV module and axis tracker system

A number of Power Conversion Units (PCU) will be located on site as well as a terminal station. A typical example of a PCU is shown in Figure 9. A typical example of a Solar Farm Substation is shown in Figure 10.

Figure 9 Typical example of power conversion unit (PCU) for solar farm

Figure 10 Typical example of a Solar Farm Substation.

5.0 Landscape Character Assessment

5.1 Landscape character zones

Three landscape character zones (LCZ) have been identified within the study area, comprising:

- LCZ 1: Open rural landscape
- LCZ 2: Bushland rural landscape
- LCZ 3: Farmhouse landscape.

Figure 11 presents the extent of the landscape character zones. For the purpose of this assessment, the key area of focus is considered to be those with a one kilometre offset from the Project. Beyond this area, it anticipated that the combined impacts of intervening landform and vegetation will combine to limit landscape and visual impacts of the Project.

5.1.1 Landscape Character Zone 1 - Open rural landscape

This LCZ is characterised by a predominantly open rural landscape with large rural lot holdings (refer to Figure 12), laid out in a mosaic of grid forms comprising agricultural fields. The orientation of many of the field boundaries is influenced by the flat to gently undulating topography. This 'mosaic grid' is emphasised with a combination of lot boundary planting, road layout with roadside planting and different crops and pasture management practices.

As mentioned above, the topography is generally flat to gently undulating. The overall landscape comprises a scattering of remnant trees spread across the open pasture landscape. Most of lower parts of the landscape have some remnant pockets of riparian and riparian native vegetation. Remnant thickets of dark green bushland occupy some of the drains and watercourses running through the landscape.

5.1.2 Landscape Character Zone 2 - Bushland rural landscape

This LCZ comprises a generally fragmented, group of landscape units, underlain by either harder rock that was likely not capable of supporting agriculture, drainage areas (Harvey River and drains) and clusters of wetland that floods during the wet season. The LCZ is often subject to dense bushland cover. The vegetation type supported by this LCZ creates partial to full enclosure of the Project landscape setting (Figure 13).

5.1.3 Landscape Character Zone 3 - Farmhouse Landscape

This LCZ is generally characterised by domestic landscapes including gardens, farmhouses and other low density residential and ancillary dwellings of varying architectural styles. The built forms are all setback from the road edge. Front yards are generally open, with lawns and simple garden beds framed by groupings of mature trees creating semi-enclosed domestic external environments. Solid boundary fencing is absent (Figure 14).

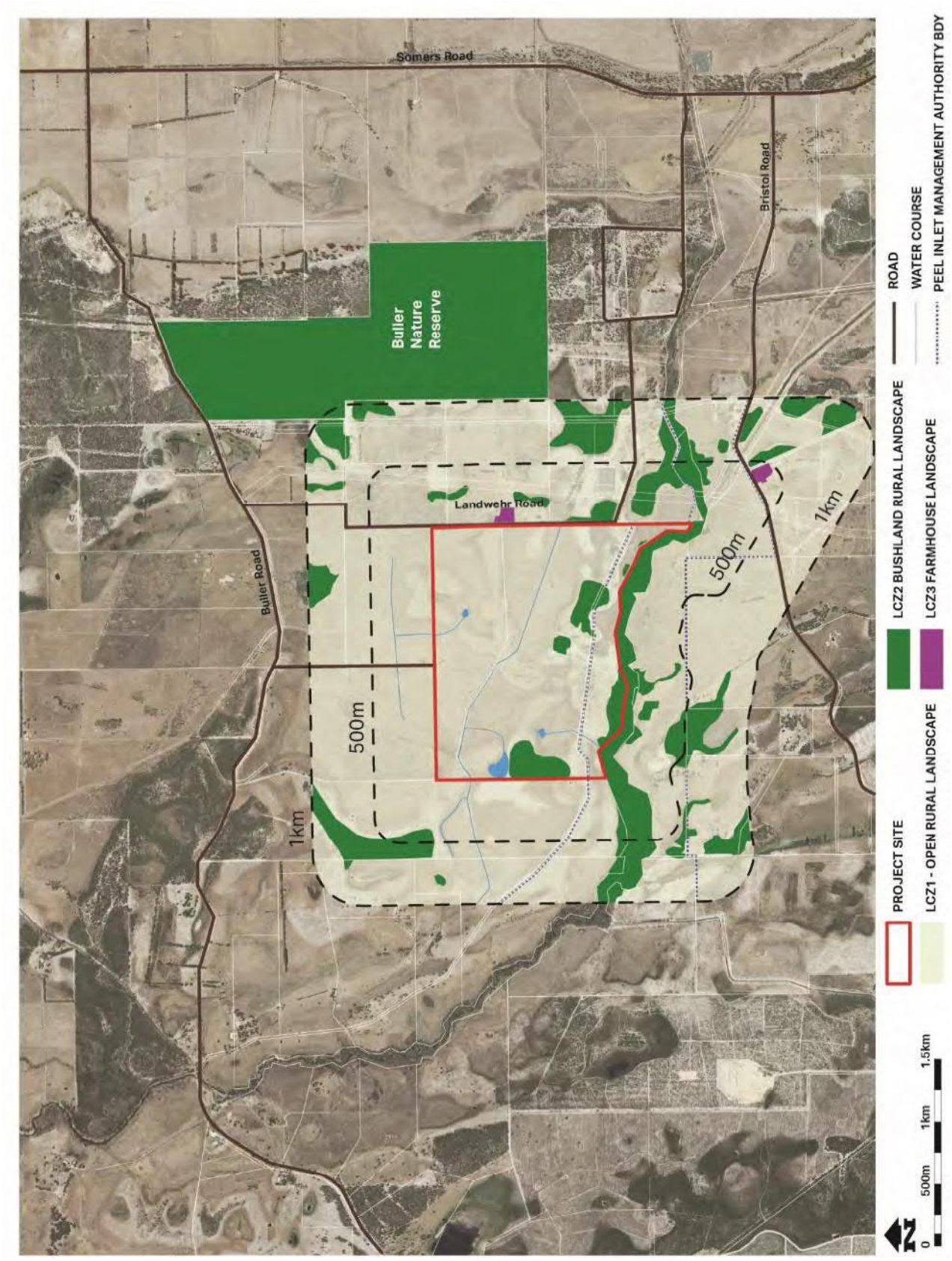


Figure 11 Landscape character zones and study area
(Source: Nearmap © 2019)

Figure 12 Examples of the open rural landscape of LCZ 1 – typical images

Figure 13 Examples of the bushland rural landscape of LCZ 2 – typical images

Figure 14 Examples of the farmhouse landscape of LCZ 3 – typical images

5.2 Existing visual buffers (vegetation analysis)

Broadening the existing vegetation analysis surrounding the Project site, it is possible to infer possible visual buffers that will contribute to the enclosure on the Project site from the main public access roads surrounding the site. These areas or buffers are composed of partial to dense clusters of remnant bushland, nature reserves, clusters of paperbark woodland scattered through the lower wetlands, Riparian forest along the Harvey River and farmland hedges. Due to its dense nature, these existing visual buffers enhance the capacity of the surrounding landscape to mitigate some of the visual effects of the Project (Figure 15).

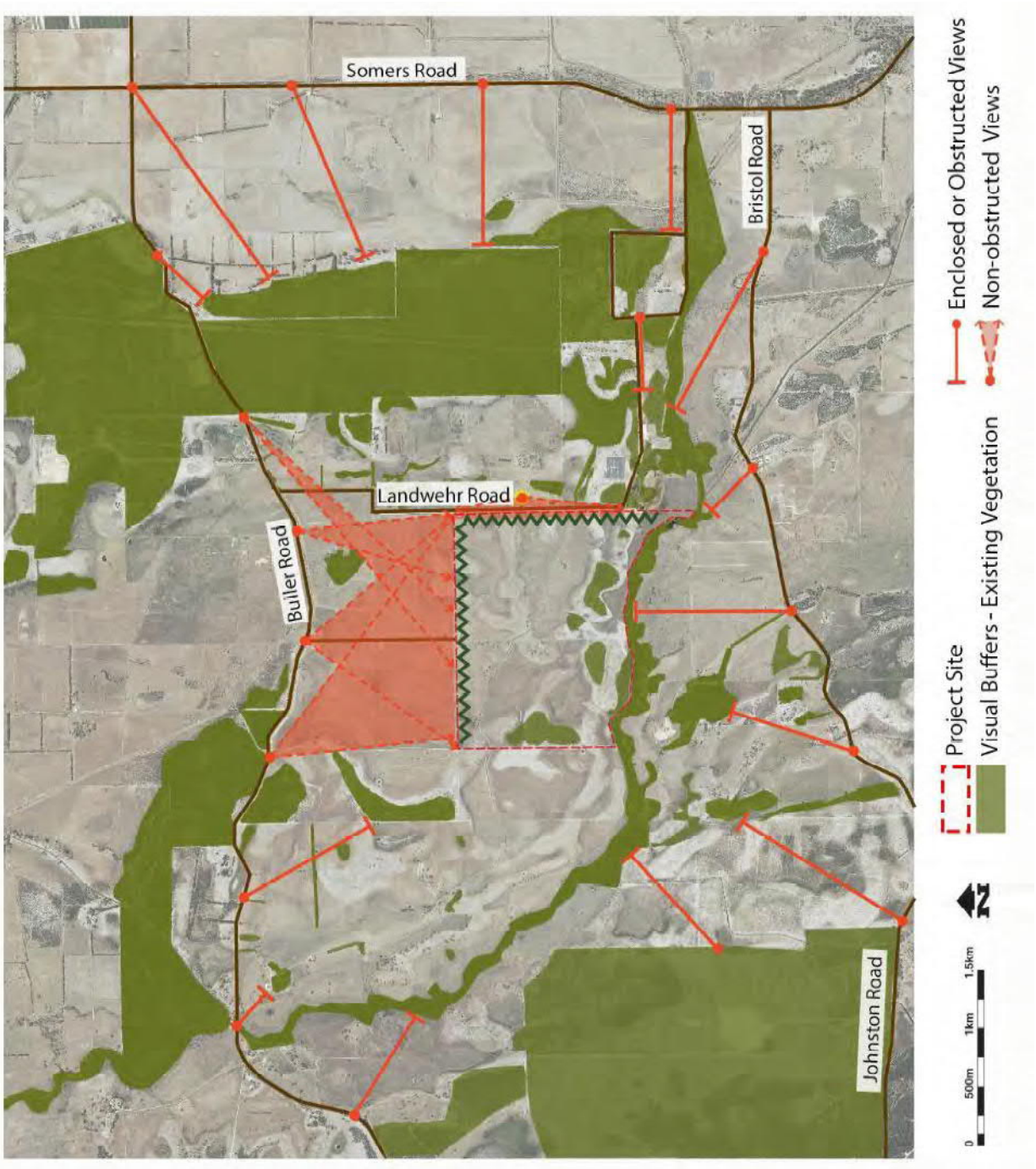


Figure 15 Existing Visual Buffers – Existing Vegetation surrounding Project site
(Source: Nearmap © 2019)

5.3 Landscape character impacts

Landscape character impacts upon the identified landscape character zones (arising from the Project) have been assessed in Tables 8, 9 and 10). The assessment has determined the likely significance of potential changes to the character of the landscape within each of the identified landscape character zones.

Table 8 Landscape character impacts assessment - LCZ 1

Landscape Character Zone 1 - Open rural landscape
Anticipated change to LCZ The Project would comprise a contrasting element across the open, gently undulating, rural landscape.
Sensitivity to change: Moderate **Susceptibility to change** The LCZ is considered to have a moderate potential to accommodate the proposed change within the context of the existing landscape but mitigated by the potential to retain vegetation and supplement roadside planting along the boundaries of the Project as reflected in the broader landscape patterns of linear windrows and roadside vegetation. **Value of LCZ** LCZ 1 is considered to be of regional value, given the regionally-consistent, intensive agriculture character and grid mosaic pattern landscape formed by fenced pastures. This character, in conjunction with the gently undulating topography, is characteristic of the landscape character and visual amenity across large areas of the surrounding region. This LCZ provides a foreground or middle ground to the way the overall landscape is viewed and valued.
Magnitude of change: Moderate **Size/scale** The scale of change in the landscape would be moderate, given the size and uncharacteristic form of the solar array within the open rural landscape setting, and other key structures including electrical terminal station and substation. However, the north and eastern boundaries of the Project would be reinstated with planting characteristic of roadside and natural bushland planting that is typically found within this LCZ, reinforcing this element of the landscape. **Geographical extent** The Project comprises the addition of a low (4m high) but contrasting feature, which will closely follow the topography of what is however part of an extensive regional setting. **Duration/reversibility** The Project would comprise a long-term but potentially temporary (30 years) change to the character of the landscape, with the potential for the site to revert back to agriculture only at the completion of this period.
Significance of landscape character impact: Moderate

Table 9 Landscape character impacts assessment - LCZ 2

Landscape Character Zone 2 - Bushland rural landscape
Anticipated change to LCZ The Project would have no direct effects on the character of this LCZ. It would have an indirect effect on the landscape setting of this LCZ through the proximate introduction of an infrastructure footprint occupied by approximately 227 ha of solar farm infrastructure (approximately 75% of the Site area).
Sensitivity to change: Low **Susceptibility to change** The ability of this LCZ to accommodate the proposed change without impacts on its landscape character is considered to be high (low sensitivity to change) given its separation from the Project area and the distinction between the contrasting characters of LCZ 1 and LCZ 2. **Value of LCZ** LCZ 2 is considered to be of regional value given that the remnant bushland is characteristic of the pre-settlement landscape condition. Parts of the LCZ are preserved as Regional Open Space including the waterway of the Harvey River on the southern boundary of the Project site. This LCZ provides a 'backdrop' or background to the way the overall landscape is viewed and valued. Also, clusters of paperbark woodland within site will provide enclosure to the overall landscape from certain points of view.
Magnitude of change: Low **Size/scale** The size of change for this LCZ is considered to be low within the context of the form and scale of the Project. In most parts of the LCZ, the height of the remnant tree canopy within this LCZ exceeds the height of the proposed Project infrastructure across the adjoining extensive, open rural landscape of LCZ 1. Change to scale of the perception of the background provided by LCZ 2 is considered to be low to negligible. **Geographical extent** The Project comprises the addition of a low (4m high) but contrasting feature, which will be perceived in the middle ground and encompassed by the background of LCZ 2 as part of the extensive regional setting. **Duration/reversibility** The Project would comprise a long-term but potentially temporary (30 years) change to the character of the landscape, with the potential for the site to revert back to agriculture at the completion of this period.
Significance of landscape character impact: Low

Table 10 Landscape character impacts assessment - LCZ 3

Landscape Character Zone 3 – Farmhouse rural landscape
Anticipated change to LCZ The Project would have no direct effects on the character of LCZ 3. It would have an indirect effect on the landscape setting of this LCZ through the proximate introduction of an infrastructure footprint occupied by approximately 227 ha of solar farm infrastructure (approximately 75% of the total area).
Sensitivity to change: Moderate **Susceptibility to change** The susceptivity of LCZ 3 to accommodate the proposed change without impacts on its landscape character is considered to be moderate given the closeness to the Project area and the distinction between the contrasting characters of LCZ 1 and LCZ 3, mainly for the Farmhouse near the Project site. The neighbouring Farmhouses will have low sensitivity due to its distance. The slightly undulating topography and stands of vegetation between LCZ 3 and the Project area will contribute to the capacity of this LCZ to accommodate the proposed change. **Value of LCZ** LCZ 3 is considered to be of local value, given most of built form is characteristic of the local vernacular of building and garden styles. Consistent dwelling setbacks from road corridors combined with a generally consistent style of open front gardens (with no solid fencing) lend an aesthetically appealing character to this LCZ. This LCZ provides a foreground to the way the overall landscape is viewed and valued.
Magnitude of change: Moderate **Size/scale** The size of change for this LCZ is considered to be moderate within the context of the form and scale of the Project. For the majority of the LCZ 3, the height of the adjacent domestic and roadside vegetation (including mature trees) within this LCZ exceed the predicted perceived height of the proposed Project infrastructure across the adjoining extensive, open rural landscape of LCZ 1. Change to scale of the perception of the background provided by LCZ 2 is considered to range from low to moderate, pending on the location of the LCZ unit when compared to the Project site topography and existing vegetation. The magnitude of change will decrease with distance to the site. **Geographical extent** The Project comprises the addition of a low (4m high) but contrasting feature, which will be perceived in the background from LCZ 3 within and as part of the extensive regional setting. **Duration/reversibility** The Project would comprise a long-term but potentially temporary (30 years) change to the character of the landscape, with the potential for the site to revert back to agriculture at the completion of this period.
Significance of landscape character impact: Moderate

6.0 Visual Impact Assessment

6.1 Desktop study

A desktop study was undertaken of the study area in order to identify potential visual receptors likely to be impacted by the Waroona Solar Farm. This included an assessment of existing planning designations, public open spaces, public roads and clusters of residential properties.

6.2 Site visit

During the site visit the representative viewpoints were confirmed and an assessment was made of each potential representative public viewpoint against the known extent of the Waroona Solar Farm project. The viewpoints are considered to be representative of:

- The variety of landscape types within the study area
- The range of public views and the types of viewers likely to be affected by the project.

6.3 Viewpoint Selection

A total of 14 representative public visual receptor locations have been identified within the study area to represent viewpoints for the assessment of potential impacts on views as a result of the Project during construction and operations, as shown in Figure 16. Photographs, descriptions and impact assessment for each follow. Photo montages of the proposed Waroona Solar Farm from selected viewpoints are included as Appendix A.

6.4 Visual receptor types

The viewpoints have been organised into three key receptor types, each of which are considered to typically share defined sensitivity to changes in the context and character of views.

6.4.1 Residents

Residents are interested in the outlook from their properties and have a sense of proprietary interest in their local environment. Residents typically have regular and prolonged viewing opportunities, so are considered likely to have a high level of sensitivity to the proposed change. All of the viewpoints assessed take into account any curtilage surrounding each residence which may be considered an extension to the dwelling for domestic or social activities.

6.4.2 Road users

Road users may generally have only a passing interest in the quality of their surroundings as they are travelling through the landscape and the Project comprises only a small component of the landscape through which they are travelling. Additionally, drivers would be expected to have much of their attention focussed on road conditions and so are considered to have moderate to low sensitivity to change. Local road users may have a moderate level of sensitivity to change, given the potential for a sense of proprietary interest in their local environment.

6.4.3 Farm Land (Private property Entrance)

Farm land users are interested in the outlook from their properties and have a sense of proprietary interest in their local environment. Farm land users will typically have regular and prolonged viewing opportunities; as the same time those opportunities will only occur when working on site, as these areas don't include residences, only sheds and other farming related facilities. In sum, these can be considered likely to have a moderate level of sensitivity to the proposed change. All of the viewpoints assessed were taken from the private properties main entrance.

6.5 Visual receptor locations

Visual receptor locations are shown in Figure 16.

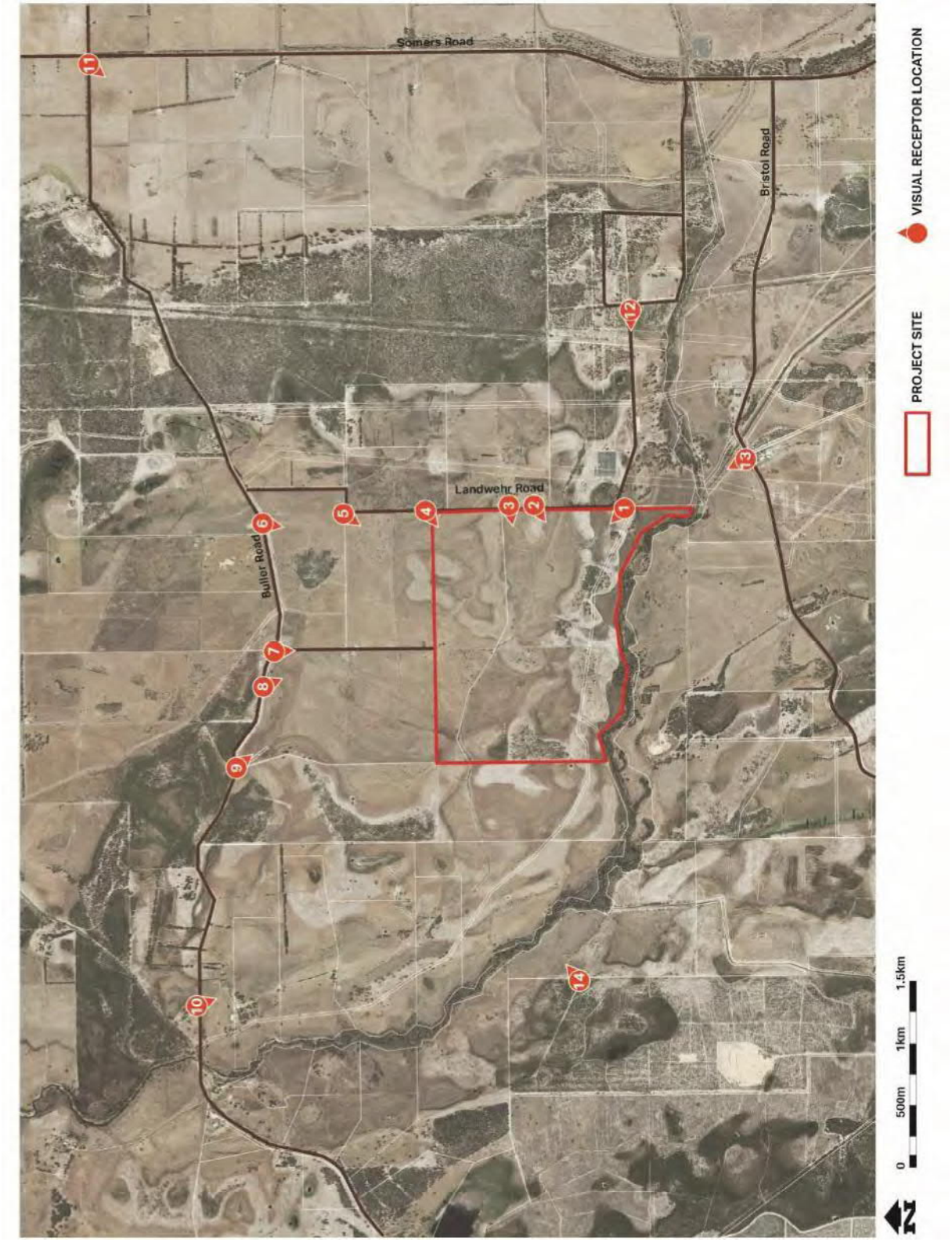


Figure 16 Visual Receptor / Viewpoint Locations

(Source: Nearmap © 2019)

6.6 Visual impact assessment

There are potential visual impacts that may occur during the construction phase of the Project. The key construction activities that may be visible from areas surrounding the Project include:

- minor civil/earthworks involved in the preparation of the site
- hardstand areas required for laydown and storage of construction materials
- temporary site facilities such as parking, toilets and amenities
- temporary site access tracks instated for construction vehicles
- plant and equipment required for the construction of the Project including:
  - medium rigid trucks, utes and light vehicles
  - piling machines
  - forklifts and assisted material handling equipment
  - water trucks for dust suppression.

The majority of construction activities which would result in physical changes to the landscape are generally temporary in nature and for the most part are restricted to specific areas within the Project site.

While extensive earthworks are not considered necessary, minor land disturbance may be required. However, the areas of disturbance would be rehabilitated, and the surrounding groundcover would be retained. Areas of earthworks would be subject to dust control measures that would aim to minimise any airborne dust that could affect local visibility.

The majority of construction activities would be unlikely to result in an unacceptable level of visual impact due to the relatively short duration (approximately 12 months) and temporary nature of the works.

There are potential visual impacts that will occur during the operational phase of the Project. The main infrastructure that may be visible from areas surrounding the Project includes:

- solar array
- electrical infrastructure
- access tracks
- fencing.

The majority of operational infrastructure which would result in physical changes to the landscape is restricted to specific areas within the Project site.

The potential visual impacts from visual receptors and viewpoints are described in Tables 11 through 24. Photomontages of three (3) key viewpoints including existing view, un-mitigated view and mitigated view are included as Appendix A. A plan showing proposed mitigation with landscaping is included as Appendix B.

6.6.1 Theoretical visibility map

The theoretical visibility of the proposed elements of the Project from surrounding areas has been broadly mapped to define a theoretical visibility map (refer to Figure 17). This provides an indication of where the Project is potentially visible from (assuming no vegetation or other structures present). This map indicates 'worst case' and is indicative only, and it does not consider the impacts of existing vegetation cover, structures or views obstructed by local topographic changes e.g. road cuttings etc.

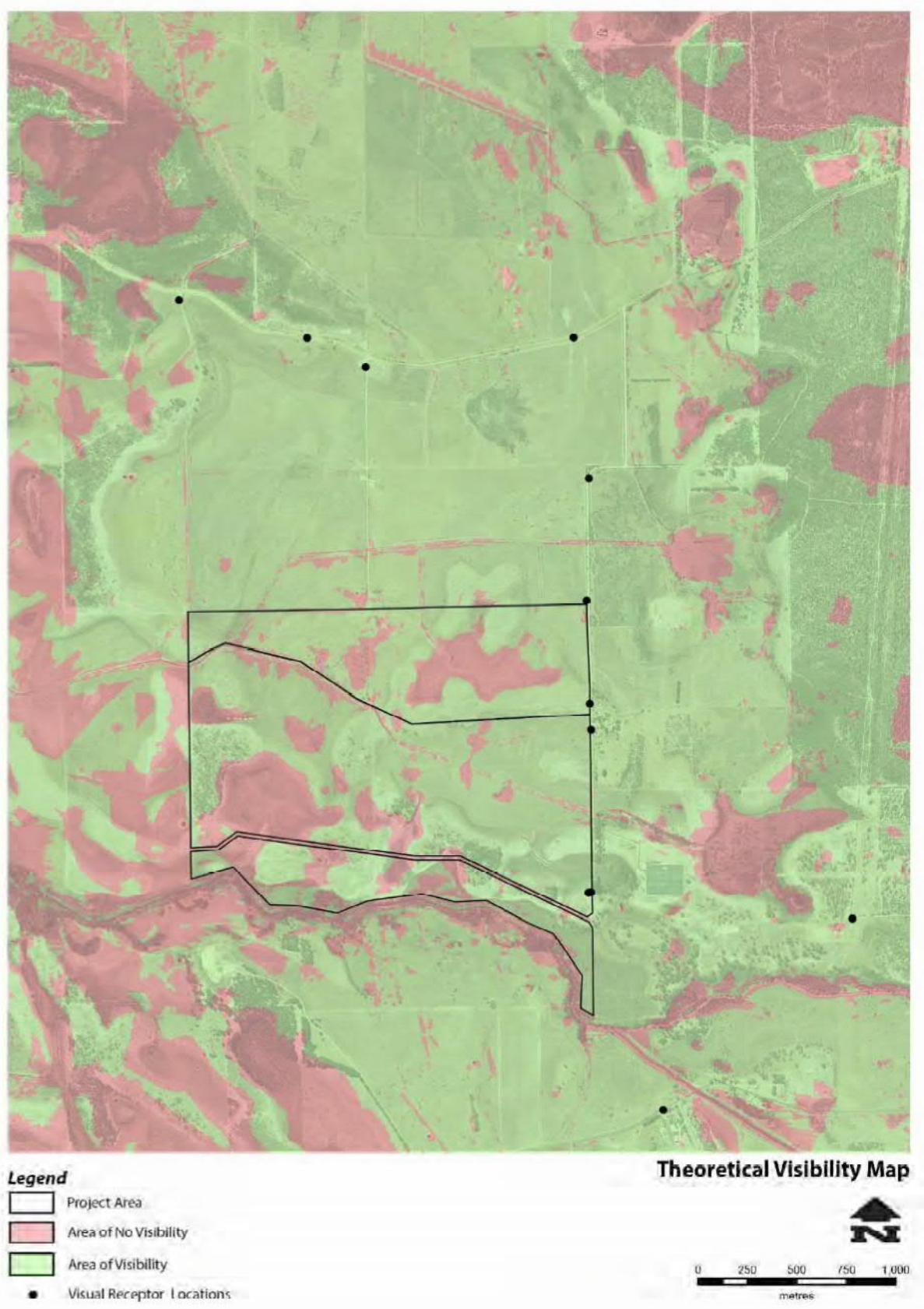


Figure 17 Theoretical visibility map

(Source: Nearmap © 2019)

Table 11 Visual impact assessment – V1 (Survey Photo 1)

V1: Road User / Proposed Main Entrance

Existing view *Area of visual change highlighted red*

Anticipated change to view
The Project will be visible throughout the entire eastern side from this viewpoint. This viewpoint is the entry location to the Project. There is little existing vegetation to screen the viewpoint, making changes to the foreground particularly visible. Nevertheless, from the roadside behind this viewpoint there are some remnants of vegetation (Jarrah trees) that will provide screening to the roadside. In this location, visual change will partly be absorbed by the clumps of vegetation to be maintained in the middle distance. Additional vegetation should be established in the foreground to assist visual mitigation (Refer to Appendix B).

Sensitivity to change: Low

Susceptibility of road user to proposed change
The nature of the access track that provides entree to this viewpoint, means that only people using the Landwehr terminal and the solar farm will be impacted by views of the project. The susceptibility of motorists travelling along this portion of road is low due to the infrequent number of road users that would be possibly impacted by views of the Project.

Value attached to view
The value attached to the view for motorists along this section of road is considered low, given the nature of the access track (no through road), remoteness of its location and infrequent number of possible users to the site (mainly terminal and solar farm workers). The viewpoint is relativity far from any surrounding rural roads.

Magnitude of change: Moderate

Size/scale
The scale of change is considered to be moderate, given the anticipated visibility of the new elements, for localised areas along the access track to this viewpoint. A substantial proportion of the view will be occupied by the Project with a noticeable change in contrast in the landscape setting.

Geographical extent
The viewpoint is located within the project site, at the boundary line, resulting in high visual detail due to the low amount of existing vegetation and flat topography.

Duration/reversibility
The duration of impacts would be expected to be long term, but potentially reversible after 30 years.

Significance of visual impact: Moderate - Low

Table 12 Visual impact assessment – V2 (Survey Photo 2)

V2: Road User / Resident

Existing view *Area of visual change highlighted red*

Anticipated change to view
The Project will be highly visible when viewed towards the northwest and southwest from this viewpoint, however, the view of the Project will be partially screened by roadside vegetation and garden vegetation when viewed from the adjacent residential lot. A denser vegetation buffer should be established in the foreground to assist visual mitigation along the extent of the resident's line of sight. (Refer to Appendix B).

Sensitivity to change: Moderate

Susceptibility of road users and residents to proposed change
The susceptibility of motorists travelling along this portion of road is low due to the infrequent number of road users that would be possibly impacted by views of the Project. The susceptibility of residents at this location of road is moderate due to the proprietary interest residents can be expected to take in changes to the view from their home and permanent nature of the view and the moderate extent of the Project visible.

Value attached to view
The value attached to the view for motorists along this section of road is considered low due to low to infrequent number of users. On the other hand, the value attached to the view for residents at this location is considered moderate, given the interest they are likely to have with regard to changes in their landscape views.

Magnitude of change: High

Size/scale
The scale of change is considered to be high, given the anticipated visibility of the new elements in the view will be high along the eastern boundary due to the low amount of screening vegetation in the foreground and planeness of the site. A high proportion of the view will be occupied by the Project with a noticeable change in contrast in the landscape setting. The view will always be seen as cars travel along the road.

Geographical extent
The viewpoint is located approximately two (2) metres from the Project boundary, resulting in high visual detail due to the existing vegetation and topography

Duration/reversibility
The duration of impacts would be expected to be long term, but potentially reversible after 30 years.

Significance of visual impact: High - Moderate (Refer to Appendix A Sheet 1)

Table 13 Visual impact assessment – V3 (Survey Photo 3)

V3: Road User / Resident

Existing view *Area of visual change highlighted red*
Anticipated change to view The Project will be highly visible when viewed towards the northwest and southwest from this viewpoint, however, the view of the Project will be partially screened by roadside vegetation and garden vegetation when viewed from adjacent residential lot. A denser vegetation buffer should be established in the foreground to assist visual mitigation along the extent of the resident's line of sight. (Refer to Appendix B).
Sensitivity to change: Moderate **Susceptibility of road users and residents to proposed change** The susceptibility of motorists travelling along this portion of road is low due to the infrequent number of road users that would be possibly impacted by views of the Project. The susceptibility of residents at this location of road is moderate due to the proprietary interest residents can be expected to take in changes to the view from their home and permanent nature of the view and the moderate extent of the Project visible. **Value attached to view** The value attached to the view for motorists along this section of road is considered low due to low to infrequent number of users. On the other hand, the value attached to the view for residents at this location is considered moderate, given the interest they are likely to have with regard to changes in their landscape views.
Magnitude of change: High **Size/scale** The scale of change is considered to be high, given the anticipated visibility of the new elements in the view will be high along the eastern boundary due to the low amount of screening vegetation in the foreground and planeness of the site. A high proportion of the view will be occupied by the Project with a noticeable change in contrast in the landscape setting. The view will always be seen as cars travel along the road. **Geographical extent** The viewpoint is located approximately two (2) metres from the Project boundary, resulting in high visual detail due to the existing vegetation and topography **Duration/reversibility** The duration of impacts would be expected to be long term, but potentially reversible after 30 years.
Significance of visual impact: High - Moderate

Table 14 Visual impact assessment – V4 (Survey Photo 4)

V4: Road User
 **Existing view** *Area of visual change highlighted red* **Anticipated change to view** The Project will be visible when viewed towards the southwest from this viewpoint. This viewpoint is from the roadside verge opposite to the corner of the Project site, overlooking the eastern and northern boundaries of the site. The view is partly screened due to existence of roadside vegetation on the verge of the Project site in this location on the eastern side but fully opened along its northern boundary. Additional vegetation should be established in the foreground to assist visual mitigation (Refer to Appendix B).
Sensitivity to change: Moderate **Susceptibility of road users to proposed change** The susceptibility of motorists travelling along this portion of road is moderate due to the infrequent number of road users that would be possibly impacted by close-up views of the Project. **Value attached to view** The value attached to the view for motorists along this section of road is considered moderate, given the proprietary interest they are likely to have with regard to changes in their rural landscape views across a network of quiet rural roads, with variable levels of screening.
Magnitude of change: Moderate **Size/scale** The scale of change is considered to be moderate, given the anticipated visibility of the new elements in the view will be high for localised areas. A moderate proportion of the view will be occupied by the Project with a noticeable change in contrast in the landscape setting. The view will be obstructed for short intervals as cars travel along the road due to the existence of clusters of vegetation. **Geographical extent** The viewpoint is located approximately 30 metres from the Project boundary, resulting in moderate visual detail due to the low amount of existing screening vegetation and flat topography, especially along the northern boundary. **Duration/reversibility** The duration of impacts would be expected to be long term, but potentially reversible after 30 years.
Significance of visual impact: Moderate (Refer to Appendix A Sheet 2)

Table 15 Visual impact assessment – V5 (Survey Photo 5)

V5: Road User / Resident

Existing view *Area of visual change highlighted red*

Anticipated change to view
The Project will be visible when viewed towards the southwest from this viewpoint. This viewpoint is from the roadside that gives access to the residential lot located near the Project site and the Landwehr Terminal. One more residential lot is located in the opposite direction of the viewpoint, further east. The view will be partially screened by roadside vegetation and partly screened by remnant vegetation in the neighbouring land. Additional vegetation should be established along the northern boundary to assist visual mitigation (Refer to Appendix B).

Sensitivity to change: Low

Susceptibility of road users and residents to proposed change
The susceptibility of motorists travelling along this portion of road is low due to the small extent of the Project visible and the infrequent number of road users that would be possibly impacted by views of the Project. The susceptibility of residents at this location of road is low due to the distance of perceived change to the view from the viewer and the small extent of the Project visible.

Value attached to view
The value attached to the view for motorists along this section of road is considered low, given the infrequent number of possible users travelling to the Site and the variable nature of existing vegetation. The value attached to the view for residents at this location is considered low, given the relatively common nature of the view.

Magnitude of change: Low

Size/scale
The scale of change is considered to be moderate, given the anticipated visibility of the new elements in the view will be noticeable only for localised areas in the view. A medium size proportion of the view will be occupied by the Project with a medium to low amount of change in contrast in the landscape setting, due to distance and the existing vegetation screening in the background.

Geographical extent
The viewpoint is located approximately 650 metres from the Project boundary, resulting in low visual detail due to the existing vegetation and topography.

Duration/reversibility
The duration of impacts would be expected to be long term, but potentially reversible after 30 years.

Significance of visual impact: Low

Table 16 Visual impact assessment – V6 (Survey Photo 6)

V6: Road User

Existing view *Area of visual change highlighted red*

Anticipated change to view
The Project will be visible when viewed towards the south / southwest from this viewpoint. This viewpoint is from the main roadside located north of the Project site. The foreground is occupied mainly by flat farm land, with clusters of existing vegetation in the background. The Project will be partly screened by this remnant vegetation. The main road is located more than one kilometre away. The viewing distance and existing vegetation make it hard to visualise the Project site from this viewpoint. Additional vegetation should be established along the northern boundary to assist visual mitigation (Refer to Appendix B).

Sensitivity to change: Low

Susceptibility of road users to proposed change
The susceptibility of motorists travelling along this portion of road is low due to the transient nature of the view, the small extent of the Project visible and the infrequent number of road users that would be possibly impacted by views of the Project.

Value attached to view
The value attached to the view for motorists along this section of road is considered moderate, given the proprietary interest they are likely to have with regard to changes in their rural landscape views across a network of quiet rural roads, with variable levels of screening.

Magnitude of change: Low

Size/scale
The scale of change is considered to be low or negligible, given the anticipated visibility of the new elements in the view will be low. A small proportion of the view will be occupied by the Project with a minimum change in contrast in the landscape setting. Existing pockets of vegetated wetland contribute to screen larger portions of the Project site from this viewpoint. Additional vegetation planted along the northern boundary will help mitigate views observed by motorists along the road.

Geographical extent
The viewpoint is located approximately 1,350 metres from the Project boundary, resulting in low to negligible visual detail due to the existing vegetation and topography.

Duration/reversibility
The duration of impacts would be expected to be long term, but potentially reversible after 30 years.

Significance of visual impact: Low

Table 17 Visual impact assessment – V7 (Survey Photo 7)

V7: Road User / Private Property Entrance (Farm Land)

Existing view *Area of visual change highlighted red*

Anticipated change to view
The Project will be visible when viewed towards the south from this viewpoint. This viewpoint is from the entrance of a farm (private property) and adjacent road. The Project will be partly screened by remnant vegetation between the viewpoint and the northern boundary of the Project. Due to the flat, expansive scene combined with low amounts of existing vegetation, some additional visual mitigation is recommended in the background from this viewpoint. Additional vegetation should be established along the northern boundary to assist visual mitigation (Refer to Appendix B).

Sensitivity to change: Moderate

Susceptibility of road users and farm land users to proposed change
The susceptibility of motorists travelling along this portion of road is low due to the transient nature of the view and the infrequent number of road users that would be possibly impacted by views of the Project. The susceptibility of farmworkers at this location is moderate, due to the distance of the perceived change to the view and the regularity of time spent on site.

Value attached to view
The value attached to the view for both motorists and farm workers along this section of land is considered moderate, given the proprietary interest they are likely to have with regard to changes in their rural landscape views across the quiet rural roads, with variable levels of screening.

Magnitude of change: Low

Size/scale
The scale of change is considered to be low, given the anticipated low visibility of the new elements in the background of the view. The open field, small amount of screening vegetation, slightly higher topography and regularity of usage by the farm workers, allows a portion of the Project to be discerned within the background of the view, however the proportion of change is considered to be low due to the distance of this viewpoint from the Project.

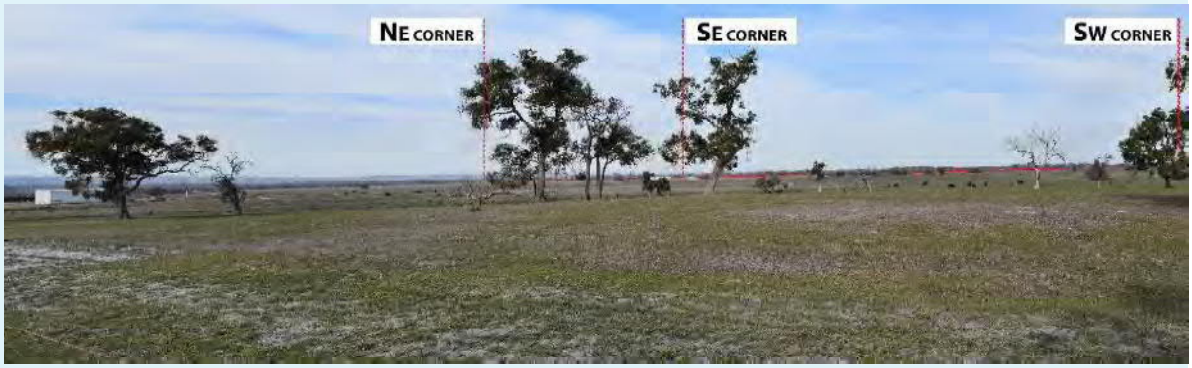
Geographical extent
The viewpoint is located approximately 1,250 metres from the Project boundary, but its elevated topography and lack of screening vegetation allows for some visual detail to be discerned in the background. Additional screening along the northern boundary of the site can mitigate this effect.

Duration/reversibility
The duration of impacts would be expected to be long term, but potentially reversible after 30 years.

Significance of visual impact: Moderate - Low

Table 18 Visual impact assessment – V8 (Survey Photo 8)

V8: Road User



Existing view *Area of visual change highlighted red*

Anticipated change to view
The Project will be visible when viewed towards the south / southeast from this viewpoint. This viewpoint is from the roadside at the top of a small hill within the flat topography of the area. Due to the topography it is possible to view a portion of the Project area in the background. Additional visual screening along the northern boundary of the site can mitigate any adverse effect on views from this viewpoint. Additional vegetation should be established along the northern boundary to assist visual mitigation (Refer to Appendix B).

Sensitivity to change: Low

Susceptibility of road users to proposed change
The susceptibility of motorists travelling along this portion of road is low due to the transient nature of the view, the small amount of Project visibility and the infrequent number of road users that would be possibly impacted by views of the Project.

Value attached to view
The value attached to the view for motorists along this section of road is considered moderate, given the proprietary interest they are likely to have with regard to changes in their rural landscape views across a network of quiet rural roads, with variable levels of screening.

Magnitude of change: Low

Size/scale
The scale of change is considered to be moderate, given the anticipated visibility of the new elements in the view will noticeable only for localised areas in the view. A small proportion of the background of the view will be occupied by the Project with a low amount of change in contrast in the landscape setting. The view will be seen for short intervals as cars travel along the road.

Geographical extent
The viewpoint is located approximately 1,380 metres from the Project boundary, but its higher topography and low amount of screening vegetation allows for a moderate visual detail in the background. This can be mitigated easily with additional screening along the northern boundary of the site.

Duration/reversibility
The duration of impacts would be expected to be long term, but potentially reversible after 30 years.

Significance of visual impact: Low (Refer to Appendix A Sheet 3)

Table 19 Visual impact assessment – V9 (Survey Photo 9)

V9: Road User / Private Property entrance (Farm Land)

Existing view *Area of visual change highlighted red*

Anticipated change to view
The Project will only slightly be visible when viewed towards the east / southeast from this viewpoint. This viewpoint is from the entrance of a farm land (private property) and adjacent road. The view is not anticipated to change due to the distance of the viewpoint from the Project and the presence of remnant vegetation. Additional visual mitigation is not considered necessary from this viewpoint.

Sensitivity to change: Low

Susceptibility of road users to proposed change
The susceptibility of motorists travelling along this portion of road is low due to the closed view and the infrequent number of road users. The susceptibility of farm workers at this location is low, due to the distance of the perceived change to the view, the existing vegetation and other elements that screen the majority of the Project and the regularity of time spent on site.

Value attached to view
The value attached to the view for both motorists and farm workers along this section of land is considered moderate, given the proprietary interest they are likely to have with regard to changes in their rural landscape views across a network of quiet rural roads, with variable levels of screening.

Magnitude of change: Low - Negligible

Size/scale
The scale of change is considered to be negligible, given the anticipated visibility of the new elements in the view will be very low. No noticeable change in contrast in the landscape setting is anticipated. The view is mostly obstructed to cars travelling along main road and users travelling the private access track due to the flatter topography and large amount of screening vegetation between the project site and the viewpoint.

Geographical extent
The viewpoint is located approximately 1,586 metres from the Project boundary, resulting in negligible visual detail due to the existing vegetation and topography.

Duration/reversibility
The duration of impacts would be expected to be long term, but potentially reversible after 30 years.

Significance of visual impact: Negligible

Table 20 Visual impact assessment – V10 (Survey Photo 10)

V10: Road User / Resident

Existing view *Area of visual change highlighted red*

Anticipated change to view
The Project will not be visible when viewed towards the east / southeast from this viewpoint. This viewpoint is from the roadside, adjacent to a residential lot. It will be screened by remnant vegetation and farm land hedging. Additional visual mitigation is not considered necessary from this viewpoint.

Sensitivity to change: Low

Susceptibility of road users and residents to proposed change
The susceptibility of motorists travelling along this portion of road is negligible due to the transient nature of the view, lack of Project visibility and the infrequent number of road users that would be possibly impacted by views of the Project. The susceptibility of residents at this location is also negligible due to the distance of perceived change to the view from the viewer and the lack of the Project visibility.

Value attached to view
The value attached to the view for motorists along this section of road is considered moderate, given the proprietary interest they are likely to have with regard to changes in their rural landscape views across a network of quiet rural roads, with variable levels of screening. The value attached to the view for residents at this location is considered moderate, given the interest they are likely to have with regard to changes in their landscape views.

Magnitude of change: Negligible

Size/scale
The scale of change is considered to be zero, given that the anticipated visibility of the new elements in the view will remain unchanged. No change in contrast in the landscape setting. The view to the Project site is obstructed by existing vegetation all along the road and within the residential lot, between Harvey river and Viewpoint V9.

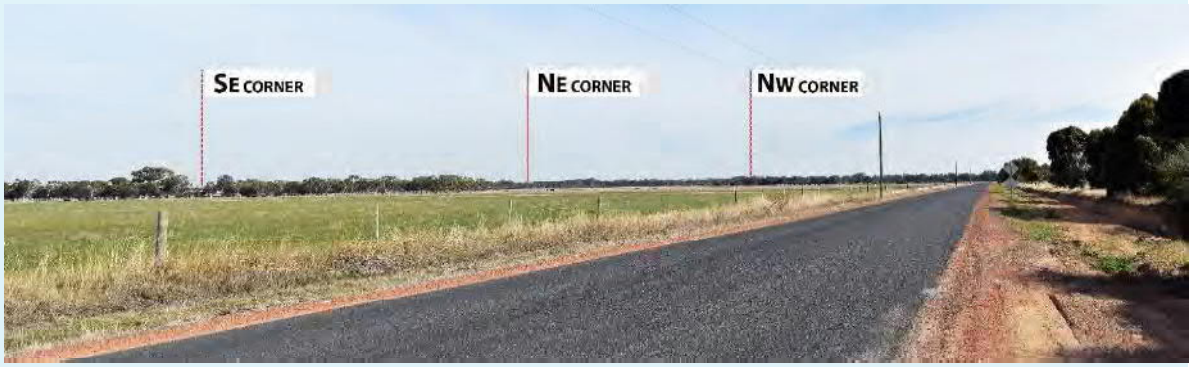
Geographical extent
The viewpoint is located approximately 2,670 metres from the Project boundary, resulting in zero visual detail due to the existing vegetation and topography.

Duration/reversibility
The duration of impacts would be expected to be long term, but potentially reversible after 30 years.

Significance of visual impact: Negligible / No change

Table 21 Visual impact assessment – V11 (Survey Photo 11)

V11: Road User



Existing view *Area of visual change highlighted red*

Anticipated change to view
The Project will not be visible when viewed towards the southwest from this viewpoint. This viewpoint is from the roadside of the main road that comes near the project site. The viewpoint is as seen from behind the Buller Nature Reserve. The view to the Project site is completely closed due to the distance to site and the existing dense vegetation in the background (Buller Nature Reserve).

Sensitivity to change: Low

Susceptibility of road users to proposed change
The susceptibility of motorists travelling along this portion of road is negligible due to the closed view, distance to site and infrequent number of road users that would be possibly impacted by views of the Project.

Value attached to view
The value attached to the view for motorists along this section of road is considered moderate, given the proprietary interest they are likely to have with regard to changes in their rural landscape views across a network of quiet rural roads, with variable levels of screening.

Magnitude of change: Negligible

Size/scale
The scale of change is considered to be zero, given that the anticipated visibility of the new elements in the view will remain unchanged. No change in contrast in the landscape setting. The view to the Project site is obstructed by existing vegetation all the way along the road, between the current viewpoint and Viewpoint V6.

Geographical extent
The viewpoint is located approximately 4,600 metres from the Project boundary, resulting in zero visual detail due to the existing vegetation and topography.

Duration/reversibility
The duration of impacts would be expected to be long term, but potentially reversible after 30 years.

Significance of visual impact: Negligible / No change

Table 22 Visual impact assessment – V12 (Survey Photo 12)

V12: Road User

Existing view *Area of visual change highlighted red*

Anticipated change to view
The Project will not be visible when viewed towards the west from this viewpoint. This viewpoint is from a public access track located east of the Project site that links Landwehr Road to Somers Road. The view is closed to the site, due to the existing roadside vegetation and overall remnant vegetation.

Sensitivity to change: Low

Susceptibility of road users to proposed change
The susceptibility of motorists travelling along this portion of road is negligible due to the closed view and infrequent number of road users that would be possibly impacted by views of the Project.

Value attached to view
The value attached to the view for motorists along this section of road is considered moderate, given the proprietary interest they are likely to have with regard to changes in their rural landscape views across a network of quiet rural roads, with variable levels of screening.

Magnitude of change: Negligible

Size/scale
The scale of change is considered to be zero, given that the anticipated visibility of the new elements in the view will remain unchanged. No change in contrast in the landscape setting is anticipated. The view to the Project site is obstructed by existing vegetation.

Geographical extent
The viewpoint is located approximately 1,300 metres from the Project boundary, resulting in zero visual detail due to the existing vegetation and topography.

Duration/reversibility
The duration of impacts would be expected to be long term, but potentially reversible after 30 years.

Significance of visual impact: Negligible / No change

Table 23 Visual impact assessment – V13 (Survey Photo 13)

V13: Road User / Resident

Existing view *Area of visual change highlighted red*

Anticipated change to view
The Project will not be visible when viewed towards the north from this viewpoint. This viewpoint is from the roadside, opposite a residential lot overlooking the riparian vegetation along the Harvey River. Views to the Project site will be closed by topography and vegetation.

Sensitivity to change: Low

Susceptibility of road users and residents to proposed change
The susceptibility of motorists travelling along this portion of road is negligible due to the transient nature of the view, lack of Project visibility and existence of the riparian vegetation along the river. The susceptibility of residents at this location is also negligible due to the distance of perceived change to the view from the viewer, the lack of Project visibility and the presence of a natural vegetated screen along the river, enclosing any views towards the north from this viewpoint.

Value attached to view
The value attached to the view for motorists along this section of road is considered moderate, given the proprietary interest they are likely to have with regard to changes in their rural landscape views across a network of quiet rural roads, with variable levels of screening. The value attached to the view for residents at this location is also considered moderate, given the interest they are likely to have with regard to changes in their landscape views.

Magnitude of change: Negligible

Size/scale
The scale of change is considered to be zero, given that the anticipated visibility of the new elements in the view will remain unchanged. No change in contrast in the landscape setting is anticipated. The view to the project site is obstructed by the existing riparian and remnant vegetation.

Geographical extent
The viewpoint is located approximately 580 metres from the Project boundary, resulting in zero visual detail due to the riparian vegetation, remnant vegetation and topography.

Duration/reversibility
The duration of impacts would be expected to be long term, but potentially reversible after 30 years.

Significance of visual impact: Negligible / No change

Table 24 Visual impact assessment – V14 (Survey Photo 14)

V14: Road User

Existing view *Area of visual change highlighted red*

Anticipated change to view
The Project will not be visible when viewed towards the east / northeast from this viewpoint. This viewpoint is from an access track that meanders through area of newly planted forest, located southwest of the Project site. Views to the Project will be closed by topography and vegetation.

Sensitivity to change: Low

Susceptibility of road users to proposed change
The susceptibility of motorists travelling along this portion of road is negligible due to the lack of Project visibility, existence of the riparian vegetation along the Harvey river and the rare number of access road users that would be possibly impacted by views of the Project.

Value attached to view
The value attached to the view for motorists along this section of road is considered moderate, given the proprietary interest they are likely to have with regard to changes in their rural landscape views across a network of quiet rural roads, with variable levels of screening.

Magnitude of change: Negligible

Size/scale
The scale of change is considered to be zero, given that the anticipated visibility of the new elements in the view will remain unchanged. No change in contrast in the landscape setting is anticipated. The view to the project site is obstructed by the existing riparian and remnant vegetation.

Geographical extent
The viewpoint is located approximately 1,750 metres from the Project boundary, resulting in zero visual detail due to the riparian vegetation, remnant vegetation and topography

Duration/reversibility
The duration of impacts would be expected to be long term, but potentially reversible after 30 years.

Significance of visual impact: Negligible / No change

7.0 Mitigation Measures

7.1 Detailed Design

Mitigation measures during the detailed design process should consider:

- further refinement in the design and layout which may assist in the mitigation of bulk and height of proposed structures
- a review of materials and colour finishes for selected components including the use of non-reflective finishes to structures where possible.

7.1.1 Draft Landscape Plan

This LVIA has determined that a planted buffer area is prescribed to the boundary of sensitive visual receptors for the purpose of mitigating visual impacts to the residents and road users. The Landscape Plan (Appendix B) provides planted buffer areas of a minimum width of:

- Ten metres buffer for approximately 150m along the boundary adjacent to the residential property located in the Landwehr Rd to minimise the extent of visible solar farm when seen from residential lot.
- Five metres buffer along all other eastern property boundaries along Landwehr Rd.
- Five metres softer buffer along Northern property boundaries, facing neighbouring farm land.

The buffer areas will contain random plantings of a variety of native / endemic trees and shrub species of differing growth habits, and a ground layer of grasses and low growing species. The intention is to reinstate screening vegetation with characteristics of local plant communities, and to reflect a consistent landscape character. The linear nature of the screen planting will be in keeping with the windrows and roadside vegetation that is regularly present in the surrounding landscape.

7.2 Construction

Mitigation measures during the construction period should consider:

- minimise tree removal where possible
- rehabilitation of disturbed areas
- protection of vegetation within the Project where retained.

7.3 Operation

Mitigation measures during the operational period should consider:

- ongoing maintenance and repair of constructed elements to maintain the visual appearance of the Project
- long term maintenance (and replacement as necessary) of screen planting within the Project to maintain visual filtering and screening of external views where appropriate.

8.0 Conclusion

This report provides an overview of the potential Landscape and Visual Impacts and required mitigation associated with the development of Waroona Solar Farm.

8.1 Potential landscape impacts

The report findings generally show that the proposed Waroona Solar Farm has the potential to result in:

- **Moderate** direct impacts to the open rural landscape character of the Pinjarra System of the Swan Coastal Plain character type within which the Project is located
- **Low** to negligible direct impacts to the bushland rural character type to which the Project is adjacent
- **Moderate** direct impacts to the farmhouse rural character type to which the Project is adjacent.

8.2 Potential visual impacts

Potential visual impacts of the proposed Waroona Solar Farm have been assessed from 14 representative public viewpoint locations ranging from **Negligible** impact through to **High - Moderate** impact. The visual impact ratings for each viewpoint are based on a consideration of the sensitivity of the visual receptors and the magnitude of expected visual change.

The greatest levels of impact are from the viewpoints in close proximity to the Project site, where the solar panels themselves will form discernible elements within a given view.

8.3 Mitigation

In order to minimise impacts on the landscape and visual character and values around the Project site, and to ensure the timely progression of approvals for the proposed solar farm, AECOM provide the following recommendations:

- Further refine the design and layout during detailed design to reduce bulk and height of proposed structures.
- Review materials and colour finishes for selected components including the use of non-reflective finishes to structures where possible.
- Avoid or minimise impacts to the native vegetation including the isolated trees in paddock and riparian vegetation; minimise tree removal and rehabilitate disturbed areas.
- Carry out the proposed mitigations as described the in the Landscape Concept Plan.
- Continuously maintain and repair the constructed elements to maintain the visual appearance of the Project.
- Provide long term maintenance (and replacement as necessary) of screen planting within the Project to maintain visual filtering and screening of external views where appropriate.

9.0 References

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Appendix A

Photomontages

Appendix A Photomontages

ISO A1 594mm x 841mm

Figure 1: Survey Photo 2. Existing view along the Eastern boundary, looking towards the site (Southwestern perspective), from Landwehr Road, adjacent to a farm housing. Distance approximately 2m from the site boundary.

Figure 2: Survey Photo 2. Proposed solar farm view from the same location without screen planting.

Figure 3: Survey Photo 2. Proposed view from the same location with screen planting along the Eastern boundary of the site.

SURVEY PHOTO 2

Photo Taken:
Latitude: -32.891771
Longitude: 115.813037
Height of Camera = approx. 1.85m
Direction of camera: approx. 230 degrees Southwest (SW)
Focal length: 24mm
Max aperture: 4

AECOM

PROJECT

WAROONA
SOLAR FARM
CONCEPT DESIGN

WAROONA
Western Australia

CLIENT

SE Waroona
Developmen
Level 27, 150 Lonsdale S
Melbourne, VIC 3000

South E

DEVELOPMENT ASSESSMENT PANEL
APPROVED
15-Nov-2019

CONSULTANT

AECOM Australia Pty Ltd
A.B.N 20 093 846 925
www.aecom.com

PROJECT NUMBER

60605068

SHEET TITLE

WAROONA SOLAR FARM
PHOTOMONTAGES SHEET 1

PROJECT NUMBER

60605068-SHT-LD-003

ISO A1 594mm x 841mm

Figure 4: Survey Photo 4. Existing view of site boundary at the Northeastern corner. View looking towards the site (Southwestern perspective), from Landwehr Road. Distance approximately 30m from the site boundary.

Figure 5: Survey Photo 4. Proposed solar farm view from the same location without screen planting.

Figure 6: Survey Photo 4. Proposed view from the same location with screen planting along the Eastern and Northern boundaries.

SURVEY PHOTO 4

Photo Taken:
Latitude: -32.885859
Longitude: 115.812871
Height of Camera = approx. 1.85m
Direction of camera: approx. 230 degrees Southwest (SW)
Focal length: 24mm
Max aperture: 4

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PROJECT

WAROONA
SOLAR FARM
CONCEPT DESIGN

WAROONA
Western Australia

CLIENT

SE Waroona
Developmen
Level 27, 150 Lonsdale S
Melbourne, VIC 3000

South E

DEVELOPMENT ASSESSMENT PANEL
APPROVED
15-Nov-2019

CONSULTANT

AECOM Australia Pty Ltd
A.B.N 20 093 846 925
www.aecom.com

PROJECT NUMBER

60605068

SHEET TITLE

WAROONA SOLAR FARM
PHOTOMONTAGES SHEET 2

PROJECT NUMBER

60605068-SHT-LD-004

Figure 4: Survey Photo 8. Existing view of the landscape along the Northern boundary of the site. View looking towards the neighbouring farm land with the site along the background (Southeastern perspective), from Buller Road. Distance approximately 1380m from the site boundary.

Figure 8: Survey Photo 8. Proposed solar farm view from the same location without screen planting.

Figure 8: Survey Photo 8. Proposed view from the same location with screen planting along the Northern boundary.

SURVEY PHOTO 8

Photo Taken:
Latitude: -32.873759
Longitude: 115.797911
Height of Camera = approx.1.85m
Direction of camera: approx. 150 degrees Southeast (SE)
Focal length: 24mm
Max aperture: 4

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PROJECT

WAROONA
SOLAR FARM
CONCEPT DESIGN

WAROONA
Western Australia

CLIENT

SE Waroona
Developmen
Level 27, 150 Lonsdale S
Melbourne, VIC 3000

South E

APPROVED
15-Nov-2019
DEVELOPMENT
ASSESSMENT PANEL

CONSULTANT

AECOM Australia Pty Ltd
A.B.N 20 093 846 925
www.aecom.com

PROJECT NUMBER

60605068

SHEET TITLE

WAROONA SOLAR FARM
PHOTOMONTAGES SHEET 3

PROJECT NUMBER

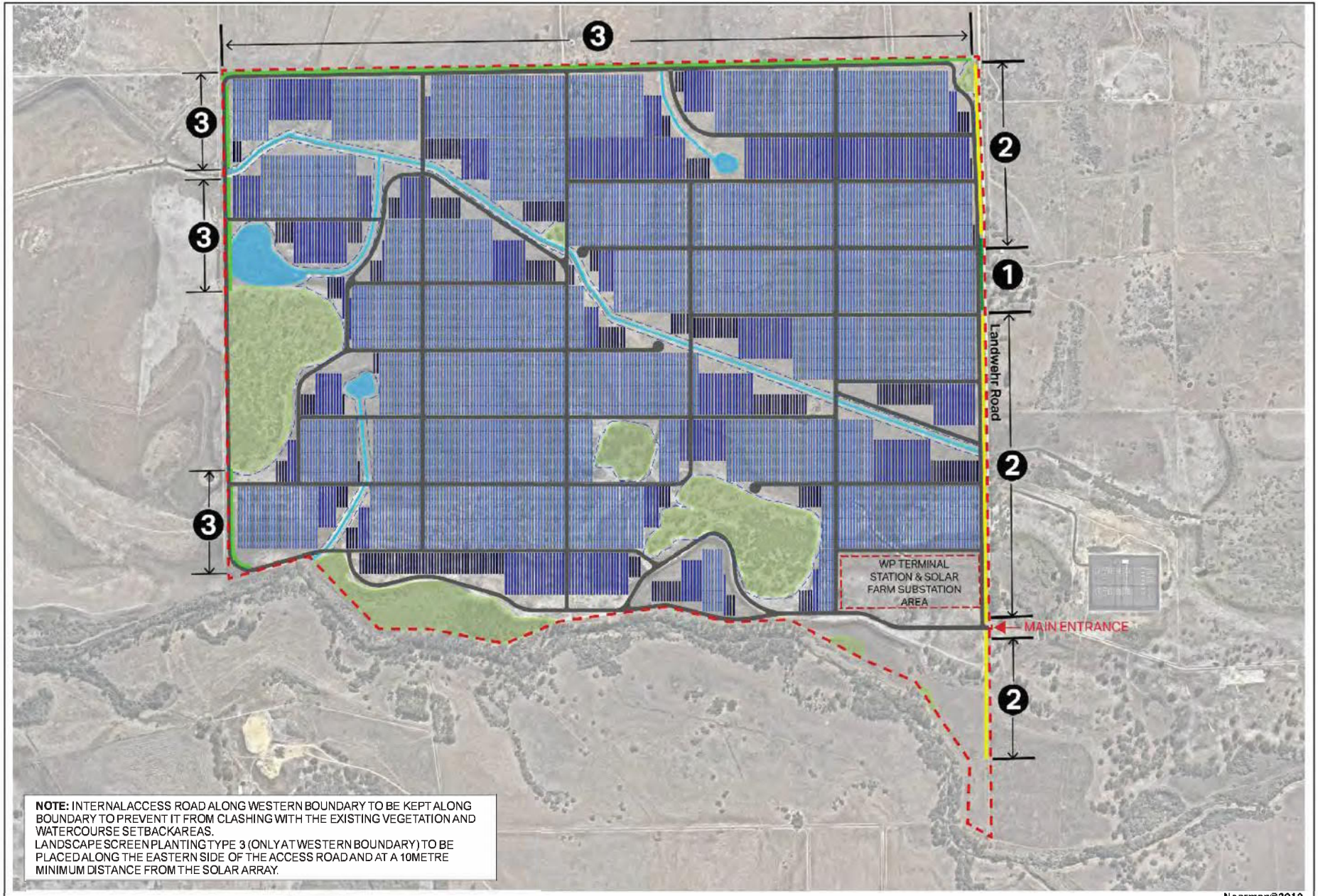
60605068-SHT-LD-005

DRAFT

Appendix B

Landscape Concept Plan

Appendix B Landscape Concept Plan



150 A1 594mm x 841mm

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PROJECT
WAROONA
SOLAR FARM
CONCEPT DESIGN

WAROONA
Western Australia

CLIENT
SE Waroona
Developmer
Level 27, 150 Lonsdale S
Melbourne, VIC 3000

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South Energy

CONSULTANT
AECOM Australia Pty Ltd
A.B.N 20093 846 925
www.aecom.com

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PROJECT NUMBER
60605068

SHEET TITLE
WAROONA SOLAR FARM
LANDSCAPE PLAN

PROJECT NUMBER
60605068-SHT-LD-001

ISO A1 594mm x 841mm

PLANT SCHEDULE

Botanical Name	Common Name	WA Native (Yes/No)	Height (m)	Spread (m)	Installation size	Installation Location and Rate	Proportion	Approx.
Trees								
Allocasuarina fraseriana	Western Sheoak	Y	10	6	30lt	Planting Area 1 & 3	50% in Other Mixes	223
Casuarina obesa	Swamp Sheoak	Y	15	8	30lt	Planting Area 1 & 3	50% in Other Mixes	223
Melaleuca rhaphiophylla	Swamp paperbark	Y	6	3	30lt	ALL	50% in Melaleuca Mixes	522
Melaleuca osullivanii		Y	3.5	2	30lt	ALL	50% in Melaleuca Mixes	522
						Density refer drawing detail		
Shrubs								
Acacia pycnantha	Golden wattle	Y	8	2	130mm	Planting Area 1 and 2	20%	325
Astartea scoparia	Common astartea	Y	2	0.5	130mm	Planting Area 1 and 2	30%	487
Kunzea glabrescens	Spearwood	Y	1.5 to 4	2 to 3	130mm	Planting Area 1 and 2	50%	812
						Density refer drawing detail		
Grasses								
Ficinia nodosa	Knobby Club Rush	Y	1	1	130mm	ALL	40%	14532
Meeboldina cana		Y	0.5 to 1	0.5	130mm	ALL	20%	7266
Lepidosperma longitudinale	Pithy Sword Sedge	Y	2	0.5	130mm	ALL	40%	14532
						Density refer drawing detail		

Note: 1. Plant selection is based on plants that are growing in the area or part of the Swan Coastal Plain Vegetation complex.

2. The plant schedule is subject to further review and confirmation on the appropriate species for the local conditions.

PLANT IMAGES


Casuarina obesa


Allocasuarina fraseriana


Melaleuca rhaphiophylla


Astartea scoparia


Acacia lasiocarpa

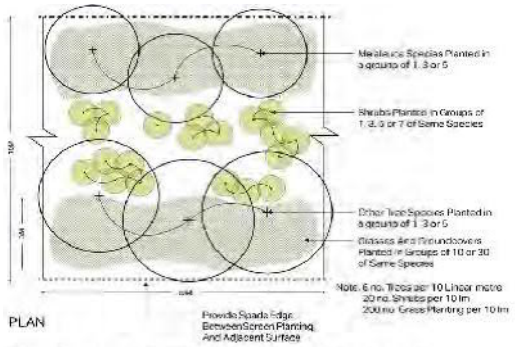

Kunzea glabrescens


Lepidosperma longitudinale

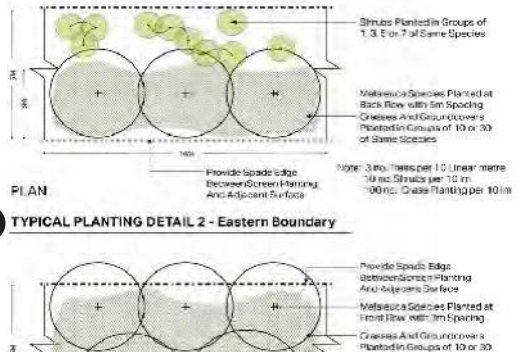

Ficinia nodosa


Meeboldina cana

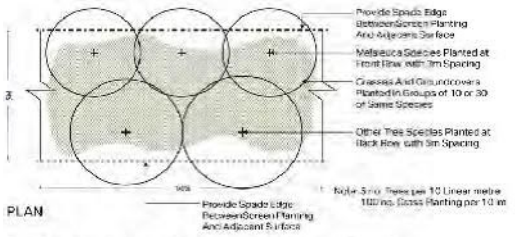
TYPICAL PLANTING DETAILS



1 **TYPICAL PLANTING DETAIL 1 - Property Front (Approx. 150m)**



2 **TYPICAL PLANTING DETAIL 2 - Eastern Boundary**



3 **TYPICAL PLANTING DETAIL 3 - Northern & Western Boundary**

Note: Along Western Boundary, Screen Planting to be relocated along the eastern side of the access road, allowing for the road to be located outside of the watercourse and existing vegetation setbacks.

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PROJECT

WAROONA
SOLAR FARM
CONCEPT DESIGN

WAROONA
Western Australia

CLIENT

SE Waroona Development Pty Ltd
Level 27, 150 Lonsdale Street
Melbourne, VIC 3000

DEV
ASSES
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15

South Energy

CONSULTANT

AECOM Australia Pty Ltd
A.B.N 20 093 846 925
www.aecom.com

PROJECT NUMBER

60605068

SHEET TITLE

WAROONA SOLAR FARM
PLANT SCHEDULE, IMAGES AND DETAILS

PROJECT NUMBER

60605068-SHT-LD-002

SE Waroona Development Pty Ltd (South Energy)
14-Aug-2019

ATTACHMENT 8

Waroona Solar Farm

Ecology Assessment

Waroona Solar Farm

Ecology Assessment

Client: SE Waroona Development Pty Ltd (South Energy)

ABN: 64 628 948 993

Prepared by

AECOM Australia Pty Ltd
3 Forrest Place, Perth WA 6000, GPO Box B59, Perth WA 6849, Australia
T +61 8 6208 0000 F +61 8 6208 0999 www.aecom.com
ABN 20 093 846 925

14-Aug-2019

Job No.: 60590394

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Quality Information

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Ref	60590394
Date	14-Aug-2019
Prepared by	L Fisher
Reviewed by	L Kirchner

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
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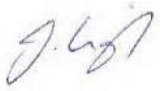
1	09-Aug-2019	Issued	Linda Kirchner Associate Director - Environment	
2	14-Aug-2019	Issued	Jared Leigh Principal Environmental Scientist - Ecologist	

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Executive Summary

An Ecological and targeted Black Cockatoo survey was undertaken for South Energy on behalf of SE Waroona Development Pty Ltd to determine the environmental constraints for a proposed Solar Farm (referred to as Waroona Solar Farm Project [the Project]). The Waroona Solar Farm Project includes a Project Area of 308 ha, located approximately eight kilometres west of Wagerup in the Shire of Waroona.

A preliminary site investigation including desktop assessment was undertaken by Ecologists Jared Leigh and Laura Fisher on 31 January 2019. This survey determined that no Threatened or Priority flora listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), Biodiversity Conservation Act 2016 (BC Act), or listed by DBCA were likely to occur and no Threatened Ecological Communities occurred in the Project Area. Potential breeding and foraging habitat for three Black Cockatoo species (including Baudin's Cockatoo Calyptorhynchus baudinii, Carnaby's Cockatoo Calyptorhynchus latirostris, and Forest Red-tailed Black Cockatoo Calyptorhynchus banksii naso) listed under the EPBC Act was mapped, and these species have the potential to utilise the Survey Area. Seven other threatened fauna species may potentially utilise the habitats within Survey Area, though the habitats present are generally poor quality, limited, isolated and highly modified.

A flora and vegetation assessment and targeted Black Cockatoo survey was undertaken by Ecologists Floora de Wit and Laura Fisher on 20 June 2019. At this time large patches of native vegetation were proposed to be retained and were excluded from the field survey. Traverses were walked through native vegetation to record general characteristics of the patch to inform the vegetation community and condition mapping. All potential Black Cockatoo breeding trees within the Survey Area were assessed and mapped and foraging quality was determined for discreet patches of native vegetation.

Six vegetation communities were recorded and mapped within the Survey Area largely comprising native trees over common pasture weeds surrounded by paddock. Of the 18.98 ha of native vegetation, 6.85 ha was mapped as Degraded and 12.13 ha was mapped as Completely Degraded. Vegetation condition reflects the current agriculture land use. Fauna habitats mapped included Paddock, Riparian and Drainage, Stags, and Mixed Trees. These habitats have the potential to be utilised by ten threatened fauna species, although they are generally poor quality, isolated and highly modified.

The Survey Area contains 201 potential Black Cockatoo breeding trees (i.e. DBH >500mm), of which 22 contain hollows potentially suitable for use by Black Cockatoos. Of these, 21 trees were dead old trees with no vegetation cover nearby, therefore their utilisation by Black Cockatoos is considered limited. The Black Cockatoo foraging assessment determined the presence of a total of:

- 1.80 ha of High Quality and 2.59 ha of Quality Carnaby's Cockatoo and Baudin's Cockatoo foraging habitat
- 3.75 ha of Quality and 0.64 ha of Low Quality Forest Red-tailed Black Cockatoo foraging habitat.

The potential presence of seven other threatened fauna species (apart from the three Black Cockatoo species), though habitat for these species is generally limited, of poor quality and highly modified.

The Survey Area is considered to have low biodiversity. Remnant patches of native vegetation are significantly altered and almost completely devoid of native understorey species. A large proportion of native trees were dead which may be a reflection of one or more factors including dieback, altered groundwater conditions, altered fire regimes, and salinity. It is likely that remaining living trees play an important role in hydrological function and therefore clearing of living native trees should be avoided where possible. Taking this into account, the following is recommended:

- Retain native vegetation, Quality and High Quality Black Cockatoo foraging habitat and Black Cockatoo breeding and potential breeding trees where possible.
- Areas supporting both hollow bearing Black Cockatoo breeding trees and good quality foraging habitat for Black Cockatoos should be prioritised. These generally include vegetation communities CcApAc, EmKgAc and CcJp, which also aids in local flood mitigation of the Harvey River.

- Native Vegetation Clearing Permit under Section 51E of the Environmental Protection Act 1986 (EP Act)
- Hold a pre-referral meeting with the Department of the Environment and Energy (DoEE) to confirm whether referral under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is required, due to potential impacts to the three threatened Black Cockatoo species if clearing of habitat is unavoidable.

1.0 Introduction

1.1 Context

South Energy on behalf of SE Waroona Development Pty Ltd is considering the potential for development of a solar farm (referred to as the Waroona Solar Farm Project [the Project]), at a site near Waroona in the southwest of Western Australia. The Project is located approximately 105 kilometres (km) south of Perth and eight kilometres west of Wagerup, in the Shire of Waroona (Figure 1). The Project site is bordered by Landwehr Road and the Harvey River and is located on a parcel of pastoral land 308 hectares (ha).

South Energy is in the site selection phase of this Project and detailed design information is not yet available. A Survey Area was defined using cadastral boundaries which was further refined to exclude several patches of remnant vegetation identified as environmental values to be retained by South Energy. The total Survey Area is 282.5 ha.

To inform the first stage of the planning and approvals process, AECOM was engaged by South Energy to undertake ecological surveys for the Project to define the environmental values of the Survey Area. A preliminary site investigation and detailed desktop review was undertaken for the Project in January 2019. This determined that Black Cockatoo potential breeding and foraging habitat was present and required a targeted survey to assess and quantify these values. This Targeted Black Cockatoo survey was completed in June 2019.

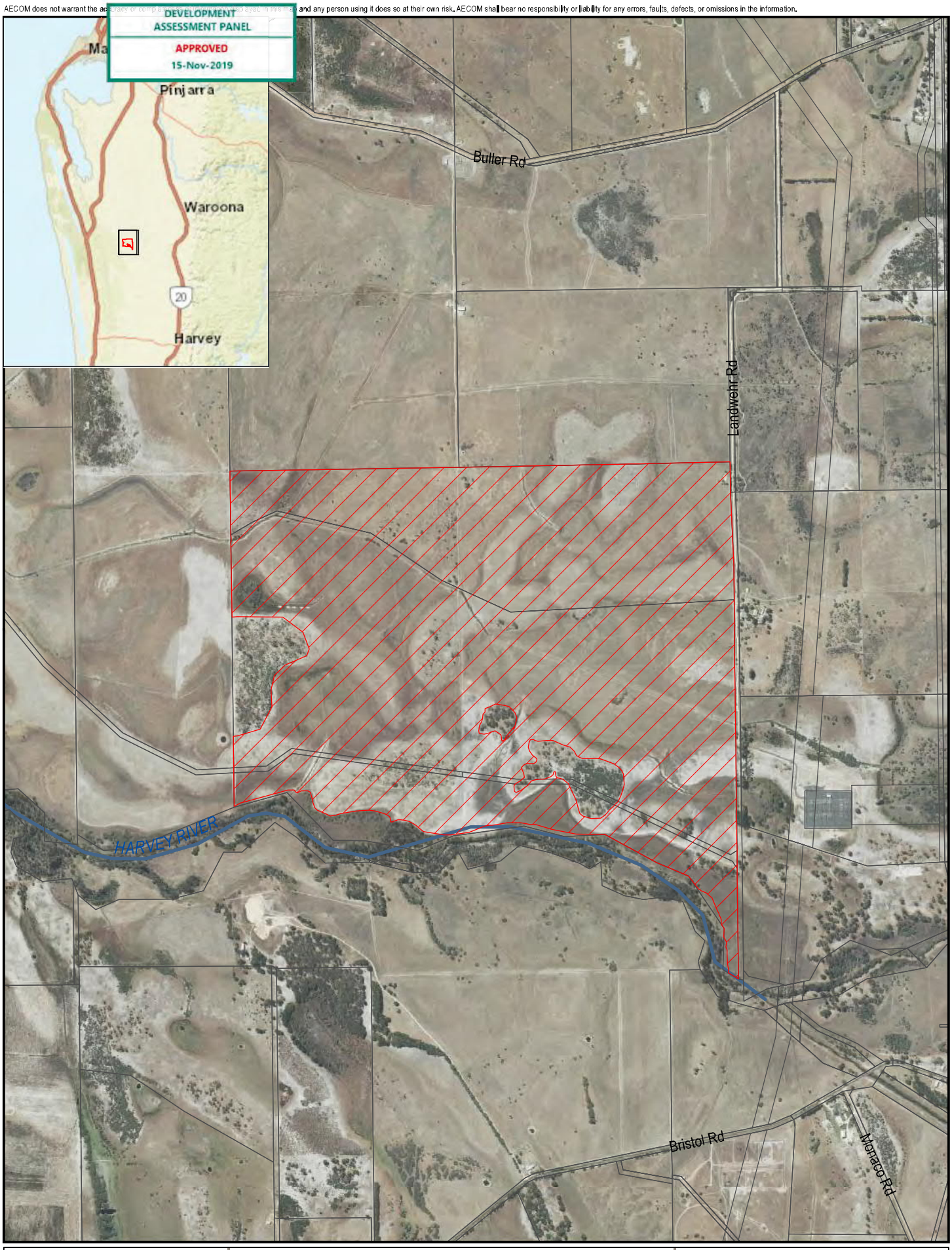
1.2 Purpose and Scope

The purpose of this report is to examine the existing environment within the Survey Area and identify the extent of any environmental values that may constrain the suitability of the site for solar farm development. Potential constraints assessed include conservation significant fauna habitat, flora species, and vegetation communities.

The scope of works for the ecological survey was to:

- Complete a desktop review to identify Threatened or Priority flora, fauna or ecological communities that may potentially occur within, or in close proximity to the Survey Area
- Undertake a field survey to:
  - verify the results of the desktop review
  - note evidence of any conservation significant biota that were not identified by the desktop review
  - investigate the presence (or likely presence) of specific Commonwealth and State-listed threatened flora and fauna species and communities
  - map and describe the flora and vegetation values including mapping vegetation communities and condition
  - identify and map potential Black Cockatoo breeding trees and foraging habitat within the Survey Area.
- Produce a technical report that includes the January and June 2019 assessments including methods, results and potential environmental constraints of the Survey Area.

DEVELOPMENT ASSESSMENT PANEL
APPROVED
15-Nov-2019



PROJECT ID 60605068
CREATED BY KW
APPROVED BY L.Fisher
LAST MODIFIED 11 JUL 2019

AECOM
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LEGEND
Survey Area
Cadastre

DATUM GDA 1994, PROJECTION MGA ZONE 50
0 150 300 450 600
metres
1:20,000 when printed at A4

Data sources: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land

Location of the Project and the Survey Area Extent

SOUTH ENERGY

WAROONA SOLAR FARM - ECOLOGICAL ASSESSMENT

Figure 1

Map Document: G:\GIS_Projects\WaroonaSolarFarm\02_MXDs\04_Ecological\Assessment\G60605068_Fig1_ProjectLocation.mxd (wyattk2)

A4 size

2.0 Legislative Framework

Table 1 summarises the key legislation and guidance governing the protection and management of Western Australia's conservation significant flora, fauna and communities.

Table 1 Relevant Legislation, Regulations and Guidance

Legislation	Purpose
Commonwealth of Australia	
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Provides for the protection of the environment and the conservation of biodiversity.
EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species, (DSEWPAC, 2012)	These guidelines are intended to assist proponents in determining whether an action needs to be referred to the Australian Government. Definitions of habitat are provided as are criteria used to judge significant impact for these Black Cockatoo species.
Revised Draft Referral Guideline for Three Threatened Black Cockatoo Species (2017).	This guideline outlines important information and requirements for proponents, particularly on habitat quality, survey expectations, standards for mitigating impacts and significant impacts.
Western Australia	
Wildlife Conservation Act 1950 (WC Act) to be superseded by the Biodiversity Conservation Act 2016 in January 2019.	Provides for the conservation and protection of Western Australia's wildlife.
Biodiversity Conservation Act 2016 (BC Act)	This Act will replace both the WC Act and the Sandalwood Act 1929. On 3 December 2016, several parts of the new Act were proclaimed by the State Governor in the Government Gazette. Provisions that replace those existing under the WC Act and Sandalwood Act 1929 (including threatened species listings and controls over the taking and keeping of native species) and their associated Regulations have come into effect on 1 January 2019.
Environmental Protection Act 1986 (EP Act)	Preventing, controlling and abating environmental harm and conserving, preserving, protecting, enhancing and managing the environment.
Biosecurity and Agriculture Management Act 2007 (BAM Act)	Provides for the management, control and prevention of certain plants and animals, and for the protection of agriculture and related resources generally.
EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016a)	Provides guidance to ensure adequate flora and vegetation data of an appropriate standard are obtained and used in EIA.
EPA Technical Guidance – Terrestrial Fauna Surveys (EPA, 2016b)	Provides guidance on the standard of survey required to assist in collecting the appropriate data for decision-making associated with the protection of Western Australia's terrestrial fauna.
EPA Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna, (EPA, 2016c)	Provides advice on fauna sampling techniques and methodologies for different regions of the State and the analysis, interpretation and reporting requirements for EIA.

2.1 Federal Legislation – *Environment Protection and Biodiversity Conservation Act 1999*

2.1.1 Matters of National Environmental Significant

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is the main piece of Federal legislation protecting biodiversity in Australia. All Matters of National Environmental Significance (MNES) are listed under the EPBC Act. These include:

- listed threatened species and ecological communities
- migratory species protected under international agreements
- Ramsar wetlands of international importance
- the Commonwealth marine environment
- world Heritage properties
- national Heritage places
- Great Barrier Reef Marine Park
- a water resource, in relation to coal seam gas development and large coal mining development
- nuclear actions.

If an action is likely to have a significant impact on a MNES this action must be referred to the Minister for the Environment for a decision on whether assessment and approval is required under the EPBC Act.

2.1.2 Flora and Fauna

Species at risk of extinction are recognised at a Commonwealth level and are categorised in one of six categories as outlined in Table 2.

Table 2 Categories of Species Listed under Schedule 179 of the EPBC Act

Conservation	Code Category
Ex	**Extinct Taxa** which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild** Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	**Critically Endangered** Taxa which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	**Endangered** Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	**Vulnerable** Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Conservation	Code Category
CD	**Conservation Dependent** Taxa which at a particular time if, at that time: the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered the following subparagraphs are satisfied: - the species is a species of fish - the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised the plan of management is in force under a law of the Commonwealth or of a State or Territory cessation of the plan of management would adversely affect the conservation status of the species.

2.1.3 Vegetation Communities

Communities can be classified as Threatened Ecological Communities (TECs) under the EPBC Act. The EPBC Act protects Australia's ecological communities by providing for:

- identification and listing of ecological communities as threatened
- development of conservation advice and recovery plans for listed ecological communities
- recognition of key threatening processes
- reduction of the impact of these processes through threat abatement plans.

Categories of federally listed TECs are described in Table 3.

Table 3 Categories of TECs that are listed under the EPBC Act

Code	Category
CE	Critically Endangered If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
E	Endangered If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
V	Vulnerable If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

2.2 Western Australian Legislation

2.2.1 Flora and Fauna

Plants and animals that are considered Threatened and need to be specially protected because they are under identifiable threat of extinction are listed under the WC Act. These categories are defined in Table 4.

Table 4 Conservation codes for WA flora and fauna listed under the *Wildlife Conservation Act 1950* updated November 2015

Code	Category
CR	**Critically Endangered Species** Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EN	**Endangered Species** Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora
VU	**Vulnerable Species** Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EX	**Presumed Extinct Species** Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
IA	**Migratory birds protected under an international agreement** Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.
CD	Special conservation
OS	Special protection for reasons other than those already mentioned

Species that have not yet been adequately surveyed to warrant being listed under the WC Act, or are otherwise data deficient, are added to a Priority Lists under Priorities 1, 2 or 3 by the State Minister for Environment. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. Categories and definitions of Priority Flora and Fauna species are provided in Table 5.

Table 5 Conservation codes for WA flora and fauna as listed by DPaW and endorsed by the Minister for Environment

Code	Category
P1	**Priority One – Poorly Known Species** Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2	**Priority Two – Poorly Known Species** Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3	**Priority Three – Poorly Known Species** Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4	**Priority Four – Rare, Near Threatened and other species in need of monitoring** a. Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. b. Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. c. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

2.2.2 Biosecurity and Agriculture Management Act 2007

Biosecurity is the management of the risk of animal and plant pests and diseases entering, emerging, establishing or spreading in WA to protect the economy, environment and community. Biosecurity is managed under the BAM Act which came into effect 1 May 2013. Exotic animals and plants can become an invasive species if they can establish in new areas where local conditions are favourable for their growth. Each organism listed under the Bam Act comes with certain legal / import requirements:

- Declared Pest, Prohibited - s12. Prohibited organisms are declared pests by virtue of section 22(1), and may only be imported and kept subject to permits.
- Permitted - s11. Permitted organisms may be subject to an import permit if they are potential carriers of high-risk organisms.
- Declared Pest - s22(2). Declared pests may be subject to an import permit if they are potential carriers of high-risk organisms, and may also be subject to control and keeping requirements once within Western Australia.
- Permitted, Requires Permit - r73. Regulation 73 permitted organisms may only be imported subject to an import permit.

Declared pests can be assigned to a C1, C2 or C3 control category under the Biosecurity and Agriculture Management Regulations 2013:

- C1 Exclusion - Organisms which should be excluded from part or all of Western Australia.
- C2 Eradication - Organisms which should be eradicated from part or all of Western Australia.
- C3 Management - Organisms that should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism or prevent or contain the spread of the organism.
- Unassigned - Declared pests that are recognised as having a harmful impact under certain circumstances, where their subsequent control requirements are determined by a Plan or other legislative arrangements under the BAM Act.

2.2.3 Communities of Local, Regional and National Significance

Significant flora and vegetation units need to take into account a number of other features other than statutory listings in accordance with the Flora and Vegetation Environmental Factor Guideline (EPA, 2016a). These include the following:

- Restricted distribution
- Degree of historical impact from threatening processes
- A role as a refuge
- Providing an important function required to maintain ecological integrity of a significant ecosystem.

3.0 Existing Environment

3.1 Climate

The Survey Area is situated in southwest WA which has a Mediterranean type climate. A Mediterranean climate is characterised by warm to hot dry summers and mild to cool wet winters. The Mediterranean climate in Australia is a result of the Indian Ocean High, a high pressure cell that shifts towards the poles in summer and the equator in winter, playing a major role in the formation of the deserts of Western Australia. Precipitation occurs during winter months, with the possibility of some summer storms.

The nearest Bureau of Meteorology (BoM) weather station is Wagerup Refinery (Station ID 009538) located 7 km south of the Survey Area. Rainfall in the months leading up to both the January and June 2019 surveys were lower than the mean (Figure 2). The variation in rainfall in the months preceding the survey is not considered to have affected the survey results.

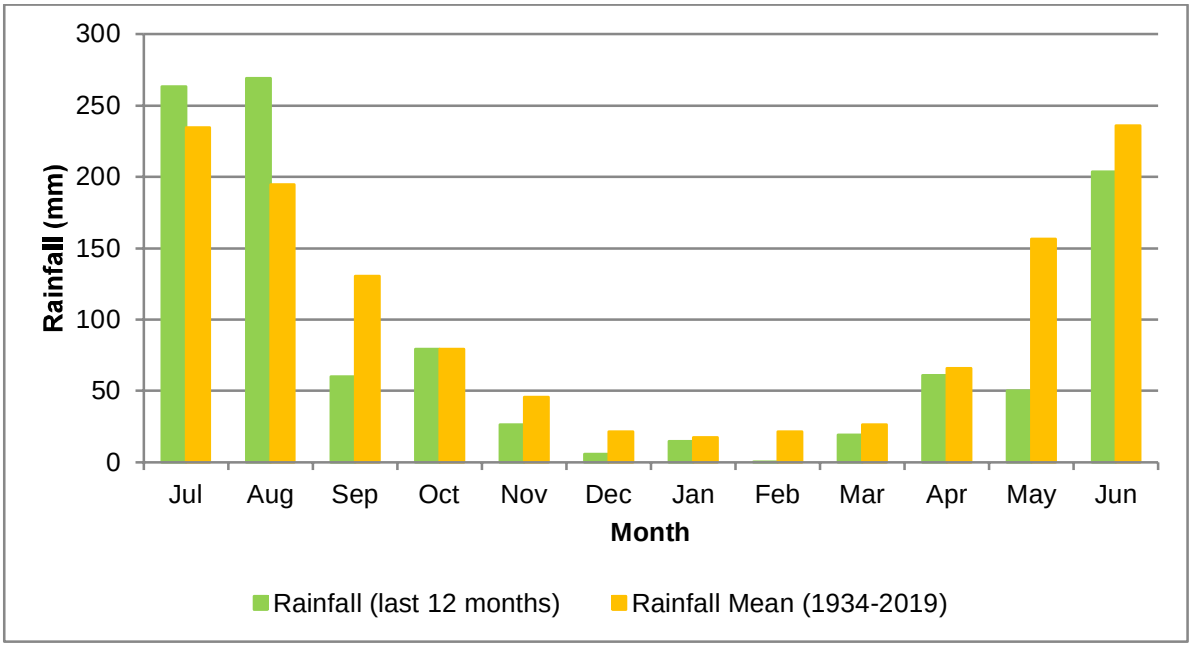


Figure 2 Rainfall recorded at the Wagerup Refinery (Station 009538)

3.2 IBRA Region

The Swan Coastal Plain bioregion, described in CALM (2002), includes Perth and the outer suburbs (excluding the Hills suburbs). The Swan Coastal Plain consists of the Dandaragan Plateau and the Perth Coastal Plain and is comprised of a narrow belt less than 30km wide of Aeolian, alluvial and colluvial deposits of Holocene or Pleistocene age (Gibson et al 1994). A complex series of seasonal fresh water wetlands, alluvial river flats, coastal limestone and several offshore islands are included in the bioregion. Younger sandy areas and limestone are dominated by heath and/or tuart woodlands, while Banksia and jarrah-Banksia woodlands are found on the older dune systems. The outwash plains at the foot of the Darling Escarpment were once dominated by Casuarina obesa-marri woodlands and Melaleuca shrublands. Extensive clearing has occurred on the Swan Coastal Plain for urban and agricultural development. The region is divided into the Dandaragan Plateau and the Swan Coastal Plain subregions.

The Swan Coastal Plain subregion, described by Mitchell et al. (2002), is a low-lying coastal plain covered with woodlands dominated by Banksia or Tuart on sandy soils, Casuarina obesa on outwash plains, and paperbark in swampy areas. The area includes a complex series of seasonal wetlands and includes Rottnest, Carnac and Garden Islands. Land use is predominantly cultivation, Conservation, urban and rural residential. The area contains a number of rare features including Holocene dunes and wetlands and a large number of rare and threatened species and ecological communities.

3.3 Soils and Geology

Purdie et al. (2004) broadly mapped two land systems within the Survey Area:

- Bassendean System (212Bs) - sand dunes and sandplains with pale deep sand, semi-wet and wet soil. This covers most of the Survey Area.
- Pinjarra System (213Pj) - Poorly drained coastal plain with variable alluvial and aeolian soils. This system presents the alluvial plain of the Harvey River located along the southern margin of the Survey Area, as well as a small depression in the north eastern corner of the Survey Area.

Land systems in the Survey Area can be broken down further into nine sub-systems that form a mosaic of sandplains, low dunes and depressions with varying drainage (In some places depressions may create poorly defined streams. Where the Pinjarra System is present, clays and duplex soils are more prevalent. These form a defined channel and banks at the Harvey River.

3.4 Vegetation

Pre-European vegetation mapping has been undertaken by Beard (1974). This mapping shows one vegetation association within the Survey Area, described as Association 1000 Low forest or woodland. Mosaic: medium forest; Jarrah-Marri / low woodland; Banksia / Low forest; Teatree (Melaleuca spp.).

Heddle et al. (1980) conducted vegetation complex mapping for the Swan Coastal Plain at a scale of 1:250,000. The mapping shows three vegetation types (Table 6) including Serpentine River, Cannington and Southern River complex.

Table 6 Vegetation complex mapping in the Survey Area completed by Heddle *et al.* (1980)

Landform Unit	Complex	Description
Pinjarra Plain	35 Serpentine River Complex	Closed scrub of Melaleuca species and fringing woodland of Eucalyptus rudis (Flooded Gum) - Melaleuca rhaphiophylla (Swamp Paperbark) along streams.
Combination Bassendean Dunes and Pinjarra Plain	40 Cannington Complex	Mosaic of vegetation from adjacent vegetation complexes of Bassendean, Karrakatta, Southern River and Vasse.
	42 Southern River Complex	Open woodland of Corymbia calophylla (Marri) - Eucalyptus marginata (Jarrah) - Banksia species with fringing woodland of Eucalyptus rudis (Flooded Gum) - Melaleuca rhaphiophylla (Swamp Paperbark) along creek beds.

4.0 Methods

The ecological assessment builds on work completed in January 2019. This section describes all the survey effort conducted to-date including the desktop review and the two field surveys.

4.1 Desktop Review

A detailed desktop review was undertaken to define the existing environment and identify potential matters of conservation significance to target during the field survey.

The desktop review was informed by publicly available government databases including Department of Biodiversity, Conservation and Attractions (DBCA) and Western Australian Museum's NatureMap (115º 48' 11" E, 32º 53' 40" S) and EPBC Act Protected Matters Search Tool (PMST). A buffer distance of 10 km was used for database searches and is considered appropriate for detecting conservation significant species in the south west region of Western Australia.

The likelihood of occurrence was determined for all conservation significant species and communities identified, using categories outlined in Table 7.

Table 7 Categories of likelihood of occurrence for species and communities

Likelihood Category	Flora	Fauna	Communities
Likely to occur	Habitat is present in the Survey Area and the species has been recorded in close proximity to the Survey Area.	Survey Area is within the known distribution of the species, habitat is present in the Survey Area and the species has been recorded in close proximity to the Survey Area.	Known occurrences of the community in close proximity to the Survey Area. Vegetation within the known occurrence appears to be congruent with vegetation in the Survey Area based on aerial imagery. Geographic location is similar to the Survey Area.
May occur	Habitat may be present and/or the species has been recorded in close proximity to the Survey Area.	Survey Area is within the known distribution of the species, marginal habitat may be present and/or the species has been recorded in close proximity to the Survey Area.	Known occurrence of the community in the local area, and/or vegetation within known occurrence appears to be congruent with vegetation in the Survey Area based on aerial imagery. Geographic location is similar to the Survey Area.
Unlikely to occur	No suitable habitat is present and the species has not been recorded in close proximity to the Survey Area.	Survey Area is outside the known distribution for the species, or no suitable habitat is present and the species has not been recorded in close proximity to the Survey Area.	Known occurrence of the community in close proximity to the Survey Area however geographic location does not occur in Survey Area.

4.2 Field Survey

4.2.1 Preliminary Site Assessment

A preliminary site assessment was conducted on 31 January 2019 by Ecologists Jared Leigh and Laura Fisher. Patches of remnant native vegetation were characterised including vegetation association, condition, and potential for utilisation by significant fauna species. Desktop review results were verified including confirmation of the absence of significant flora species and vegetation communities. An inventory of fauna species observed was also compiled.

4.2.2 Reconnaissance Flora and Vegetation Assessment

The flora and vegetation assessment included collecting data from traverses in areas of remnant native vegetation. The survey was completed by Ecologists Floora de Wit and Laura Fisher on 20 June 2019.

Five traverses were completed in areas of remnant native vegetation. Traverses included walking through the patch on foot and recording patch characteristics including landform, flora species and community complexity, and evidence of disturbance, Traverses were considered suitable for capturing the floristic data for the Project as all patches were mostly devoid of native vegetation species. Quadrats was not considered an efficient method for capturing floristic data for this Project.

Each traverse was given a unique site number, and the following parameters recorded:

- date
- location (accuracy of 5 m)
- soil details (type, colour, moisture)
- landform
- vegetation condition using the Keighery (1994) scale and description of disturbance
- fire history
- species list
  - estimated height
  - estimated percentage cover (for trees both percentage within quadrat and within community was recorded to enable better description of vegetation community).

4.2.3 Targeted Black Cockatoo Survey

A targeted Black Cockatoo survey was conducted to identify potential breeding, roosting and foraging habitat for the three threatened Black Cockatoo species that are likely to occur in the Survey Area. These are Carnaby's Cockatoo Calyptorhynchus latirostris (Endangered under the EPBC Act and under the WC Act), the Forest Red-tailed Black Cockatoo Calyptorhynchus banksii naso (Vulnerable under the EPBC Act and under the WC Act) and Baudin's Cockatoo Calyptorhynchus baudinii (Endangered under the EPBC Act and under the WC Act). The survey was conducted on 20 June 2019 in accordance with DSEWPaC (2012) and DotEE (2017) by Ecologists Floora de Wit and Laura Fisher.

4.2.3.1 Breeding Habitat

The Black Cockatoo breeding habitat assessment focussed on quantifying breeding and potential breeding trees within the Survey Area. Table 8 defines breeding habitat and identifies those trees that Black Cockatoos will utilise as breeding trees, according to DSEWPaC (2012).

The following information was collected for all potential breeding trees with suitable hollows or a Diameter at Breast Height (DBH) >500 mm (Eucalyptus wandoo >300 mm). Details collected for each tree included:

- location
- tree species
- DBH
- number of potentially suitable hollows

- hollow details – including dimensions, height from ground, direction, type of hollow, evidence of use, etc.

Table 8 Potential breeding habitat trees for Black Cockatoo species

Habitat	Carnaby's Cockatoo	Forest Red-Tailed Black Cockatoo	Baudin's Cockatoo
Specific breeding habitat	Generally in woodland or forest, but also breeds in former woodland or forest now present as isolated trees. Nest in hollows in live or dead trees of salmon gum E. salmonophloia, wandoo, tuart, jarrah E. marginata, flooded gum E. rudis, york gum E. loxophleba subsp. loxophleba, powderbark E. accedens, karri and marri.	Generally in woodland or forest, but may also breed in former woodland or forest now present as isolated trees. Nest in hollows in live or dead trees of marri, karri, wandoo, bullich E. megacarpa, blackbutt E. patens, tuart and jarrah.	Generally in woodland or forest, but may also breed in former woodland or forest now present as isolated trees. Nest in hollows in live or dead trees of karri Eucalyptus diversicolor, marri Corymbia calophylla, wandoo E.wandoo and tuart E. gomphocephala.
Definition of breeding habitat	'Breeding habitat' is defined in these referral guidelines as trees of species known to support breeding within the range of the species which either have a suitable nest hollow OR are of a suitable DBH to develop a nest hollow. For most tree species, suitable DBH is 500 mm. Note that E. wandoo is DBH >300 mm.		

4.2.3.2 Roosting Habitat

Table 9 defines the suitable trees that the three Western Australian Black Cockatoo species may utilise as roosting trees. Both white-tailed Black Cockatoo species roost in or near riparian environments or near other permanent water sources. The Forest Red-Tailed Black Cockatoo prefers the edges of forests for roosting (DSEWPaC, 2012). Potential roosting trees were searched for and assessed during the field survey.

Evidence of roosting usually involves large amounts of bird scat beneath a large, mature tree, with a significant amount of broken branches, twigs etc. on the ground. Roosting sites were searched for throughout the Survey Area.

Table 9 Suitable Roosting Trees for the Three Western Australian Threatened Black Cockatoo Species

Carnaby's Cockatoo	Forest Red-Tailed Black Cockatoo	Baudin's Cockatoo
Generally in or near riparian environments or natural and artificial permanent water sources. Flat-topped yate E. occidentalis, salmon gum, wandoo, marri, karri, blackbutt, tuart, introduced eucalypts (for example blue gum) and introduced pines.	Tall jarrah, marri, blackbutt, tuart and introduced eucalypt trees within or on the edges of forests.	Generally in or near riparian environments or other permanent water sources. Jarrah, marri, flooded gum, blackbutt E. patens, tuart, and introduced eucalypts including blue gum E. globulus, and lemon scented gum Corymbia citriodora.

Source: DSEWPaC (2012).

4.2.3.3 Foraging Habitat

The quality of foraging habitat not only reflects the availability of food sources, but also the proximity to reliable water sources, connectivity to other suitable habitat, presence of breeding and potential breeding trees, and proximity to confirmed roost and breeding sites (amongst others). These parameters were utilised by the DotEE (2017) to produce a draft quality of foraging habitat scoring system, which has been slightly amended by AECOM (Table 12). This scoring system was utilised to

assess potential foraging habitat for Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo and Baudin's Cockatoo throughout the Survey Area.

The scoring tool is used by initially defining the quality of the overall habitat present (i.e. Very High Quality, High Quality, Quality and Low Quality) and then adding or subtracting points from this depending on the ecological values of the habitat (i.e. proximity to water, proximity to a known roost site, evidence of foraging material etc.). This determines an overall quantitative rating. Table 10 defines the levels of foraging habitat quality used during the assessment.

Table 11 defines the foraging and common food items for the three Western Australian Black Cockatoo species.

Table 10 Black Cockatoo Foraging Assessment Scoring

Score	Foraging Quality
1 – 3	Low Quality
4 – 6	Quality
7 – 8	High Quality
>8	Very High Quality

Table 11 Foraging and Common Food Items for Black Cockatoo Species

Species	Carnaby's Cockatoo	Forest Red-tailed Black Cockatoo	Baudin's Cockatoo
Foraging	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as Banksia spp. (including Dryandra spp.), Hakea spp. and Grevillea spp. Forages in pine plantations (Pinus spp.), eucalypt woodland and forest that contains foraging species. Also individual trees and small stands of these species.	Jarrah and marri woodlands and forest, and edges of karri forests including wandoo and blackbutt, within the range of the subspecies.	Eucalypt woodlands and forest, and proteaceous woodland and heath. During the breeding season feed primarily on native vegetation, particularly marri. Outside the breeding season, may feed in fruit orchards (mostly apple and pear, but also persimmon) and tips of Pinus spp.
Foraging: common food items	Seeds, flowers and nectar of native proteaceous plant species (for example, Banksia spp., Hakea spp., Dryandra spp, and Grevillea spp), eucalypts and Callistemon. Also seeds of introduced species including Pinus spp., Erodium spp., wild radish, canola, almonds and pecan nuts; insects and insect larvae; occasionally flesh and juice of apples and persimmons.	Mostly seeds of marri and jarrah, also Eucalyptus caesia, illyarrie E. erythrocorys and some introduced eucalypts such as river red gum E. camaldulensis and flooded gum E. grandis, Allocasuarina cones, fruits of snottygobble Persoonia longifolia and mountain marri Corymbia haematoxylon. On the Swan Coastal Plain, often feed on introduced cape lilac Melia azedarach.	Mostly marri (seeds, flowers, nectar and grubs) and proteaceous trees and shrubs. Also other native seeds and introduced fruits; insects and insect larvae; pith of kangaroo paw Anigozanthos flavidus; juice of ripe persimmons; tips of Pinus spp. And seeds of apples and pears.

Source: DSEWPaC (2012).

Table 12 Quality of Foraging Habitat Assessment Tool

Initial Score	Carnaby's Cockatoo	Forest Red-tailed Black Cockatoo	Baudin's Cockatoo
10	Quality foraging habitat that is being managed for Black Cockatoos, including successful rehabilitation, and/or has some level of protection from clearing	Quality foraging habitat that is being managed for Black Cockatoos, including successful rehabilitation, and/or has some level of protection from clearing	Quality foraging habitat that is being managed for Black Cockatoos, including successful rehabilitation, and/or has some level of protection from clearing
7	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species (e.g. *Banksia* sp., *Hakea* sp. and *Grevillea* sp.) as well as eucalypt (not mallee) woodland and forest that is dominated by foraging species. Does not include orchards, canola, or areas under a RFA	Jarrah and Marri woodlands and forest, and edges of Karri forests, including Wandoo and Blackbutt, within the range of the subspecies. Does not include areas under a RFA	Eucalypt woodlands and forest, and proteaceous woodland and heath, particularly marri. Does not include orchards or areas under RFA
5	Pine plantation, mallee eucalypts, introduced eucalypts and /or native vegetation with foraging species that are not dominant	Introduced eucalypts, introduced Cape lilac (*Melia acedarach*) and /or native vegetation with foraging species that are not dominant	Pine plantation or introduced eucalypts
1	Individual foraging plants or small stand of foraging plants (≤2 ha)	Individual foraging plants or small stand of foraging plants (≤2 ha)	Individual foraging plants or small stand of foraging plants (≤2 ha)
Additions: Context adjustor – attributes improving habitat quality			
+3	Is within the Swan Coastal Plain	Jarrah and/or Marri shows good recruitment (i.e. evidence of young trees)	Is within the known foraging area
+3	Contains trees known to be used for breeding and / or with suitable nest hollows	Contains trees known to be used for breeding and / or with suitable nest hollows	Contains trees known to be used for breeding
+2	Primarily comprises Marri	Primarily contains Marri and / or Jarrah	Primarily contains marri
+2	Contains trees with potential to be used for breeding (DBH ≥500 mm or ≥300 mm for Salmon Gum and Wandoo)		
+1	Known to be a large or key roosting site		
Subtractions: Context adjustor – attributes reducing habitat quality			
-2	Does not contain evidence of foraging by species		
-2	No other foraging habitat within 6 km		
-1	Is >12km from known roosting site		
-1	Is >12 km from known breeding location		
-1	Is >2 km from watering point		
-1	Disease present (e.g. *Phytophthora cinnamomi* or Marri canker)		

Source: DotEE (2017) – amended by AECOM

4.3 Assumptions and Limitations

Limitations are inherent with any ecological assessment. The limitations associated with the ecological assessment are outlined in Table 13. The limitation assessment scale ranges from "not", "minor", "moderate", "significant".

Table 13 Limitations of the assessment

Limitation	Assessment
Availability of contextual information on the region	**Not a limitation** Sufficient contextual information is available on the Swan Coastal Plain.
Competency/experience of consultant conducting survey	**Not a limitation** Jared is an ecologist with over 15 years' experience in the environmental industry who has conducted fauna surveys in a range of bioregions within Western Australia. Floora is an ecologist with over 10 years' experience conducting surveys of similar scope. Laura is an ecologist with over two years' experience in the environmental industry conducting surveys of similar scope.
Scope (i.e. what life forms were sampled)	**Minor limitation** All areas of potential foraging habitat were inspected and every potential breeding tree within the Survey Area was assessed for suitability. Due to size of some trees, vision of the entire tree was not always possible when looking for hollows, and in this case the precautionary principle was utilised.
Proportion of flora/fauna identified, recorded and/or collected (based on sampling, timing and intensity)	**Minor Limitation** Floristic data was collected from all patches of native vegetation within the Survey Area. No direct or indirect evidence of the three Black Cockatoos were recorded during the survey. Potential Baudin's Cockatoo Calyptorhynchus baudinii foraging evidence was recorded under a Marri tree in the January 2019 survey on a selection of Marri nuts. This cannot be confirmed with confidence due to the similarities of Baudin's foraging markings comparative to other bird species. Fauna habitat mapping was conducted at a broad-scale. Mapping was conducted using hand-held computer (Samsung tablet) units and aerial photo interpretation. The accuracy of the mapping is subject to the accuracy of the unit and access to satellite information (generally < 6 metres). As such, these points should not be relied on for detailed design purposes. Floristic data was collected out of the defined 'ideal survey season'. Additional spring surveys are unlikely to identify additional significant environmental values that were not able to be detected during the January and June survey events.
Sources of information	**Minor limitation** DBCA database, Naturemap, EPBC Act PMST, DoEE (2017) and DSEWPaC (2012) were utilised to inform the surveys.
Completeness (was relevant area fully surveyed)	**Not a limitation** The objectives of the surveys were met. Only areas included in the Survey Area were surveyed to assess their environmental values. If the areas of native vegetation outside the Survey Area require clearing an additional survey will be required.

Limitation	Assessment
Remoteness and/or access problems	**Minor limitation** The majority of the Survey Area was traversed on-ground and was accessible. One isolated patch in the northwest corner of the Survey Area was isolated from the main paddock by a hand-made drain which was full of water at the time of the June 2019 survey. Black Cockatoo assessments were conducted from the edge and are considered an adequate representation of the patch.
Timing, weather, season, cycle	**Not a limitation** The Survey Area is within the modelled distribution of all three Black Cockatoo species. The survey was completed outside the regular flowering season for species on the Swan Coastal Plain. However, due to the degradation of the site, an in-season survey is not expected to identify any other significant environmental=.
Disturbances (e.g. fire flood, accidental human intervention) which affected results of the survey	**Not a limitation** The surveys were not disrupted or impacted.
Intensity (was the intensity adequate)	**Not a limitation** The Survey Area was assessed over two days which enabled sufficient time to assess each patch of remnant vegetation and record all potential Black Cockatoo breeding habitat trees.
Resources (degree of expertise available in identification)	**Not a limitation** The resources (time, equipment and expertise) were sufficient for the surveys. All surveyors have sufficient experience in the environmental industry and conducting relevant surveys.

5.0 Desktop Review Results

The PMST identified a number of Matters of National Environmental Significance (MNES) that may occur, or for which suitable habitat may occur within the Survey Area. Results of the PMST search as requested on 25 January 2019 are summarised in Table 14.

Table 14 Summary of PMST Results

MNES	Number of occurrences
World Heritage Properties	None
National Heritage Places	None
Wetlands of International Importance (Ramsar Sites)	Peel-Yalgorup system, within 10 km of Ramsar
Listed Threatened Ecological Communities and Threatened Species	Two Threatened Ecological Communities: - Banksia Woodlands of the Swan Coastal Plain (EPBC: Endangered) - Clay Pans of the Swan Coastal Plain (EPBC: Critically Endangered) 24 listed threatened species including: - 12 listed fauna species - 12 listed flora species
Migratory Species	10 migratory species
Commonwealth Marine Areas	None

5.1 Threatened and Priority Ecological Communities

Two Threatened Ecological Communities (TECs) listed under the EPBC Act were identified in the desktop review, including the Banksia Woodlands of the Swan Coastal Plain (Banksia Woodlands TEC) and the Clay Pans of the Swan Coastal Plain.

The Banksia Woodlands TEC is listed as Endangered under the EPBC Act and relates to three State-listed TECs, and eight Priority Ecological Communities (PECs).

The Banksia Woodlands TEC incorporates woodland of Banksia species with scattered Eucalypts and other tree species over a species rich mix of sclerophyllous shrubs, graminoids, and forbs. The community shows high endemism and considerable local variation in species composition across its range. It is restricted to the southwest of WA on the Swan Coastal Plain. It occurs mainly on deep Bassendean and Spearwood sands or occasionally on Quindalup sands.

The Clay Pans of the Swan Coastal Plain is listed as Critically Endangered under the EPBC Act. The Clay Pans TEC occurs where clay soils form an impermeable layer close to the surface with wetlands forming as a result of rainfall to fill them in winter, drying out to impervious pans in summer (DSEWPaC, 2012). Floristic composition is generally a shrubland over geophytes, herbs and sedges with no specific dominant species common across all occurrences.

The Clay Pans TEC corresponds to four ecological community types in WA including:

- Herb rich saline shrublands in clay pans (FCT07) – Vulnerable
- Herb rich shrublands in clay pans (FCT08) – Vulnerable
- Dense shrublands on clay flats (FCT09) – Vulnerable
- Shrublands on dry clay flats (FCT10a) – Endangered.

5.2 Conservation Significant Flora

A total of 39 Threatened and Priority flora species were identified during the desktop review as potentially occurring within the Survey Area. These include 26 species listed as Priority flora and 13 species listed under the WC Act and EPBC Act.

A review of habitat and spatial data determined that eight species are likely to within the Survey Area (Table 15). After reviewing the habitat present within the Survey Area following the site inspection, the likelihood of these species has been downgraded to 'may occur' or 'unlikely to occur' as no suitable habitat was present. All eight of these species are Threatened flora, listed under the EPBC Act and WC Act. Flora species considered likely to occur within the Survey Area are detailed in Appendix A including their conservation status and habitat.

Table 15 Threatened and Priority flora species that are 'likely to occur' or 'may occur' within the Survey Area

Taxon	State WC Act / DBCA	Federal EPBC Act	Likelihood of Occurrence	Post-Survey Likelihood
Andersonia gracilis	Vulnerable	Endangered	Likely to occur	Unlikely to occur
Diuris micrantha	Vulnerable	Vulnerable	Likely to occur	May occur
Diuris purdiei	Endangered	Endangered	Likely to occur	Unlikely to occur
Drakaea elastica	Critically Endangered	Endangered	Likely to occur	Unlikely to occur
Drakaea micrantha	Endangered	Vulnerable	Likely to occur	Unlikely to occur
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	Critically Endangered	Critically Endangered	Likely to occur	Unlikely to occur
Synaphea sp. Pinjarra Plain (A.S. George 17182)	Endangered	Endangered	Likely to occur	Unlikely to occur
Synaphea stenoloba	Critically Endangered	Endangered	Likely to occur	Unlikely to occur

5.3 Conservation Significant Fauna

The desktop review identified 26 conservation significant fauna species that could potentially occur within the Survey Area. The likelihood of occurrence of fauna species was determined by assessing the likely presence of suitable habitat in the Survey Area and reviewing the recent records and distribution of the species (Appendix B). The desktop assessment determined that:

- three species are 'likely to occur'
- 13 species 'may occur'
- ten species are 'unlikely to occur'.

After reviewing the habitat present within the Survey Area following the site inspection, the likelihood of these species has been amended, generally due to minimal or poor quality habitat being present. The revised assessment determined that:

- three species are 'likely to occur'
- seven species 'may occur'
- 16 species are 'unlikely to occur'.

Table 16 documents the ten threatened fauna species that 'may occur' or are 'likely to occur' within the Survey Area.

Table 16 Conservation significant fauna species considered as 'likely to occur' or 'may occur' within the Survey Area

Species	State WC Act / DBCA	Federal EPBC Act
Calidris ferruginea Curlew Sandpiper	Critically Endangered	Migratory
Calyptorhynchus banksii naso Forest Red-tailed Black Cockatoo	Vulnerable	Vulnerable
Calyptorhynchus baudinii Baudin's Cockatoo	Endangered	Vulnerable
Calyptorhynchus latirostris Carnaby's Cockatoo	Endangered	Endangered
Falco peregrinus Peregrine Falcon	Other specially protected fauna	-
Plegadis falcinellus Glossy Ibis	Migratory	Migratory
Tringa nebularia Common greenshank	Migratory	Migratory
Notamacropus Irma Western Brush Wallaby	Priority 4	-
Phascogale tapoatafa subsp. wambenger South-western Brush-tailed Phascogale	Species of special conservation interest	Vulnerable
Pseudocheirus occidentalis Western Ringtail Possum	Critically Endangered	Critically Endangered

6.0 Field Survey

6.1 Vegetation

6.1.1 Threatened and Priority Ecological Communities

No TECs or PECs were recorded in the Survey Area.

The Banksia Woodlands TEC was considered during the field survey. None of the patches of remnant native vegetation met the key diagnostic criteria that defines this TEC as outlined in the conservation advice. Furthermore, the significant degradation of vegetation confirms that vegetation is not representative of the Banksia Woodlands TEC.

The Clay Pans TEC incorporates a shrubland over species rich layer of geophytes, herbs and sedges. The degraded condition of the wetlands within the Survey Area has reduced vegetation to common pasture weeds and some native herbs and sedges. The continued eroding processes would consider the area unsuitable for representing the Clay Pans TEC.

6.1.2 Vegetation Communities

Six native vegetation communities were mapped within the Survey Area extending 18.98 ha which represents 6.72% of the total Survey Area (Table 17; Figure 3).

Tree death was prominent throughout all areas of native vegetation. Understorey was predominantly absent with some evidence of regrowth of herbs once inundated areas dried up.

Table 17 Vegetation types mapped within the Survey Area

Code	Description	Details
Cc	Corymbia calophylla medium open woodland over pasture weeds and grasses.	Survey effort: N/A. Survey Area: 5.72 ha Condition: Completely Degraded
CcApAc	Corymbia calophylla and Banksia ilicifolia low to mid open woodland with Acacia pulchella low sparse shrubland over *Arctotheca calendula and *Hypochaeris glabra low closed forbland.	Survey effort: one traverse (Waroona 02). Survey Area: 1.87 ha. Condition: Completely Degraded – Degraded
CcJp	Corymbia calophylla and Melaleuca rhaphiophylla tall open trees over Juncus preissianus and Xanthorrhea preissii low closed mixed sedge and shrubland.	Survey effort: one traverse (Waroona 05). Survey Area: 1.54 ha Condition: Completely Degraded – Degraded
EmKgAc	Eucalyptus marginata and Banksia ilicifolia low to mid open woodland with Kunzea glabrescens and Acacia pulchella low sparse shrubland over *Arctotheca calendula, *Ehrharta sp. and *Romula rosea low closed mixed forb and grassland.	Survey effort: one traverse (Waroona 03). Survey Area: 4.42 ha Condition: Completely Degraded – Degraded
Mr	Melaleuca rhaphiophylla low open woodland over pasture weeds and grasses.	Survey effort: one traverse (Waroona 01). Survey Area: 3.55 ha Condition: Completely Degraded
MrJp	Melaleuca rhaphiophylla low open woodland with Juncus preissianus and Solanum nigrun low sparse shrubland over *Arctotheca calendula, ?Xanthosia huegelii, and Oxalis pes-caprae low closed forbland.	Survey effort: one traverse (Waroona 04). Survey Area: 1.86 ha Condition: Degraded
Paddock	Cleared paddock comprising common pasture weeds.	Survey Area: 257.5 ha

Code	Description	Details
		Condition: Cleared

6.1.3 Condition

Vegetation condition was mapped as Completely Degraded to Degraded.

The condition reflects the current land use of agriculture. Areas of remnant native vegetation have not been fenced, therefore cattle grazing has contributed to the ongoing decline of vegetation condition.

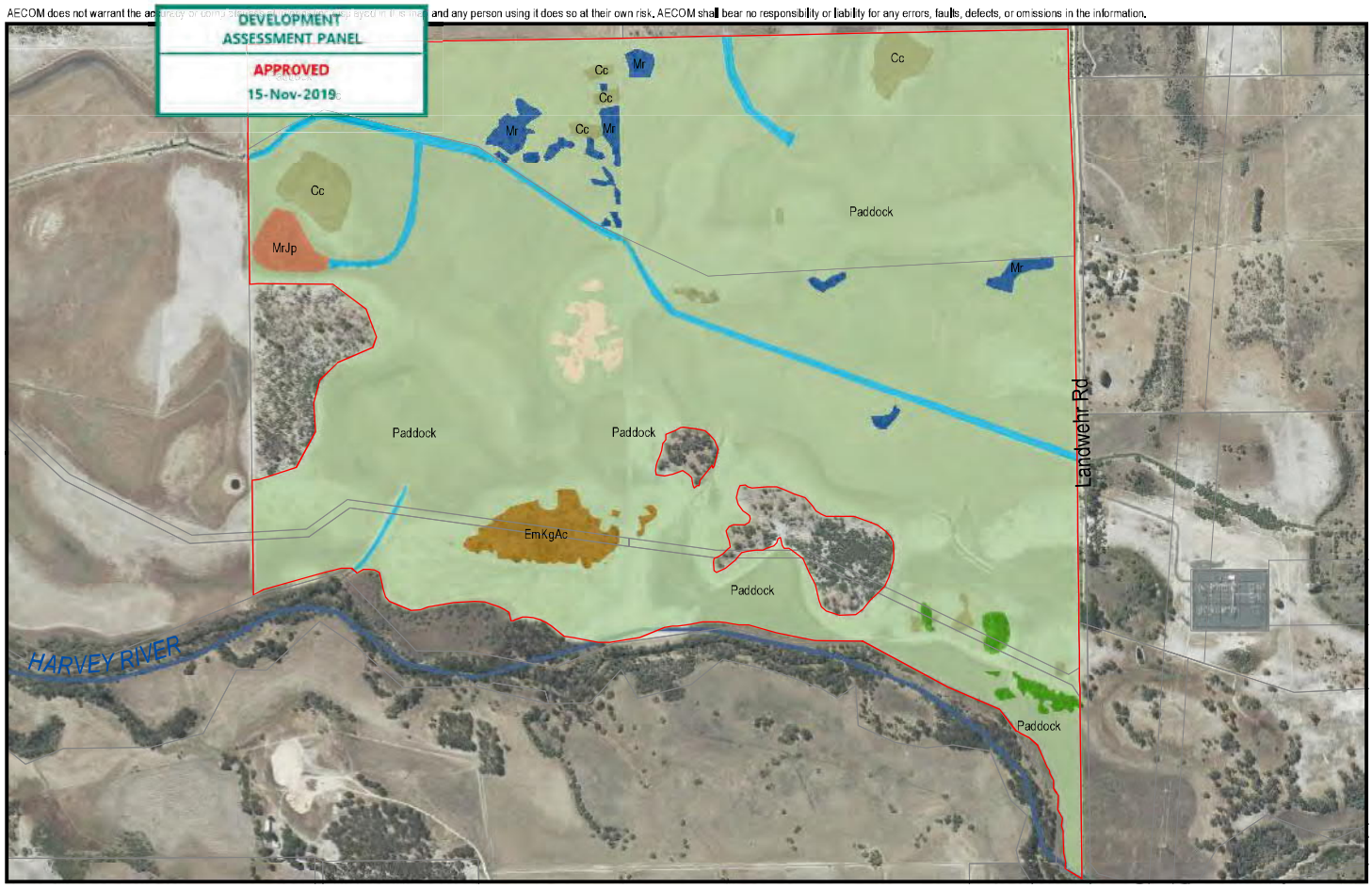
Altered hydrology may be affecting stands of trees, as noted by the numerous dead trees present. At this time we are unable exclude dieback as a contributing factor to vegetation decline.

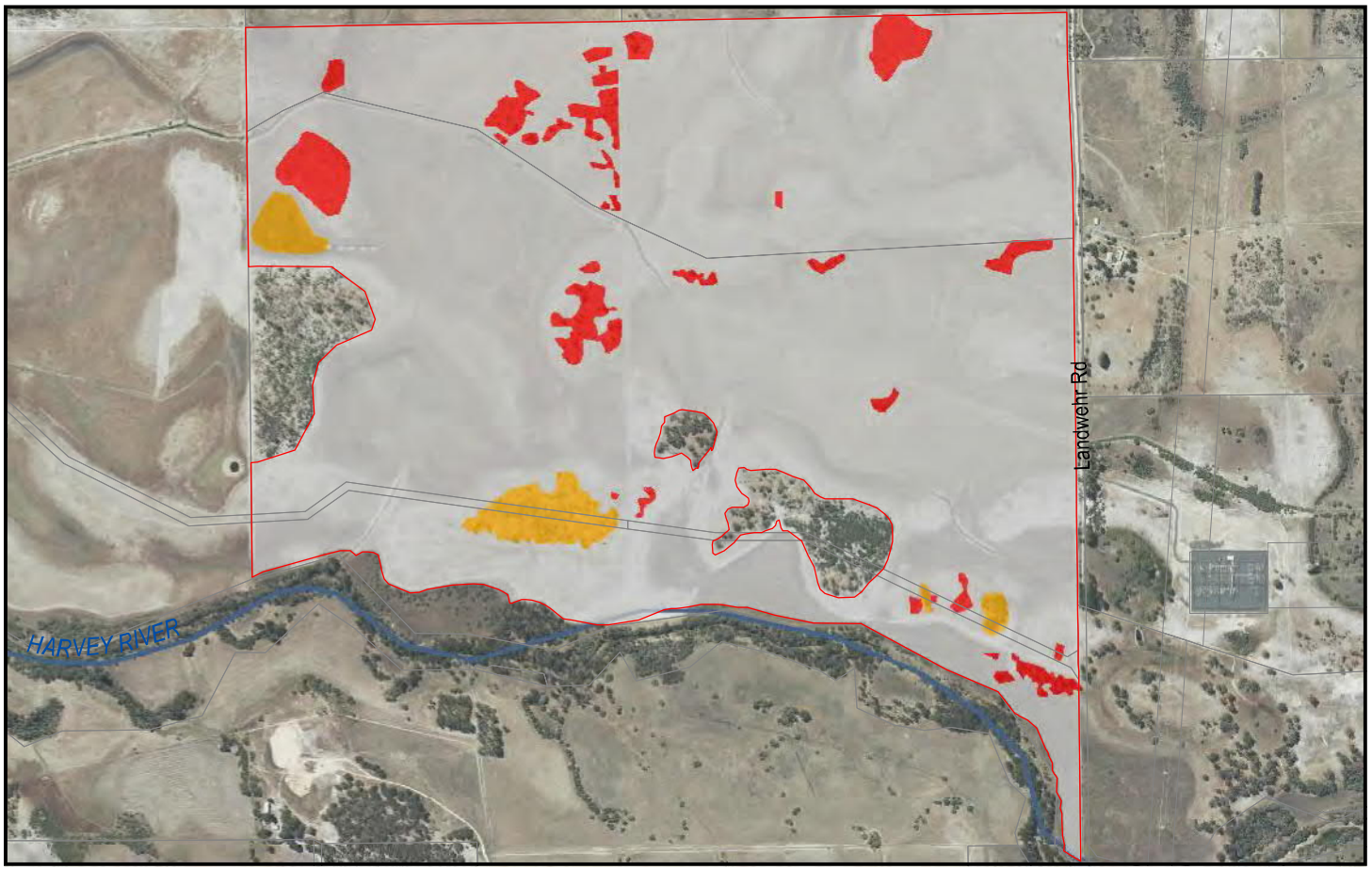
The extent of the various vegetation condition categories mapped for the Survey Area present in Table 18 and Figure 3.

Table 18 Vegetation condition mapped in the Survey Area

Condition Scale	Survey Area (ha)
Cleared	263.8
Completely Degraded	12.13
Degraded	6.85

DEVELOPMENT ASSESSMENT PANEL
APPROVED
15-Nov-2019





PROJECT ID 60605068
CREATED BY KW
APPROVED BY L.Fisher
LAST MODIFIED 30 JUL 2019

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DATUM GDA 1994, PROJECTION MGA ZONE 50

0 150 300 450 600
metres

1:17,500 when printed at A4

LEGEND

Survey Area
Cadastre

Vegetation Communities
Cc
CcApAc
CcJp
Drainage
EmKgAc
Mr
MrJp
Paddock

Vegetation Condition
Completely Degraded
Degraded
Cleared

Data sources:

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2019).

Vegetation Communities and Condition

SOUTH ENERGY

WAROONA SOLAR FARM - ECOLOGICAL ASSESSMENT

Figure 3

Map Document: G:\GIS_Projects\WarconaSolarFarm\02_MXDs\05_EcologicalAssessmentUpdated\G60605068_Fig3_VegCommunitiesCondition.mxd (WyattK2)

A4 size

6.2 Fauna

6.2.1 Conservation Significant Fauna

Twenty-five vertebrate fauna species were recorded during the field survey. This comprised 18 bird, one reptile and six mammal species (Table 19). Of these, two were of conservation significance:

- Baudin's Cockatoo (Calyptorhynchus latirostris) - listed as Endangered under the EPBC Act and WC Act
- Tree Martin (Petrochelidon nigricans) - listed as Marine under the EPBC Act.

Species listed as Marine under the EPBC Act are only considered of conservation significance when recorded within Commonwealth Land. Given the Survey Area does not contain any Commonwealth land the Tree Martin is not considered conservation significant for the purposes of this Project and will not be discussed further.

Table 19 Fauna species recorded during the field survey

Species	Common Name	Status	Observation
Birds			
Anas superciliosa	Pacific Black Duck	Native	Flock of eight birds observed in drainage line to north of Survey Area
Artamus cinereus	Black-faced Woodswallow	Native	Several individuals observed around eucalypts to southeast of Survey Area
Aquila audax	Wedge-tailed Eagle	Native	Two birds observed flying over Survey Area
Barnardius zonarius semitorquatus	Australian Ring-neck Parrot	Native	Observed multiple times throughout Survey Area
Calyptorhynchus latirostris	Baudin's Cockatoo	Native	Possible foraging evidence recorded under Marri tree.
Coracina novaehollandiae	Black-faced Cuckooshrike	Native	One observed in mature eucalypt in paddock
Corvus coronoides	Australian Raven	Native	Heard and seen several times in Survey Area
Cracticus tibicen	Australian Magpie	Native	Common throughout Survey Area
Egretta novaehollandiae	White-faced Heron	Native	Observed flying over Survey Area
Eolophus roseicapilla	Pink and Grey Galah	Native	Two individuals observed in eucalypt
Gerygone fusca	Western Gerygone	Native	Heard in mixed eucalypt stand
Pachycephala rufiventris	Rufous Whistler	Native	Heard in riverine habitat
Pardalotus striatus	Striated Pardalote	Native	Heard in mature trees towards east of Survey Area
Pelecanus conspicillatus	Australian Pelican	Native	Two birds observed flying over Survey Area
Purpureicephalus spurius	Red-capped Parrot	Native	Probably foraging evidence observed beneath Marri to east of Survey Area
Petrochelidon nigricans	Tree Martin	Native	Observed several times throughout Survey Area
Rhipidura albiscapa	Grey Fantail	Native	Observed several times in trees within paddock

Species	Common Name	Status	Observation
Rhipidura leucophrys	Willie Wagtail	Native	Observed several times within native vegetation in and around paddock
Mammals			
Bos taurus	Domestic Cattle	Introduced	Scat and prints observed throughout Survey Area
Macropus fuliginosus	Western Grey Kangaroo	Native	Commonly observed in paddocks
Canis lupis	Feral Dog	Introduced	Tracks observed along tracks to east of Survey Area
Oryctolagus cuniculus	European Wild Rabbit	Introduced	Scat and digging observed in stand of mixed eucalypts
Sus scrofa	Feral Pig	Introduced	Diggings observed adjacent river to southeast of Survey Area
Vuples vulpes	European Red Fox	Introduced	Scat observed several times through Survey Area and one individual observed towards east of Survey Area
Reptiles			
Varanus gouldii	Sand Goanna	Native	Observed under eucalypt

Five introduced fauna species were recorded during the field survey. The species and their legal status under the BAM Act are listed below:

- Domestic Cattle (Bos taurus) – Permitted s11
- Feral Dog (Canis lupis) - Declared Pest – s22(2) (C3 Exempt)
- European Wild Rabbit (Oryctolagus cuniculus) (Feral) – Declared Pest – s22(2)
- Feral Pig (Sus scrofa) – Declared Pest – s22(2)
- European Red Fox (Vulpes vulpes) - Declared Pest - s22(2) (C3 Exempt).

Refer to Section 2.2.2 for explanations of BAM Act categories.

6.2.2 Fauna Habitats

Four broadly defined fauna habitats were mapped within the Survey Area. These comprise:

- Paddock with Scattered Trees and Drainage Areas: 235.04 ha
- Riparian Vegetation, Dams and Drainage: 31.32 ha
- Mixed Trees: 10.81 ha
- Stags: 5.31 ha

Table 20 describes these four fauna habitats and discusses the conservation significant fauna species that may potentially utilise these habitats, or aspects of these habitats.

Table 20 Broadscale Fauna Habitats of the Survey Area

Fauna Habitat	Description	Conservation Significant Species Potentially Utilising Habitat	Photo
Paddock with Scattered Trees and Drainage Areas Extent: 235.04 ha	This habitat is predominantly cleared paddocks with scattered individual or clumps of large mature eucalypts (and other vegetation). It also contains multiple drainage lines and lower lying drainage areas of varying size. Some of the large eucalypts contain hollows and may provide significant fauna habitat. These trees may be classified as Black Cockatoo breeding and potential breeding trees, and it is recommended that they are avoided where possible.	• Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) may utilise the mature eucalypts for foraging, roosting and / or breeding habitat • Mammals including the South-western Brush-tailed Phascogale (*Phascogale tapoatafa subsp. wambenger*) and Western Ringtail Possum (*Pseudocheirus occidentalis*) may utilise the mature eucalypts and *Agonis flexuosa* • Western Brush Wallaby (*Notamacropus Irma)* may utilise the habitat • Waterbird species may also utilise aspects of this habitat when damp or flooded.	   
Riparian Vegetation, Dams and Drainage	This fauna habitat contains riparian vegetation, the dams and drainage lines. The riverine habitat contains mature Flooded	• Mammals including the Western Brush Wallaby (*Notamacropus Irma)* may utilise the riverine habitat • Waterbird species may also utilise aspects of this habitat.	

Fauna Habitat	Description	Conservation Significant Species Potentially Utilising Habitat	Photo
Extent: 31.32 ha	Gums and Paperbarks, with a generally degraded understorey (weeds and feral animals [e.g. Feral Pigs]). Note that only the more significant drainage lines through the paddocks are identified and there are multiple other drainage lines / areas in the paddocks. The area of this habitat to the southeast area of the Survey Area directly north of the river appears to be a flood plain with cracking clays.		

Fauna Habitat	Description	Conservation Significant Species Potentially Utilising Habitat	Photo
Stags Extent: 5.31 ha	These are areas of mostly mature dead trees (stags) with no understorey.	• Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) may utilise these stags as breeding habitat.	
Mixed Trees Extent: 10.81 ha	This habitat predominantly comprises stands of mature eucalypts (*Eucalyptus marginata and Corymbia calophylla*) over a degraded and mostly cleared understorey. Proteaceous species and *Agonis flexuosa* was observed in several stands. These areas generally contain light grey sandy soils.	• Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) may utilise the mature eucalypts and proteaceous species within this habitat for foraging, roosting and / or breeding habitat • Mammals including the South-western Brush-tailed Phascogale (*Phascogale tapoatafa subsp. wambenger*), Western Ringtail Possum (*Pseudocheirus occidentalis*), and Western Brush Wallaby (*Notamacropus Irma)* may utilise this habitat depending on understorey and species present.	 

6.2.3 Conservation Significant Fauna Species

Based on the desktop assessment and the field survey, Carnaby's Cockatoo (Calyptorhynchus latirostris), Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso) and Baudin's Cockatoo (Calyptorhynchus baudinii) are considered to have the potential to utilise habitats within the Survey Area. Breeding and foraging habitat is present.

Marginal, generally poor quality and highly modified habitat also exists for the following species:

- Peregrine Falcon (Falco peregrinus) may utilise the larger eucalypts
- Western Brush Wallaby (Notamacropus Irma) which may utilise the areas of mixed trees and adjacent paddocks
- South-western Brush-tailed Phascogale (Phascogale tapoatafa subsp. wambenger) and the Western Ringtail Possum (Pseudocheirus occidentalis) which may utilise the areas of mixed trees, though these are generally smaller patches that are very isolated and of poor quality.
- wetland bird species including the Glossy Ibis (Plegadis falcinellus), Curlew Sandpiper (Calidris ferruginea), Common Greenshank (Tringa nebularia), Some of these species may utilise the poor quality drainage and wetland habitats, and areas within the paddocks which are highly modified but likely to flood over winter.

6.3 Black Cockatoos

6.3.1 Breeding and Potential Breeding Trees

The Survey Area contains 201 potential Black Cockatoo breeding trees of suitable DBH, of which 22 contain hollows potentially suitable for use by Black Cockatoos. Refer to Table 21 and Figure 4 for the details of the 22 trees including their location, species, height, DBH and number of suitable hollows.

A comprehensive list of all potential Black Cockatoo breeding trees is provided in Appendix C.

Table 21 Trees with potentially suitable Black Cockatoo hollows within the Survey Area

ID	Longitude	Latitude	Species	Height (m)	DBH (cm)	Number of suitable hollows
5	115.4829	-32.5310	Stag	15	124	1
19	115.4844	-32.5420	Stag	16	85	1
34	115.4839	-32.5356	Stag	18	83	1
42	115.4836	-32.5355	Stag	8	92	1
56	115.4732	-32.5319	Stag	15	97	2
63	115.4758	-32.5350	Stag	25	180	2
75	115.4755	-32.5351	Jarrah (Eucalyptus marginata)	22	128	1
79	115.4752	-32.5351	Stag	30	113	1
87	115.4759	-32.5335	Stag	15	124	1
91	115.4759	-32.5337	Stag	18	101	2
92	115.4759	-32.5336	Stag	10	113	1
97	115.4830	-32.5335	Stag	15	125	1
112	115.4829	-32.5314	Stag	24	76	2
114	115.4810	-32.5330	Stag	25	66	1
118	115.4890	-32.5330	Stag	12	98	1
141	1151.4835	-32.5357	Stag	30	222	3
152	115.4732	-32.5322	Stag	15	108	3

ID	Longitude	Latitude	Species	Height (m)	DBH (cm)	Number of suitable hollows
158	115.4759	-32.5346	Stag	8	105	1
170	115.4759	-32.5350	Stag	18	110	1
177	115.4810	-32.5350	Stag	10	87	3
190	115.4759	-32.5331	Stag	15	105	1
197	115.4810	-32.5329	Marri (Corymbia calophylla)	25	102	1

6.3.2 Roosting Trees

No roosting trees were identified within the Survey Area.

6.3.3 Foraging Habitat

Black Cockatoo foraging habitat predominantly comprises isolated patches of Marri trees within paddocks. Significant dead trees were recorded in these patches and this has reduced the foraging quality of several patches.

The Survey Area contains Carnaby's Cockatoo (Calyptorhynchus latirostris) foraging habitat (Figure 5), comprising:

- 1.80 ha of High Quality foraging habitat
- 2.59 ha of Quality foraging habitat.

No Carnaby's Cockatoo foraging evidence was recorded in the Survey Area however evidence has been recorded nearby.

The Survey Area contains Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso) foraging habitat (Figure 5), comprising:

- 3.75 ha of Quality foraging habitat
- 0.64 ha of Low Quality foraging habitat.

No Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso) foraging evidence was recorded in the Survey Area.

The Survey Area contains Baudin's Cockatoo (Calyptorhynchus baudinii) foraging habitat (Figure 5), comprising:

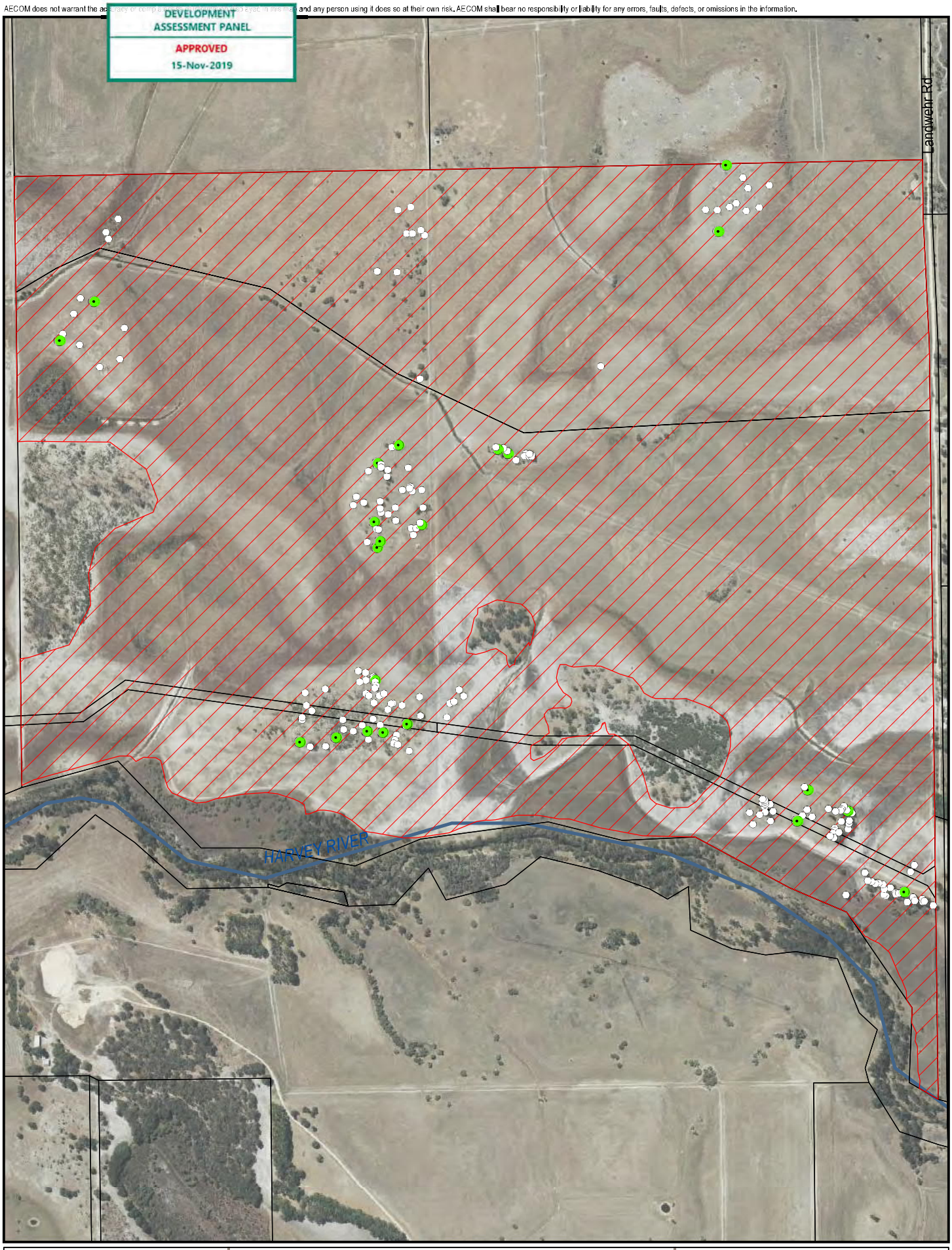
- 1.80 ha of High Quality foraging habitat
- 2.59 ha of Quality foraging habitat.

Potential foraging evidence of the Endangered Baudin's Cockatoo (Calyptorhynchus latirostris) was recorded under a Marri tree in the January 2019 survey (Plate 1).

Refer to Appendix D for the foraging quality assessments.

Plate 1 Possible Baudin's Cockatoo foraging evidence

DEVELOPMENT ASSESSMENT PANEL
APPROVED
15-Nov-2019



PROJECT ID 60605068
CREATED BY KW
APPROVED BY L.Fisher
LAST MODIFIED 11 JUL 2019

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N

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 100 200 300 400
metres

1:11,000 when printed at A4

LEGEND
Survey Area
Cadastre
Black Cockatoo Breeding Trees
Hollows
No Hollows

Data sources:

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2019).

Potential Black Cockatoo Breeding Trees

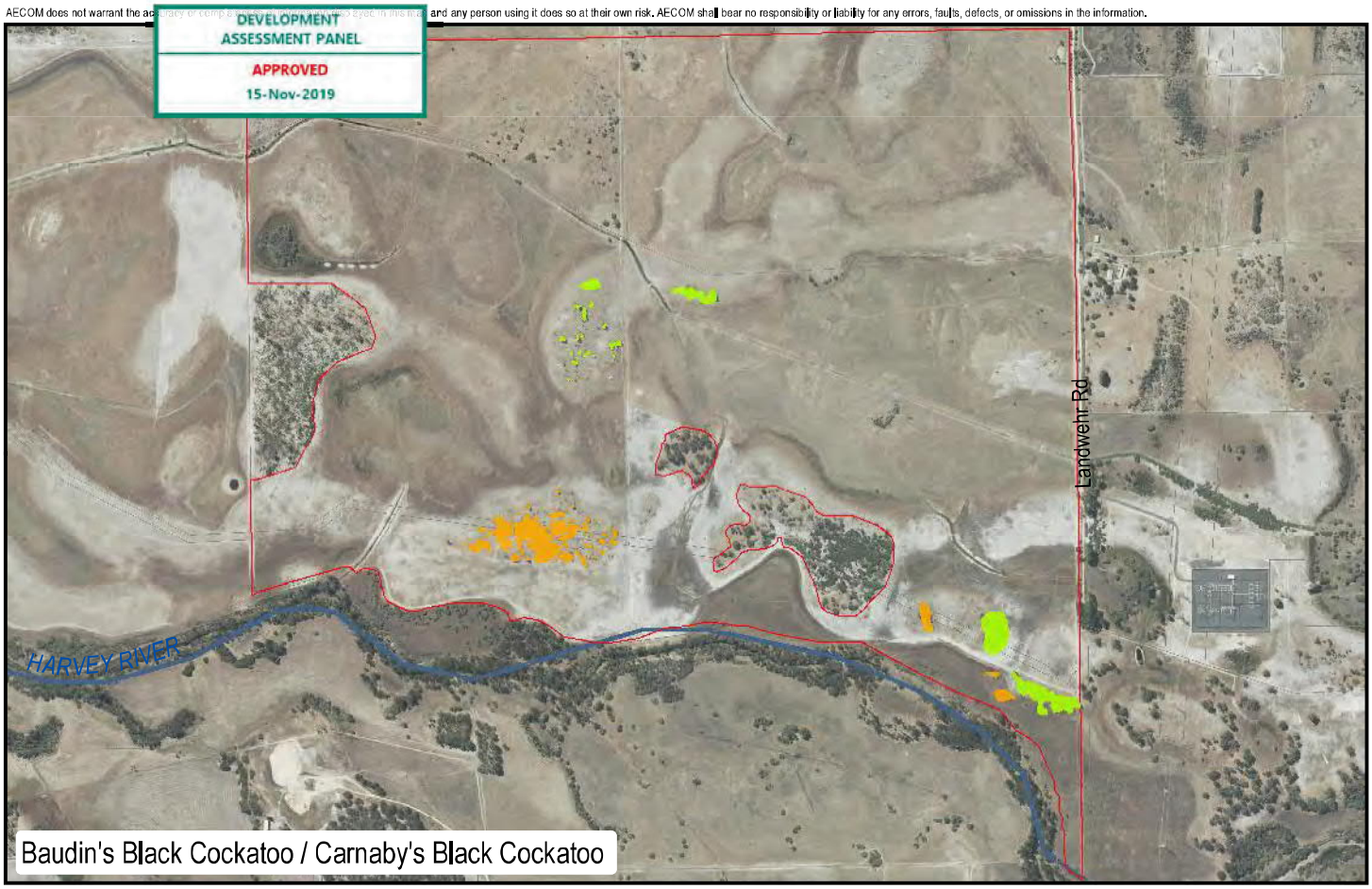
SOUTH ENERGY

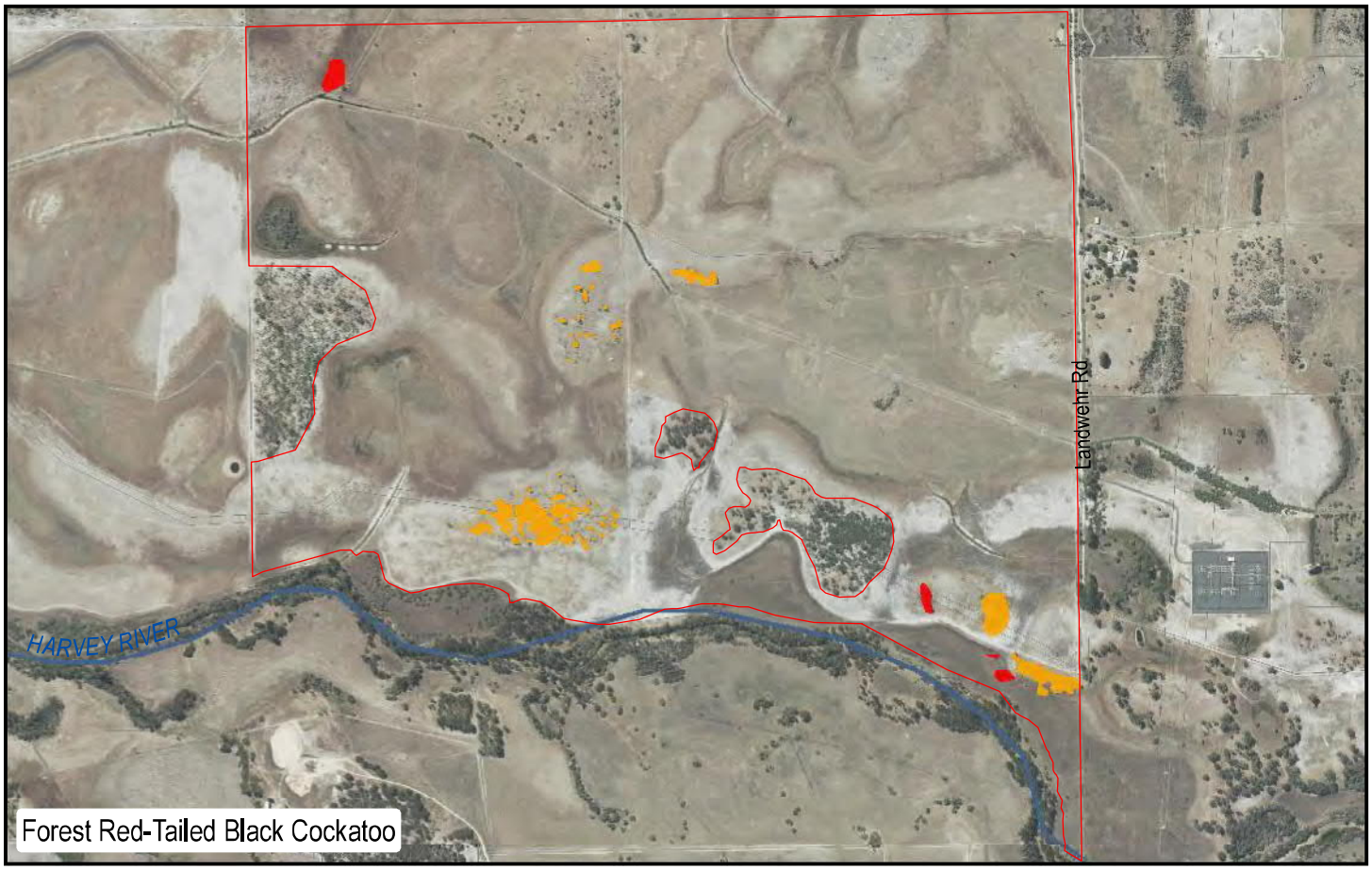
WAROONA SOLAR FARM - ECOLOGICAL ASSESSMENT

Figure 4

Map Document: G:\GIS_Projects\WaroonaSolarFarm\02_MXDs\04_Ecological\Assessment\G60605068_Fig4_PotentialBlackCockatooBreedingTrees.mxd (wyattk2)

A4 size





PROJECT ID 60605068
CREATED BY KW
APPROVED BY J.Leigh
LAST MODIFIED 30 JUL 2019

AECOM
www.aecom.com

N

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 150 300 450 600
metres

1:17,500 when printed at A4

LEGEND

Black Cockatoo Foraging Quality
- High Quality
- Quality
- Low Quality

- Survey Area
- Cadastre

Data sources:

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010).

Black Cockatoo Foraging Habitat

SOUTH ENERGY

WAROONA SOLAR FARM - ECOLOGICAL ASSESSMENT

Figure
5

Map Document: G:\GIS_Projects\WaroonaSolarFarm\02_MXDs\05_EcologicalAssessmentUpdated\G60605068_Fig5_BlackCockatooForagingHabitat.mxd (WyattK2)

A4 size

7.0 Conclusion

7.1 Summary

An ecological assessment was undertaken for the Waroona Solar Farm Project by two AECOM Ecologists. The ecological survey identified the following environmental values:

- Eight significant flora species were considered likely to occur in the Survey Area. The likelihood of these species was downgraded to 'may occur' or 'unlikely to occur' following the site inspection as no suitable habitat was present.
- A total of 18.98 ha of remnant native vegetation was mapped, varying in condition between Completely Degraded to Degraded. None of this vegetation represented a TEC or PEC.
- 22 trees containing potentially suitable breeding hollows for Black Cockatoos, with a further 179 potential breeding trees (with a suitable DBH and no potentially suitable hollows).
- A total of 4.39 ha of High Quality and Quality foraging habitat for Carnaby's Cockatoo and Baudin's Cockatoo, and a total of 4.39 ha of Quality and Low Quality foraging habitat for the Forest Red-tailed Black Cockatoo.
- The potential presence of seven other threatened fauna species (apart from the three Black Cockatoo species), though habitat for these species is generally limited, of poor quality and highly modified.

A constraint for the Project is the presence of foraging and breeding habitat for the three Western Australian Threatened Black Cockatoo species. This is discussed further in Section 7.2.

The survey effort for the Project is considered suitable for assessing the environmental values of the Survey Area.

7.2 Recommendations

It is recommended that South Energy retain native vegetation, Quality and High Quality Black Cockatoo foraging habitat and Black Cockatoo breeding and potential breeding trees where possible. Areas supporting both hollow bearing Black Cockatoo breeding trees and good quality Black Cockatoo foraging habitat should be prioritised. These generally include vegetation communities CcApAc, EmKgAc and CcJp (refer to Figure 3), which also aid in local flood mitigation of the Harvey River.

Clearing of more than one hectare of Quality (and above) Black Cockatoo foraging habitat, or any breeding habitat, has the potential to require a referral under the EPBC Act. We would recommend refining the Project footprint to minimise potential impacts to these areas, and / or hold a pre-referral meeting with the DoEE to confirm the requirement for a referral under the EPBC Act.

Planting areas onsite with Black Cockatoo foraging habitat and erecting Black Cockatoo nesting boxes are options for offsetting the clearing of Black Cockatoo breeding and foraging habitat. An initial assessment has determined that at least eight hectares of land is potentially available and suitable for planting of foraging species. This area is likely to be an underestimation depending on the ability to plant near infrastructure. An additional approximately seven hectares could potentially be planted with foraging species, but further investigation would be required to assess the suitability of this land due to its probable flooding and heavy clay nature. Flora species recommended to plant for Black Cockatoo foraging habitat would include Banksia sessilis, B. ilicifolia, Allocasuarina fraseriana, Corymbia calophylla and Eucalyptus marginata, as well as most locally endemic proteaceous species.

Clearing of native vegetation in Western Australia can also require a Native Vegetation Clearing Permit under Part V of the EP Act. This may need to be obtained prior to the clearing of the native vegetation in the Survey Area.

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Appendix A

Flora Desktop Results

Appendix A Flora Desktop Results

Taxon	State WC Act / DBCA	Federal EPBC Act	Source	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
Andersonia gracilis	VU	EN	PMST	*Andersonia gracilis* is currently known from the Badgingarra, Dandaragan and Kenwick areas where it is found on seasonally damp, black sandy clay flats near or on the margins of swamps, often on duplex soils supporting low open heath vegetation with species such as *Calothamnus hirsutus, Verticordia densiflora* and *Kunzea recurva* over sedges.	Likely to occur	Unlikely to occur
Acacia flagelliformis	P4		Naturemap	Sandy soils. Winter-wet areas.	May occur	May occur
Acacia semitrullata	P4		Naturemap	White / grey sand, sometimes over laterite, clay. Sandplains, swampy areas.	May occur	May occur
Aponogeton hexatepalus	P4		Naturemap	Mud. Freshwater: ponds, rivers, claypans.	Unlikely to occur	Unlikely to occur
Blennospora doliiformis	P3		Naturemap	Grey or red clay soils over ironstone. Seasonally-wet flats.	Unlikely to occur	Unlikely to occur
Boronia capitata subsp. gracilis	P3		Naturemap	White / grey or black sand. Winter-wet swamps, hillslopes.	May occur	May occur
Caladenia huegelii	CR	EN	PMST	*Caladenia huegelii* is found on the Swan Coastal Plain within 20 km of the coast; from just north of Perth to the Busselton area over a distance of over 250 km. Throughout its range the species tends to favour areas of thick undergrowth. Soil is usually deep grey-white sand associated with the Bassendean sand-dune system. However, rare plants have been known to extend into the Spearwood system (in which calcareous yellow sands dominate) in some areas.	Unlikely to occur	Unlikely to occur
Caladenia speciosa	P4		Naturemap	White, grey or black sand.	May occur	May occur
Carex tereticaulis	P3		Naturemap	Black peaty sand.	Unlikely to occur	Unlikely to occur
Chamaescilla gibsonii	P3		Naturemap	Winter-wet flats, shallow water-filled claypans.	May occur	May occur

Taxon	State WC Act / DBCA	Federal EPBC Act	Source	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
Chamelaucium sp. Gingin (N.G.Marchant 6)	VU	EN	PMST	*Chamelaucium* sp. Gingin is endemic to Western Australia and is confined to the Gingin / Chittering area, where it is known from a range of only 3 km. There are six populations of this species which are highly fragmented. The species occurs on white/yellow sand supporting open low woodland with *Eucalyptus todtiana, Banksia attenuata* and Hibbertia sp.	Unlikely to occur	Unlikely to occur
Conostylis pauciflora subsp. pauciflora	P4		Naturemap	Grey sand, limestone. Hillslopes, consolidated dunes.	Unlikely to occur	Unlikely to occur
Diuris micrantha	VU	VU	Naturemap / PMST	*Diuris micrantha* is found from east of Kwinana and south towards the Frankland area. The species is known from seven populations and is found on dark, grey to blackish, sandy clay-loam substrates in winter wet depressions or swamps.	Likely to occur	May occur
Diuris purdiei	EN	EN	Naturemap	*Diuris purdiei* occurs from the south of Perth to near the Whicher Range. It grows in sand to sandy clay soils in areas subject to winter inundation, amongst native sedges and dense heath with scattered emergent *Melaleuca preissiana, Eucalyptus calophylla, E. marginate and Nuytsia floribunda*.	Likely to occur	Unlikely to occur
Drakaea elastica	CE	EN	Naturemap	*Drakaea elastica* occurs on the Swan Coastal Plain over a range of 350 km from Cataby in the north to Busselton in the south. The species is known from 42 populations and occurs on bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps, typically in *banksia* woodland or spearwood thicket vegetation.	Likely to occur	Unlikely to occur
Drakaea micrantha	EN	VU	Naturemap	The Dwarf Hammer-orchid is known from 32 populations that occur from Perth to Albany. The species is usually found in cleared fire breaks or open sandy patches that have been disturbed. The species occurs in infertile grey sands in *Banksia*, Jarrah and Common Sheoak woodland or forest.	Likely to occur	Unlikely to occur
Eleocharis keigheryi	VU	VU	PMST	*Eleocharis keigheryi* is known from 15 populations that occur between north of Eneabba and south-east to Qualeup. The species grows in clay or sandy loam, emergent in freshwater creeks and claypans.	May occur	May occur
Eucalyptus x balanites	CE	EN	PMST	*Eucalyptus balanites* is known from two populations, separated by 210 km. These two populations occur in Badgingarra National Park and City of Armadale. The species grows on light coloured sandy soils over laterite. Habitat consists of gently sloping heathlands, open mallee woosland over shrubland or heathland with emergent mallees.	Unlikely to occur	Unlikely to occur

Taxon	State WC Act / DBCA	Federal EPBC Act	Source	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
Galium leptogonium	P3		Naturemap	No information available.	May occur	
Gastrolobium sp. Harvey (G.J. Keighery 16821)	P2		Naturemap	Black peaty sandy clay, brown sandy clay. Winter-wet flats, margins of billabongs.	May occur	Unlikely to occur
Haloragis aculeolata	P2		Naturemap	Black sand or clay over limestone. Winter-wet flats.	May occur	Unlikely to occur
Haloragis scoparia	P1		Naturemap	There is no information available for this species.	May occur	
Hemigenia microphylla	P3		Naturemap	Sandy clay, peaty clay, granite. Winter-wet depressions.	May occur	
Hibbertia spicata subsp. leptotheca	P3		Naturemap	Near-coastal limestone ridges, outcrops and cliffs.	Unlikely to occur	Unlikely to occur
Platysace filiformis	P3		Naturemap	Frequently on lateritic gravelly soils. Often in moist areas.	May occur	Unlikely to occur
Platysace ramosissima	P3		Naturemap	Sandy soils.	May occur	
Pterostylis frenchii	P2		Naturemap	Calcareous sand with limestone, laterite. Faltlands and gentle slopes.	May occur	Unlikely to occur
Schoenus natans	P4		Naturemap	Winter-wet depressions.	May occur	
Schoenus sp. Waroona (G.J. Keighery 12235)	P3		Naturemap	Clay or sandy clay. Winter-wet flats.	May occur	
Sphaerolobium calcicola	P3		Naturemap	White-grey-brown sand, sandy clay over limestone, black peaty sandy clay. Tall dunes, winter-wet flats, interdunal swamps, low-lying areas.	Unlikely to occur	Unlikely to occur
Stylidium longitubum	P4		Naturemap	Sandy clay, clay. Seasonal wetlands.	May occur	
Stylidium trudgenii	P3		Naturemap	Margins of winter-wet swamps, depressions.	May occur	
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CE	CE	PMST	*Synaphea* sp. Fairbridge Farm (D. Papenfus 696) is known from five populations that occur from Serpentine to Dardanup, south of Perth. The species grows in grey, clayey sand with lateritic pebbles in low woodland areas near winter flats.	Likely to occur	Unlikely to occur

Taxon	State WC Act / DBCA	Federal EPBC Act	Source	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
Synaphea odocoileops	P1		Naturemap	Brown-orange loam and sandy clay, granite. Swamps, winter-wet areas.	May occur	May occur
Synaphea sp. Pinjarra Plain (A.S. George 17182)	EN	EN	PMST	*Synaphea* sp. Pinjarra Plain (A.S. George 17182) is known from 12 populations in six locations occurring from Mundijong to West Coolup over a range of 54 km. The species grows on flat terrain on grey-brown sandy loams or heavier brown clay-sand overlain by laterite pebbles. The species occurs more often on boundaries of seasonal wetlands, in soils with moderate drainage.	Likely to occur	Unlikely to occur
Synaphea sp. Serpentine (G.R. Brand 103)	CE	CE	PMST	*Synaphea* sp. Serpentine (G.R. Brand 103) is known from six populations that occur from Byford to Serpentine over a range of 18 km. The species grows predominantly on flat terrain on grey-brown sandy loams to clay in seasonally wet areas.	May occur	May occur
Synaphea stenoloba	CE	EN	Naturemap / PMST	*Synaphea stenoloba* is known from 11 subpopulations that occur from south of Perth, from Pinjarra to Boyanup. The species grows in loamy soils in low lying areas that are occasionally inundated. Associated vegetation is generally swampy heath to 1 m high with scattered emergent *Nuytsia floribunda*.	Likely to occur	Unlikely to occur
Triglochin trichophora	P4		Naturemap	Sand, limestone. Swamps.	May occur	May occur
Tripterococcus sp. Brachylobus (A.S. George 14234)	P4		Naturemap	No information available.	May occur	May occur

Appendix B

Potentially Occurring Fauna Species

Appendix B Fauna Species that may occur in the Survey Area

Species	Source		Commonwealth *EPBC Act*	State *WC Act*	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
	EPBC	DBCA					
Birds							
Botaurus poiciloptilus Australasian Bittern	+		Endangered	EN	The Australasian Bittern is a large thick-necked bird, growing to a length of 66 to 76 cm. The Australasian Bittern occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. There are currently two known sub-populations including the south-eastern and the south-western sub-populations. It's preferred habitat is comprised of wetlands with tall dense vegetation where it forages in still, shallow water up to 0.3 m deep, edges of pools or waterways, or from platforms or mats of vegetation over deep water. Freshwater habitats dominated by sedges, rushes and reeds are preferred.	May occur	Unlikely to occur
Calidris canutus Red Knot	+		Endangered (Marine)	VU	The Red Knot is a widely distributed marine and migratory species. It is common In the north-west of Western Australia with populations in the tens of thousands recorded at 80-mile Beach, not far from the study area (Bamford et al. 2008). The species mainly inhabits intertidal mudflats, sand flats, in estuaries, bays and lagoons. They are occasionally seen on inland salt lakes and wetlands but hardly every use freshwater swamps.	Unlikely to occur	Unlikely to occur
Calidris ferruginea Curlew Sandpiper	+		Migratory & Marine (Bonn, CAMBA, JAMBA, ROKAMBA)	CE	The Curlew Sandpiper is a small, slim weighing 57 g. In Australia, Curlew Sandpipers occur around the coasts and are also quite widespread inland, though in smaller numbers. In Western Australia, they are widespread around coastal and sub coastal plains from Cape Arid to the south-west Kimberley.	May occur	May occur

Species	Source		Commonwealth *EPBC Act*	State *WC Act*	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
	EPBC	DBCA					
Calidris ruficollis Red-necked Stint		+	Migratory & Marine (Bonn, CAMBA, JAMBA, ROKAMBA)	IA	The Red-necked Stint is the smallest wader in Australia and is distributed along most of the Australian coastline, with the greatest densities in Victoria and Tasmania. The nearest internationally important site for the species is the Alfred Cove Nature Reserve on the Swan River (DotE, 2015).	May occur	Unlikely to occur
Calyptorhynchus banksii naso Forest Red-tailed Black Cockatoo	+	+	Vulnerable	VU	The Forest red-tailed Black Cockatoo requires tree hollows of Karri (*E. diversicolor*), Jarrah (*E. marginata*) and Marri (*Corymbia calophylla*) forests to nest and breed. Flocks move out onto the Swan Coastal Plain in search of food from exotic trees such as the White Cedar (Johnstone et al, 2010). The foraging habitat for the species consists of Jarrah and Marri woodlands and forest within its range.	Likely to occur	Likely to occur
Calyptorhynchus baudinii Baudin's Cockatoo	+	+	Vulnerable	EN	Habitat critical to the survival of this species includes forests of Karri (*E. diversicolor*), Jarrah (E. *marginata*) and Marri (*C. calophylla*), in areas of 600 mm average rainfall per year. Individuals typically move north through the Perth region from March to May and south through the Perth region from August to October. This species ranges north to Gidgegannup and Hoddy Well and west to the Eastern Strip of the Swan Coastal Plain including West Midland in the north, heading south through Armadale, Byford and continues south and towards the coast until Lake Clifton where it continues to hug the coastline to east of Albany (Johnstone *et al,* 2010).	Likely to occur	Likely to occur
Calyptorhynchus latirostris Carnaby's Cockatoo	+	+	Endangered	EN	Carnaby's Cockatoo is a postnuptial nomad and typically moves west soon after breeding. The species nests in hollows of smooth-barked eucalypts, particularly Salmon Gum (*Eucalyptus salmonophloia)* and Wandoo (*E. Wandoo)* but is not limited to these eucalypts. Diet consists of an array of Proteaceous and Eucalypt species prevalent on the Swan Coastal Plain. Foraging habitat, including *banksia* woodlands, is considered to be habitat critical to the survival of the species (Johnstone *et al.,* 2010).	Likely to occur	Likely to occur

Species	Source		Commonwealth *EPBC Act*	State *WC Act*	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
	EPBC	DBCA					
Falco peregrinus Peregrine Falcon		+		S	A well-known falcon, the Peregrine inhabits a vast array of environs in Australia. Usually uncommon and migratory (Pizzey & Knight, 2007). This species lays its eggs in recesses of cliff faces, tree hollows or large abandoned nests (Bamford, 2008).	May occur	May occur
Leipoa ocellata Malleefowl	+		Vulnerable	VU	Mallefowl is found in semi-arid to arid shrublands and low woodlands of Australia's interior, particularly areas dominated by mallee trees and/or *Acacia* shrubs. The species is highly sensitive to grazing by sheep and other herbivores, and altered fire regimes (Benshemesh, 2007).	Unlikely to occur	Unlikely to occur
Numenius madagascariensis Eastern Curlew	+		Critically Endangered (Marine)	VU	The Eastern Curlew is Australia's largest shorebird and a long-haul flyer. It is easily recognisable, with its long, down-curved bill. It takes an annual migratory flight to Russia and north-eastern China to breed, arriving back home to Australia in August to feed on crabs and molluscs in intertidal mudflats. (DotEE, 2019).	May occur	Unlikely to occur
Oxyura australis Blue-billed Duck		+		P4	The Blue-billed Duck is endemic to south eastern and south western Australia. It prefers deep water in large permanent wetlands and swamps with aquatic vegetation. This species of duck is fully aquatic and rarely comes onto land (OEH, 2015).	Unlikely to occur	Unlikely to occur
Plegadis falcinellus Glossy Ibis		+	Migratory & Marine (Bonn)	IA	The Glossy Ibis occupies well vegetated wetlands, wet pastures, floodwaters, brackish wetlands and mudflats. This species is a non-breeding visitor to south-west Western Australia (Pizzey & Knight, 2007).	May occur	May occur
Rostratula australis Australian Painted-snipe	+		Endangered (Marine)	EN	The Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans (DotE, 2015) This species is a very rare summer visitor to the south-west of Western Australia. Breeding habitat in Western Australia is not quite known however a nest located near Moora was located in a tussock beside a swamp (Johnstone & Storr, 1998).	Unlikely to occur	Unlikely to occur

Species	Source		Commonwealth *EPBC Act*	State *WC Act*	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
	EPBC	DBCA					
Thinornis rubricollis Hooded Plover		+		P4	The Hooded Plover is a medium-sized sandy-brown plover. It has a black head and a white nape, and the black hindneck collar extends around and forks onto the breast. West of the Nullarbor Plain, Hooded Plovers are also often recorded on ocean beaches, but they are just as likely to be seen foraging at salt lakes, sometimes hundreds of kilometres from the coast (http://birdlife.org.au/bird-profile/hooded-plover, accessed Nov 2018).	Unlikely to occur	Unlikely to occur
Tringa nebularia May		+	Migratory & Marine (Bonn, CAMBA, JAMBA, ROKAMBA)	IA	The Common Greenshank is a largely built wader, weighing up to 190 g for both sexes. The species is found in inland wetlands and sheltered coastal habitats (DotEE, 2018).	May occur	May occur
Mammals							
Dasyurus geoffroii Chuditch, Western Quoll	+	+	Vulnerable	VU	Following European settlement, the range of this species contracted dramatically, from much of the continent to a small area in the south west. It currently only occurs in areas dominated by sclerophyll forest or drier woodland, heath and mallee shrubland (Van Dyck & Strahan, 2008). Most records are found in the contiguous Jarrah forests of the south west of Western Australia (DotEE, 2018).	Unlikely to occur	Unlikely to occur
Hydromys chrysogaster Water-rat		+		P4	The Water Rat is one of the few Australian mammals adapted to the aquatic environment. It has a streamlined body and broad, partially webbed hind feet. The species occurs in the vicinity of permanent bodies of fresh or brackish water. Dens are made at the end of tunnels in banks and occasionally in logs (Van Dyck & Strahan, 2008).	May occur	Unlikely to occur
Isoodon fusciventer Quenda		+		P4	The Quenda or Southern Brown Bandicoot exists only in a fragmented distribution to its former range in southern south western and eastern Australia. It is found in forest, woodland, heath and shrub communities in these regions. Preferred habitat usually consists of a combination of sandy soils and dense heathy vegetation (Van Dyck & Strahan, 2008).	May occur	Unlikely to occur

Species	Source		Commonwealth *EPBC Act*	State *WC Act*	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
	EPBC	DBCA					
Notamacropus Irma Western Brush Wallaby		+		P4	The Western Brush-wallaby occurs in the south-west of Western Australia. Its preferred habitat consists of open sclerophyll forest or woodland and favours open flats over scrub thickets. It is also found in larger areas of mallee and heathland in the wheat belt and is uncommon in wet sclerophyll forest (Van Dyck & Strahan, 2008).	May occur	May occur
Phascogale tapoatafa subsp. *wambenger* South-western Brush-tailed Phascogale		+	Vulnerable	CD	In the south-west, the Brush-tailed Phascogale has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees. Records are less common in high rainfall areas (DBCA, 2012).	May occur	May occur
Pseudocheirus occidentalis Western Ringtail Possum	+	+	Critically Endangered	CE	This species is restricted to the south-west corner of Western Australia. Closer to the coast it is closely associated with Peppermint (*Agonis flexuosa*) forest and woodland and Tuart (*Eucalyptus gomphocephala*) with a peppermint mid-story. Further from the coast the species is found in Jarrah (*Eucalyptus marginata*), Wandoo (*Eucalyptus wandoo*) and Marri (*Corymbia calophylla*) forest (Van Dyck & Strahan, 2008).	May occur	May occur
Other							
Ctenotus ora Coastal Plains Skink		+		P3	The Coastal Plains Skink is restricted to the dunes of the Swan Coastal Plain in heath in sandy soil. The species has a preference for sandy substrates with low vegetation with open eucalyptus woodland over *banksia*. It is known to occur as far north as Pinjarra and south as far as Yallingup Brook, where it occupies coastal dunes (Kay & Keogh, 2012).	Unlikely to occur	Unlikely to occur
Falsistrellus mackenziei Western False Pipistrelle		+		P4	Western False Pipistrelles live mainly in wet sclerophyll forests of Karri, Jarrah and Tuart eucalypts. They roost in hollows in old trees, branches and stumps, in colonies of 5 to 30 bats (OEH, 2015).	Unlikely to occur	Unlikely to occur

Species	Source		Commonwealth *EPBC Act*	State *WC Act*	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
	EPBC	DBCA					
Geotria Australia Pouched Lamprey		+		P3	Adults spawn in the headwaters of freshwater rivers and streams. When the larvae hatch, they drift downstream and burrow into soft muddy sediments. After metamorphosis the young adults migrate downstream to estuaries and coastal waters where they feed (Bray & Gomon, 2018).	Unlikely to occur	Unlikely to occur
Idiosoma nigrum Swan Coastal Plain Shield-backed trapdoor spider		+		P3	This species can be found in burrows of heavy clay soils in areas of open York Gum (*Eucalyptus loxophleba*), Salmon Gum (*E. salmonophloia*) and Wandoo *E. wandoo*) woodland, where Acacia acuminata forms a sparse understorey (Avon Catchment Council, 2007).	Unlikely to occur	Unlikely to occur
Westralunio carteri Carter's Freshwater Mussel	+		Vulnerable	VU	This bivalve species is the only mussel species known to inhabit freshwater systems of south-west Western Australia (Klunzinger *et al.*, 2014).	May occur	Unlikely to occur

Appendix C

Potential Black Cockatoo Trees within the Survey Area

Appendix C Potential Black Cockatoo Trees within the Survey Area

Table 22 Potential Black Cockatoo breeding trees within the Survey Area

FID	Species	Tree Height	DBH	Suitable Hollows	Hollow Comments
0	Stag	12	86	0	
1	Stag	18	88	0	
2	Stag	18	74	0	
3	Stag	14	106	0	
4	Stag	15	124	1	
5	Stag	8	138	0	
6	Stag	15	102	0	
7	Stag	17	64	0	
8	Marri (Corymbia calophylla)	18	66	0	
9	Stag	18	56	0	
10	Marri (Corymbia calophylla)	30	83	0	
11	Stag	16	64	0	
12	Stag	16	58	0	
13	Marri (Corymbia calophylla)	22	81	0	
14	Stag	5	146	0	
15	Marri (Corymbia calophylla)	30	102	0	
16	Marri (Corymbia calophylla)	20	55	0	
17	Marri (Corymbia calophylla)	35	69	0	
18	Stag	16	85	1	
19	Marri (Corymbia calophylla)	20	54	0	
20	Marri (Corymbia calophylla)	18	55	0	
21	Marri (Corymbia calophylla)	20	53	0	
22	Marri (Corymbia calophylla)	20	60	0	
23	Marri (Corymbia calophylla)	30	81	0	
24	Marri (Corymbia calophylla)	18	53	0	
25	Marri (Corymbia calophylla)	20	53	0	

FID	Species	Tree Height	DBH	Suitable Hollows	Hollow Comments
26	Marri (Corymbia calophylla)	30	101	0	
27	Marri (Corymbia calophylla)	18	64	0	
28	Marri (Corymbia calophylla)	20	75	0	
29	Marri (Corymbia calophylla)	25	71	0	
30	Marri (Corymbia calophylla)	25	81	0	
31	Marri (Corymbia calophylla)	22	62	0	
32	Marri (Corymbia calophylla)	20	57	0	
33	Stag	18	83	1	
34	Marri (Corymbia calophylla)	25	73	0	
35	Marri (Corymbia calophylla)	22	57	0	
36	Marri (Corymbia calophylla)	20	56	0	
37	Marri (Corymbia calophylla)	20	60	0	
38	Stag	20	54	0	
39	Marri (Corymbia calophylla)	25	97	0	
40	Stag	16	89	0	
41	Stag	8	92	1	
42	Stag	20	98	0	
43	Marri (Corymbia calophylla)	25	67	0	
44	Marri (Corymbia calophylla)	25	85	0	
45	Stag	8	103	0	
46	Marri (Corymbia calophylla)	30	76	0	
47	Stag	12	59	0	
48	Stag	20	96	0	
49	Marri (Corymbia calophylla)	20	77	0	
50	Stag	30	190	0	
51	Stag	20	136	0	
52	Stag	20	113	0	
53	Stag	30	105	0	
54	Stag	25	94	0	1 hollow too deep

FID	Species	Tree Height	DBH	Suitable Hollows	Hollow Comments
55	Stag	15	97	2	
56	Jarrah (Eucalyptus marginata)	30	110	0	
57	Jarrah (Eucalyptus marginata)	8	89	0	
58	Stag	20	90	0	
59	Stag	6	81	0	1 hollow too shallow
60	Stag	5	89	0	
61	Jarrah (Eucalyptus marginata)	30	152	0	
62	Stag	25	180	2	1 additional hollow looks deep
63	Stag	10	146	0	
64	Stag	25	113	0	Bees, many small hollows
65	Stag	25	94	0	
66	Stag	17	62	0	
67	Stag	18	133	0	
68	Jarrah (Eucalyptus marginata)	20	85	0	
69	Stag	30	117	0	Hollow used by Gallahs and bees
70	Stag	20	53	0	
71	Stag	16	55	0	
72	Stag	20	102	0	
73	Eucalyptus accedens	8	88	0	
74	Jarrah (Eucalyptus marginata)	0	112	0	
75	Jarrah (Eucalyptus marginata)	22	128	1	1 hollow, looks deep
76	Jarrah (Eucalyptus marginata)	18	104	0	
77	Jarrah (Eucalyptus marginata)	20	116	0	
78	Stag	30	113	1	
79	Stag	18	112	0	
80	Stag	20	86	0	
81	Stag	18	73	0	
82	Jarrah (Eucalyptus marginata)	20	65	0	
83	Jarrah (Eucalyptus marginata)	18	72	0	
84	Stag	14	149	0	
85	Stag	16	111	0	

FID	Species	Tree Height	DBH	Suitable Hollows	Hollow Comments
86	Stag	15	124	1	
87	Jarrah (Eucalyptus marginata)	20	76	0	
88	Stag	25	83	0	
89	Stag	18	103	0	
90	Stag	18	101	2	
91	Stag	10	113	1	
92	Jarrah (Eucalyptus marginata)	12	110	0	
93	Stag	25	103	0	
94	Stag	8	130	0	
95	Stag	17	75	0	
96	Stag	15	125	1	
97	Marri (Corymbia calophylla)	18	62	0	
98	Marri (Corymbia calophylla)	18	62	0	
99	Stag	5	99	0	
100	Stag	13	52	0	
101	Stag	15	65	0	
102	Stag	12	60	0	
103	Stag	18	62	0	
104	Stag	16	75	0	
105	Stag	12	56	0	
106	Stag	14	68	0	
107	Stag	12	87	0	
108	Stag	16	80	0	
109	Stag	10	76	0	
110	Stag	24	100	0	
111	Stag	24	76	2	
112	Stag	15	67	0	
113	Stag	25	66	1	
114	Marri (Corymbia calophylla)	22	54	0	
115	Marri (Corymbia calophylla)	25	78	0	
116	Stag	20	85	0	
117	Stag	12	98	1	
118	Stag	10	73	0	
119	Stag	10	169	0	

FID	Species	Tree Height	DBH	Suitable Hollows	Hollow Comments
120	Marri (Corymbia calophylla)	25	73	0	
121	Marri (Corymbia calophylla)	26	90	0	
122	Marri (Corymbia calophylla)	24	83	0	
123	Marri (Corymbia calophylla)	22	63	0	
124	Stag	14	51	0	
125	Stag	15	54	0	
126	Stag	24	133	0	
127	Stag	15	105	0	
128	Marri (Corymbia calophylla)	22	61	0	
129	Marri (Corymbia calophylla)	22	171	0	
130	Marri (Corymbia calophylla)	24	68	0	
131	Stag	20	160	0	1 hollow used by bees
132	Stag	4	180	0	
133	Stag	18	146	0	
134	Marri (Corymbia calophylla)	25	99	0	
135	Marri (Corymbia calophylla)	25	73	0	
136	Marri (Corymbia calophylla)	20	57	0	
137	Stag	18	81	0	
138	Stag	14	86	0	
139	Stag	15	148	0	
140	Stag	30	222	3	
141	Stag	18	51	0	
142	Marri (Corymbia calophylla)	12	59	0	
143	Marri (Corymbia calophylla)	20	99	0	
144	Stag	7	60	0	
145	Stag	12	99	0	
146	Stag	30	86	0	Hollow used by bees
147	Stag	20	54	0	
148	Stag	18	66	0	
149	Stag	24	81	0	
150	Stag	6	67	0	

FID	Species	Tree Height	DBH	Suitable Hollows	Hollow Comments
151	Stag	15	108	3	
152	Stag	6	121	0	
153	Stag	20	143	0	
154	Stag	24	99	0	
155	Stag	20	85	0	2 hollows. Facing up on very burnt trunk. Can't assess. Unlikely to be suitable for BCs
156	Stag	6	67	0	
157	Stag	8	105	1	
158	Stag	14	57	0	
159	Stag	12	177	0	
160	Jarrah (Eucalyptus marginata)	24	61	0	
161	Stag	10	90	0	
162	Stag	14	113	0	
163	Stag	10	60	0	
164	Stag	16	71	0	
165	Stag	12	132	0	3 hollows. Used by bees. Unable to assess. Unlikely to be suitable for BCs.
166	Jarrah (Eucalyptus marginata)	12	51	0	
167	Stag	18	96	0	
168	Stag	8	97	0	
169	Stag	18	110	1	
170	Stag	12	59	0	
171	Stag	8	56	0	
172	Stag	8	99	0	
173	Jarrah (Eucalyptus marginata)	14	83	0	
174	Stag	14	62	0	
175	Stag	12	50	0	
176	Stag	10	87	3	
177	Jarrah (Eucalyptus marginata)	22	71	0	
178	Stag	18	98	0	
179	Stag	3	131	0	
180	Stag	10	108	0	
181	Stag	16	59	0	
182	Stag	8	104	0	

FID	Species	Tree Height	DBH	Suitable Hollows	Hollow Comments
183	Marri (Corymbia calophylla)	18	76	0	
184	Stag	14	165	0	
185	Marri (Corymbia calophylla)	24	98	0	
186	Stag	8	76	0	
187	Marri (Corymbia calophylla)	14	63.5	0	
188	Marri (Corymbia calophylla)	14	60	0	
189	Stag	15	105	1	
190	Stag	14	94	0	
191	Marri (Corymbia calophylla)	12	63	0	
192	Marri (Corymbia calophylla)	18	99	0	
193	Marri (Corymbia calophylla)	16	64	0	
194	Stag	16	74	0	
195	Stag	12	68	0	
196	Marri (Corymbia calophylla)	25	102	1	
197	Stag	14	62	0	
198	Marri (Corymbia calophylla)	0	0	0	unable to access paddock
199	Marri (Corymbia calophylla)	0	0	0	unable to access paddock
200	Marri (Corymbia calophylla)	0	0	0	unable to access paddock

Appendix D

Black Cockatoo Foraging Habitat

Appendix D Carnaby's Cockatoo Foraging Habitat

Table 23 Carnaby's Cockatoo foraging habitat

Initial score	Is within the Swan Coastal Plain? (+3)	Contains trees known to be used for breeding and / or with suitable nest hollows (+3)	Primarily comprises Marri (+2)	Contains trees with potential to be used for breeding (+2)	Known to be large or key roosting site (+2)	Does not contain evidence of foraging by species (-2)	No other foraging habitat within 6 km (-2)	Is > 12 km from known breeding location (-1)	Is >12km from known roosting site (-1)	Is >2km from watering point (-1)	Disease Present (-1)	Final Score	Comments
1	3	3	2	2	0	-2	0	0	0	0	-1	8	High Quality Cc (hollows)
1	3	0	2	2	0	-2	0	0	0	0	-1	5	Quality Cc (no hollows)
1	3	3	2	2	0	-2	0	0	0	0	-1	8	High Quality CcApAc (hollows)
1	3	3	0	2	0	-2	0	0	0	0	-1	6	Quality EmKgPo (hollows)
1	3	3	2	2	0	-2	0	0	0	0	-1	8	High Quality CcJp (hollows)
1	3	0	2	2	0	-2	0	0	0	0	-1	5	Quality CcJp (no hollows)

Appendix D Forest Red-tailed Black Cockatoo Foraging Habitat

Table 24 Forest Red-tail Black Cockatoo Foraging Habitat

Initial score	Jarrah and/or Marri shows good recruitment (+3)	Contains trees known to be used for breeding and / or with suitable nest hollows (+3)	Primarily Contains Marri / jarrah (+2)	Contains trees with potential to be used for breeding (+2)	Known to be large or key roosting site (+2)	Does not contain evidence of foraging by species (-2)	No other foraging habitat within 6 km (-2)	Is > 12 km from known breeding location (-1)	Is >12km from known roosting site (-1)	Is >2km from watering point (-1)	Disease Present (-1)	Final Score	Comments
1	0	3	2	2	0	-2	0	0	0	0	-1	5	Quality Cc (hollows)
1	0	0	2	2	0	-2	0	0	0	0	-1	2	Low Quality Cc (no hollows)
1	0	3	2	2	0	-2	0	0	0	0	-1	5	Quality CcApAc (hollows)
1	0	3	2	2	0	-2	0	0	0	0	-1	5	Low Quality EmKgPo (hollows)
1	0	3	2	2	0	-2	0	0	0	0	-1	5	Quality CcJp (hollows)
1	0	0	2	2	0	-2	0	0	0	0	-1	2	Low Quality CcJp (no hollows)

Appendix D Baudin's Cockatoo Foraging Habitat

Table 25 Baudin's Cockatoo Foraging Habitat

Initial score	Is within the known foraging area (+3)	Contains trees known to be used for breeding and / or with suitable nest hollows (+3)	Primarily comprises Marri (+2)	Contains trees with potential to be used for breeding (+2)	Known to be large or key roosting site (+2)	Does not contain evidence of foraging by species (-2)	No other foraging habitat within 6 km (-2)	Is > 12 km from known breeding location (-1)	Is >12km from known roosting site (-1)	Is >2km from watering point (-1)	Disease Present (-1)	Final Score	Comments
1	3	3	2	2	0	-2	0	0	0	0	-1	8	High Quality Cc (hollows)
1	3	0	2	2	0	-2	0	0	0	0	-1	5	Quality Cc (no hollows)
1	3	3	2	2	0	-2	0	0	0	0	-1	8	High Quality CcApAc (hollows)
1	3	3	0	2	0	-2	0	0	0	0	-1	6	Quality EmKgPo (hollows)
1	3	3	2	2	0	-2	0	0	0	0	-1	8	High Quality CcJp (hollows)
1	3	0	2	2	0	-2	0	0	0	0	-1	5	Quality CcJp (no hollows)

ATTACHMENT 9

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Waroona Development Pty Ltd
16-Aug-2019

DEVELOPMENT ASSESSMENT PANEL
APPROVED
15-Nov-2019

Preliminary Environmental Management Plan

Waroona Solar Farm

Preliminary Environmental Management Plan

Waroona Solar Farm

Client: Waroona Development Pty Ltd

Co No.: 630 130 433

Prepared by

AECOM Australia Pty Ltd
3 Forrest Place, Perth WA 6000, GPO Box B59, Perth WA 6849, Australia
T +61 8 6208 0000 F +61 8 6208 0999 www.aecom.com
ABN 20 093 846 925

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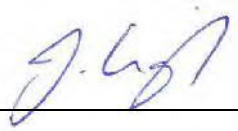
1	16-Aug-2019	Updated with Client Comments	Jared Leigh Principal Environmental Scientist (Ecologist)	

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Abbreviations

Abbreviations	Term
AECOM	AECOM Australia Pty Ltd
AS	Australian Standard
ASS	Acid Sulphate Soil
ASSDMP	Acid Sulphate Soil and Dewatering Management Plan
BAM Act	*Biosecurity and Agriculture Management Act 2007*
BC Act	*Biodiversity Conservation Act 2016* (WA)
CEMP	Construction Environmental Management Plan
DFES	Department of Fire and Emergency Services
DoEE	Department of the Environment and Energy
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EMP	Environmental Management Plan (detailed)
Ha	Hectare
km	Kilometre
m	Metre
MNES	Matters of National Environmental Significance
PEMP	Preliminary Environmental Management Plan
PV	Photovoltaic
RIWI Act	*Rights in Water Irrigation Act 1914*
SPP	State Planning Policy
The Applicant	SE Waroona Development Pty Ltd / South Energy
The Project	Waroona Solar Farm Project
WA	Western Australia

1.0 Introduction

1.1 Plan Scope and Purpose

This Preliminary Environmental Management Plan (PEMP) sets out the initial environmental management framework for the proposed Waroona Solar Farm (the Project) for South Energy on behalf of SE Waroona Development Pty Ltd (the Applicant), overarching environmental management processes to be implemented during the detailed design, construction, operation and decommissioning of the Project. The purpose of this document is to support the Project's planning development application.

Commercial and delivery details of the construction and operation phases are yet to be finalised, therefore some systems and operational details are not available at this time. As such this document is intended for further development, including changes that are dependent on the outcomes of the planning approvals process. Nonetheless, the PEMP intends to address the expected sources of potential environmental impacts identified through preliminary investigations and the strategies, processes and management measures that will be adopted to avoid or minimise such impacts.

This document will form the basis from which the Applicant or its contractors prepare any detailed Environmental Management Plans (EMPs) and environmental sub-plans that may be required through conditions of Project approval. Depending on the details of approval conditions and the environmental management needs of the Project, the detailed management plans may be prepared in a phased manner to address the various stages of the Project lifecycle (e.g. construction, operations and decommissioning).

This PEMP has been developed in line with the principles of the *Australia / New Zealand – International Organisation for Standardisation – Standard 14001 (Environmental Management System) (AS/NZS ISO 14001)* and aims to facilitate a regular review and 'continual improvement' in overall environmental performance over the life of the Project.

This plan outlines the following:

- Overarching Project environmental management system and objectives.
- A summary of identified environmental aspects and associated objectives relevant to the development of the Project.
- Organisational structure, roles and responsibilities for environmental management.
- Procedures for staff environmental awareness training and communication.
- Processes for stakeholder consultation and communication.
- Procedures for environmental monitoring, auditing, record keeping and reporting.
- Procedures for investigating and responding to complaints and incidents and implementing corrective actions.
- Measures for emergency preparedness and response.
- An outline of the potential structure for the detailed EMPs that will be developed prior to the commencement of construction.
- A summary of key management strategies to avoid and minimise the environmental and amenity impacts of the construction, operation and decommissioning of the facility.
- Processes for periodic review of environmental performance and continual improvement.

1.2 Setting and Preliminary Project Details

The Project is located approximately 105 km south of Perth and 10 km south west of Waroona, in the Shire of Waroona (Figure 1). This site comprises a parcel of pastoral land approximately 308 ha in area, which overlies two parcels of land: Lot 25 on Plan 59266 (Land ID 3800597) and 981 Buller Road, Lot 24 on Plan 59266 (Land ID 11769799). The land is currently zoned under the Shire of Waroona Local Planning Scheme No. 7 (the Scheme) as 'Rural 1 – General Farming'.

Land surrounding the subject site is pastoral land and is currently zoned as General Farming. The immediate surrounds can be described as follows:

- North: Farmland
- South: Harvey River and regional open space
- East: Landwehr Road, farmland and Buller Nature Reserve
- West: Farmland and Harvey River.

The main surface water features within the Project area are the Harvey River Main Drain and Domain Main Drain. The Harvey River Main Drain runs along the southern and western boundary of the Project area. The Domain Main Drain runs through the northern section of the Project area and discharges into the Harvey River approximately two kilometres northwest of the Project area.

Almost half of the Project area has been mapped as wetlands indicating that surface water runoff is collected in low lying basins associated with these wetlands. Where there is some relief, water drains away from the site, towards the Domain Main drain and Harvey River Main Drain.

The geomorphic wetlands mapped within the Project area comprise 14 Multiple Use Wetlands, one Resource Enhancement Wetland and one Conservation Category Wetland. No wetland specific permits would be required to develop Multiple Use wetlands, however, impacts to these wetlands has been addressed in the development application submitted to the Shire of Waroona to demonstrate that the development would not impact the surface water catchment or any associated sensitive environmental receptors such as Conservation Wetland UFI 14,584 (Harvey River foreshore), Harvey River and the Peel Harvey Inlet.

The Project footprint comprises cleared farming land, generally used for cropping and grazing, along with areas of native riparian vegetation and mixed trees. Several man-made agricultural dams and drains have been built within the Project area. No clearing of native vegetation is currently required within the Conservation Category Wetland. The majority of the remaining mapped wetlands have been cleared and are now used for agriculture. These are likely to correspond with slight depressions in an otherwise flat landscape.

The Project lies within the Murray groundwater area and Waroona groundwater sub-area. The Murray groundwater area is proclaimed under Section 26D of *Rights in Water and Irrigation Act 1914* (RiWI Act).

The Project has a low to moderate risk of Acid Sulphate Soils (ASS) occurring over the entire site. If an ASS condition is placed on the development approval for the Project, dewatering is proposed, or disturbance of >100 m^3 of soil is proposed then an ASS investigation may be required and an ASS Dewatering Management Plan (ASSDMP) may need to be prepared and implemented.

The Project concept design is provided in

Figure 1 and may be subject to modification as a result of outcomes of the approval and detailed design process. The Project will likely comprise the following principal infrastructure:

- Solar arrays, comprising single axis tracking systems using monocrystalline solar photovoltaic (PV) panels.
- Centralised inverter and transformer blocks.
- Designated substation and operations & maintenance facility area.
- Fencing.
- Site access roads.

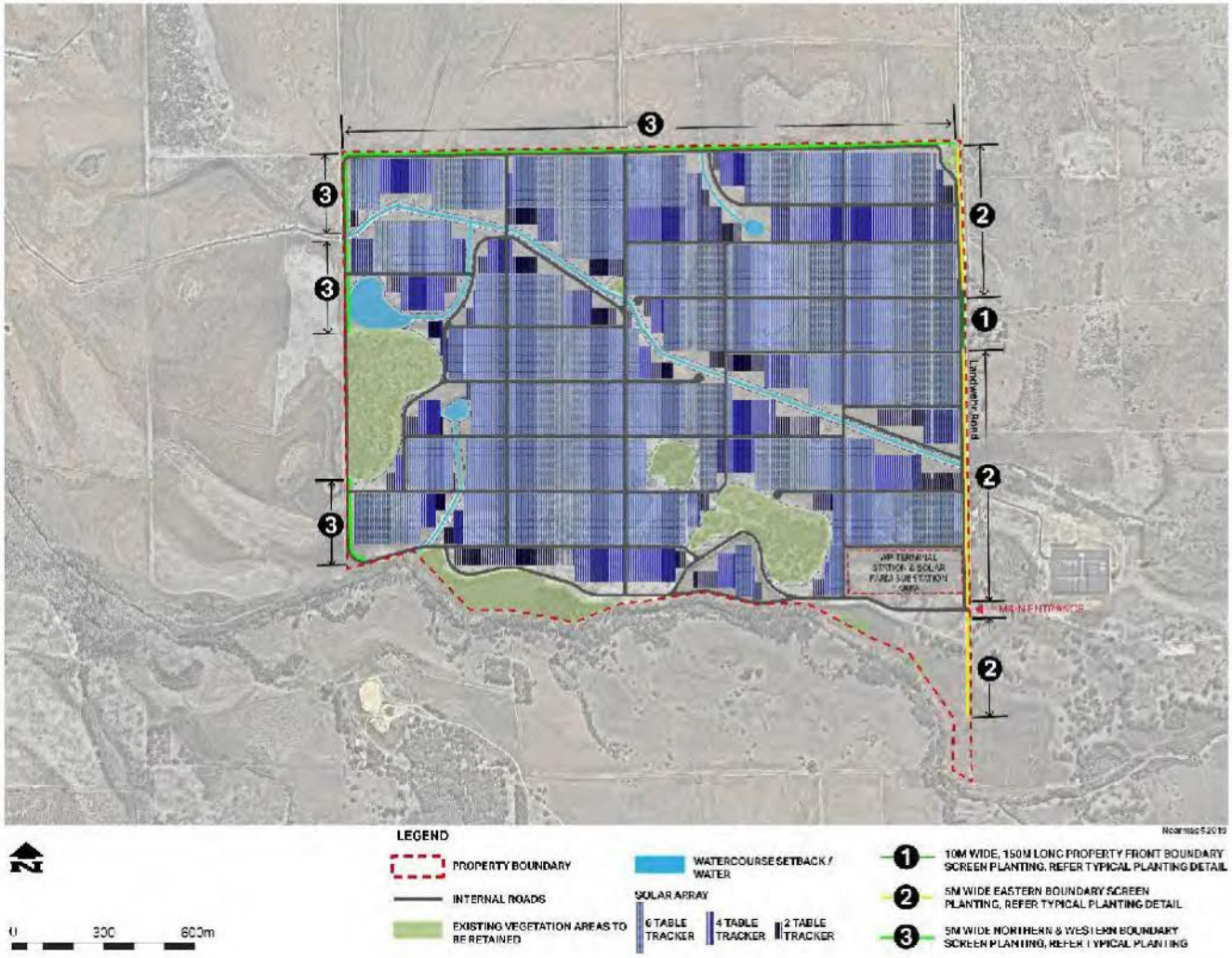

Figure 1 Waroona Solar Farm Preliminary Design

1.2.1 Site Ecology

AECOM Australia Pty Ltd (AECOM) completed a desktop assessment, targeted Black Cockatoo survey and a detailed flora, vegetation and fauna assessment of the Project area in January and June 2019 (AECOM, 2019a). Only areas included within the development footprint were surveyed to assess their environmental values. If the additional patches of native vegetation require clearing within the Project area, an additional survey will be required. Key ecological values identified during the survey are summarised below.

Six native vegetation communities were recorded and mapped within the survey area in a Completely Degraded to Degraded condition. The condition reflects the current land use of agriculture. Areas of remnant native vegetation have not been fenced, therefore cattle has contributed to the ongoing decline of vegetation condition. Altered hydrology may be affecting stands of trees, as noted by the numerous dead trees present. At this time we are unable exclude dieback as a contributing factor to vegetation decline. The total area of native vegetation mapped within the survey area extends approximately 18.98 ha.

Four broadly defined fauna habitats were mapped within the Project area, comprising:

- **Paddock with Scattered Trees and Drainage Areas** - may be utilised by Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*), the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*), South-western Brush-tailed Phascogale (*Phascogale tapoatafa subsp. wambenger*), Western Ringtail Possum (*Pseudocheirus occidentalis*), Western Brush Wallaby (*Notamacropus Irma)* and various waterbird species.
- **River and Riparian Vegetation, Dams and Drainage** - may be utilised by Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*), the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*), South-western Brush-tailed Phascogale (*Phascogale tapoatafa subsp. wambenger*), Water-rat (Hydromys chrysogaster), Quenda (*Isoodon fusciventer*), Western Ringtail Possum (*Pseudocheirus occidentalis*), Western Brush Wallaby (*Notamacropus Irma),* Carter's Freshwater Mussel and various waterbird species.
- **Mixed Trees** - may be utilised by Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*), the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*), South-western Brush-tailed Phascogale (*Phascogale tapoatafa subsp. wambenger*), Quenda (*Isoodon fusciventer*), Western Ringtail Possum (*Pseudocheirus occidentalis*), and Western Brush Wallaby (*Notamacropus Irma)*.
- **Stags** (mature dead trees) - may be utilised by Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*), and the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*).

Twenty-five species of conservation significance have the potential to occur within the Project area, based on the desktop assessment. Three species are 'likely to occur', 13 'may occur' and ten are 'unlikely to occur'.

Based on the desktop assessment and the field survey, Carnaby's Cockatoo (*Calyptorhynchus latirostris),* Forest Red-tailed Black Cockatoo *(Calyptorhynchus banksii naso)* and Baudin's Cockatoo *(Calyptorhynchus baudinii)* are considered to have the potential to utilise habitats within the Survey Area. Breeding and foraging habitat is present, although generally highly modified.

Marginal, generally poor quality and highly modified habitat also exists for the following species:

- Peregrine Falcon (*Falco peregrinus*) may utilise the larger eucalypts
- Western Brush Wallaby (*Notamacropus Irma*) which may utilise the areas of mixed trees and adjacent paddocks
- South-western Brush-tailed Phascogale (*Phascogale tapoatafa* subsp. *wambenger*) and the Western Ringtail Possum (*Pseudocheirus occidentalis*) which may utilise the areas of mixed trees, though these are generally smaller patches that are very isolated and of poor quality.
- wetland bird species including the Glossy Ibis *(Plegadis falcinellus),* Curlew Sandpiper (*Calidris ferruginea),* Common Greenshank *(Tringa nebularia),* Some of these species may utilise the poor quality drainage and wetland habitats, and areas within the paddocks which are highly modified but likely to flood over winter.

Twenty-five vertebrate fauna species were recorded during the field survey, comprising 18 bird, six mammal and one reptile species. Of these, two were of conservation significance:

- Baudin's Cockatoo (*Calyptorhynchus latirostris*) - listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Biodiversity Conservation Act 2016* (WA).
- Tree Martin (*Petrochelidon nigricans*) - listed as Marine under the EPBC Act.

Species listed as Marine under the EPBC Act are only considered of conservation significance when recorded within Commonwealth Land. Given the Survey Area does not contain any Commonwealth land the Tree Martin is not considered conservation significant for the purposes of this Project and will not be discussed further.

The Survey Area contains 201 potential Black Cockatoo breeding trees (i.e DBH >500mm), of which 22 contain hollows potentially suitable for use by Black Cockatoos. Of these, 21 trees were dead old trees with no vegetation cover nearby, therefore their utilisation by Black Cockatoos is considered limited. The Black Cockatoo foraging assessment determined the presence of:

- 1.80 ha of High Quality and 2.59 ha of Quality Carnaby's Cockatoo foraging habitat
- 0.64 ha of Quality and 3.75 ha of Low Quality Forest Red-tailed Black Cockatoo foraging habitat
- 1.80 ha of High Quality and 2.59 ha of Quality Baudin's Cockatoo foraging habitat.

The Survey Area is considered to have low biodiversity. Remnant patches of native vegetation are significantly altered and almost completely devoid of native understorey species. A large proportion of native trees were dead which may be a reflection of one or more factors including dieback, altered groundwater conditions, altered fire regimes, and salinity. It is likely that remaining living trees play an important role in hydrological function therefore clearing of living native trees should be avoided where possible.

1.2.2 Site Heritage

AECOM completed a due diligence assessment of the Project area in April 2019 (AECOM, 2019b), comprising a desktop cultural heritage assessment to identify any registered archaeological and heritage sites and heritage constraints. There are no known Registered Aboriginal Heritage Sites or European Heritage Sites within the Project area.

Cultural heritage values are not likely to constrain development of the Project area, however archaeological surveys of the Project area have not been completed. If any artefacts of cultural significance are uncovered during development, further approvals may be required.

The possibility of artefacts of cultural significance to be uncovered during development should be managed using an unexpected finds management plan or procedure. The Project's detailed EMP will incorporate a procedure for unexpected finds of heritage items during the Project works.

1.2.3 Bushfire Risk

A designated bushfire prone area is an area that has been identified and designated by the Fire and Emergency Services Commissioner under the *Fire and Emergency Services Act 1998* (as amended). Such areas are identified on the Department of Fire and Emergency Services (DFES) 'Map of Bush Fire Prone Areas'. Designation of an area as being bushfire prone reflects the potential of bushfire to affect that site. It acts as a mechanism for initiating further assessment in the planning and building processes. The south-eastern corner of the Project is located within a bushfire prone area.

The foundation for bushfire planning statutory regulations in WA is the 'State Planning Policy 3.7 Planning in Bushfire Prone Areas' (SPP 3.7). Implementation of this SPP is guided by the 'Guidelines for Planning in Bushfire Prone Areas' and Australian Standard 3959 Construction of Buildings in Bushfire-Prone Areas (AS 3959). Project infrastructure should be appropriately sited away from bushfire prone areas to reduce bushfire risk. Bushfire planning is required to be consistent with the SPP 3.7 and should be considered during planning for the Project. Bushfire management measures will be addressed in the Project's detailed EMP.

2.0 Environmental Management Framework

This document provides an overarching Project environmental management framework to be implemented through detailed EMP(s) and any required sub-plans, which will incorporate the key environmental objectives and management strategies that are identified in this document.

All detailed management plans will be prepared in consultation with the relevant authorities and will be subject to endorsement by the responsible authority, prior to the commencement of on-the-ground activities.

2.1 Legislative and Regulatory Context

The detailed EMP(s) and any required sub-plans will address compliance with applicable regulatory requirements, environmental protection policies, other relevant guidelines and codes of practice and, where appropriate, will include a performance indicator schedule to be utilised for monitoring environmental compliance.

2.1.1 Key Legislation

A wide range of laws, regulations and policies are relevant to the Project development works. Table 1 describes the key Commonwealth and State environmental legislation relevant to the proposed development. It also considers key regulatory and industry guidance relevant to the Project.

Table 1 Regulatory framework relevant to Waroona Solar Farm

Topic	Legislation, policy and guidelines
Air Quality	Commonwealth Legislation National Environment Protection (Ambient Air Quality) Measure National Environment Protection (Air Toxics) Measure State Legislation *Environmental Protection Act 1986*
Contamination and Hazardous Materials / Waste	Commonwealth Legislation National Environment Protection (Assessment of Site Contamination) Measure 1999. State Legislation *Environmental Protection Act 1986* *Contaminated Sites Act 2003* *Dangerous Goods Safety Act 2004* Landfill Waste Classification and Waste Definitions 1997 amended 2009 Environmental Protection (Controlled Waste) Regulations 2004 Australian Standard 1940 Storage and Handling of Flammable and Combustible Liquids Guidelines and Best Practice Assessment and management of contaminated sites Contaminated sites guidelines (December 2014) Identification, reporting and classification of contaminated sites in Western Australia Contaminated Sites Guidelines (June 2017)
Cultural Heritage	Commonwealth Legislation *Aboriginal and Torres Strait Island Heritage Protection Act 1984* State Legislation *Heritage Act 2018* *Aboriginal Heritage Act 1972* Aboriginal Heritage Regulations 1974 *Environmental Protection Act 1986*

Topic	Legislation, policy and guidelines
Environmental Impact Assessment	Commonwealth Legislation *Environment Protection and Biodiversity Conservation Act 1999* *Environment Protection and Biodiversity Conservation Regulations 2000* State Legislation *Environmental Protection Act 1986*
Fire Prevention and Protection	State Legislation *Bushfires Act 1954* *Dangerous Goods Act 1985* *Fire and Emergency Services Act 1998* *Occupational Safety and Health Act 1984* Bushfires Regulations 1954 (WA) Guidelines and Best Practice SPP3.7 Planning in Bushfire Prone Areas DPLH Guidelines for Planning in Bushfire Prone Areas AS 3959-2009 Construction of buildings in bushfire-prone areas.
Flora and Fauna	Commonwealth Legislation *Environment Protection and Biodiversity Conservation Act 1999* *Environment Protection and Biodiversity Conservation Regulations 2000* State Legislation *Biodiversity Conservation Act 2016* (WA; BC Act) Biodiversity Conservation Regulations 2018
Invasive Species and Pests	State Legislation *Biosecurity and Agriculture Management Act 2007* (BAM Act)
Noise	State Legislation *Environmental Protection Act 1986* Guidelines and Best Practice Environmental Protection (Noise) Regulations 1997
Land Use and Planning	State Legislation Peel Region Planning Scheme (2003) Shire of Waroona District Planning Scheme No.7 *Planning and Development Act 2005*
Traffic	State Legislation *Road Traffic Act 1974* (WA)
Water Quality	State Legislation *Rights in Water and Irrigation Act 1914* (RIWI Act) *Environmental Protection Act 1986* (EP Act) Guidelines and Best Practice Assessment and management of contaminated sites Contaminated sites guidelines (December 2014) Identification, reporting and classification of contaminated sites in Western Australia Contaminated Sites Guidelines (June 2017)
Air Quality	Commonwealth Legislation National Environment Protection (Ambient Air Quality) Measure National Environment Protection (Air Toxics) Measure State Legislation *Environmental Protection Act 1986*

Topic	Legislation, policy and guidelines
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Noise	State Legislation *Environmental Protection Act 1986* Guidelines and Best Practice Environmental Protection (Noise) Regulations 1997
Land Use and Planning	State Legislation Peel Region Scheme (2013) Shire of Waroona Local Planning Scheme No.7 *Planning and Development Act 2005*

Topic	Legislation, policy and guidelines
Traffic	State Legislation *Road Traffic Act 1974* (WA)
Water Quality	State Legislation *Rights in Water and Irrigation Act 1914* (RIWI Act) *Environmental Protection Act 1986* Guidelines and Best Practice Assessment and management of contaminated sites Contaminated sites guidelines (December 2014) Identification, reporting and classification of contaminated sites in Western Australia Contaminated Sites Guidelines (June 2017)

2.1.2 Environmental and Planning Approvals

Any approvals required pursuant to legislation listed in Table 1, as determined during the planning permit application process and in consultation with the relevant authorities, will be obtained prior to the commencement of the relevant Project works or activities.

Environment

The WA state approvals process is administered by Part IV and Part V of the EP Act. Part IV relates to Projects that have the potential to significantly impact the environment and are usually of a scale that warrants some involvement with public stakeholders. Impacts to the environment include impacts on protected flora, vegetation communities, fauna and their habitats. Referral under Part IV (Section 38) of the WA *Environmental Protection Act 1986* (EP Act) is not anticipated due to characteristics of the Project and potential environmental impacts.

Approval may need to be sought in conjunction with a Commonwealth environmental assessment under the EPBC Act if there are impacts on Matters of National Environmental Significance (MNES) depending on the final locations of infrastructure. The clearing of Black Cockatoo breeding trees with hollows or clearing of more than 1 ha of foraging vegetation would require referral under the EPBC Act as a significant impact to MNES. If these trees and high quality habitat can be retained, it could be reasoned that the impact on the species would not be significant and therefore would not require referral. These requirements will be assessed following the preparation of the Project concept design.

The Project area primarily comprises cleared farming land with areas of native vegetation. Native vegetation clearing requirements could be undertaken as prescribed clearing (Section 51C) exemptions under the WA Environmental Protection (Clearing of Native Vegetation) Regulations 2004 if the area native vegetation clearing is less than 5 ha. Relevant exemptions for clearing at this site could include Item 1 (clearing to construct a building), Item 12 (clearing for vehicular tracks) and Item 19 (clearing of isolated trees) of Regulation 5. However, depending on the Project layout and area of native vegetation clearing required, a clearing permit under Part V of the EP Act may be required.

Impacts on watercourses registered as a proclaimed area by Department of Water and Environmental Regulation (DWER) are permitted under the requirements under the *Rights in Water and Irrigation Act 1914* (RIWI Act). Section 11/17/21A permits are necessary to interfere or obstruct the beds and banks of a watercourse or wetland, under the RIWI Act.

A Bed and Banks Permit may be required if works interfere or obstruct Harvey River. A 5C licence to take surface water would be required to take water from Harvey River. However, these requirements are not anticipated for the Project.

The Project has a low to moderate risk of Acid Sulphate Soils (ASS) occurring at depth over the entire site. If an ASS condition is placed on the development approval for the Project, dewatering is proposed, or disturbance of >100 m^3 of soil is proposed then an ASS investigation may be required and an ASS ASSDMP may need to be prepared and implemented.

The concept design puts an emphasis on the avoidance of disturbance to ecological values as much as reasonably practicable. The final layout and detailed EMP will incorporate any ecology requirements laid out in the development approval.

Planning

The Peel Region Scheme 2009 (PRS) is a statutory region scheme which is administered by the Western Australian Planning Commission, with the objective of promoting sustainable development whilst protecting areas of regional conservation and recreational significance. The PRS prevails over the local planning scheme, should any inconsistencies with the two schemes be identified.

The *'Shire of Waroona Planning Scheme No. 7'* is the regional development framework which the site falls within, currently zoned as Rural – General Farming. A Development Application under the Scheme is required. The Scheme provides the framework for relevant decisions and controls for the use and development of land for the Project.

2.2 Environmental Aspects and Objectives

In alignment with AS/NZS ISO 14001 environmental aspects are defined here as "*elements of an organization's activities, products, or services that have, or may interact with the environment.*"

Correlating with these identified aspects are environmental objectives, which in general outline the environmental goals to be achieved by the Project. These goals, which broadly correspond to the Project's performance targets, can be achieved through specified actions (e.g. management and mitigation measures) or through compliance with regulations, set standards, or codes of practice, within defined periods of time.

Principal Project aspects that may have the potential to result in an impact on the environment, as well as respective objectives are outlined in Table 2. These are preliminary only and should be subject to review under the following circumstances:

- During preparation of the detailed EMP(s) and any required sub-plans (to reflect the outcomes of the development approvals and detailed design process, etc.).
- Prior to the transition to the next phase of the Project lifecycle (e.g. operations or decommissioning).
- When there is a change in Project scope or site conditions, including significant design alterations or new technical information becoming available.
- If subsequent revisions of the EMP(s) indicate the need to re-evaluate one or more of the environmental aspects.

The detailed EMP(s) and any required environmental sub-plans will address the environmental aspects and describe strategies to mitigate the associated impacts and risks.

Table 2 Environmental Aspects and Objectives for the Waroona Solar Farm

Aspects	Objectives	Construction Phase	Operational Phase	Decommissioning Phase
Overall				
Project Approach	• Comply with all relevant environmental laws, regulations, policies and guidelines. • Safeguard Project associated human health, local amenity and natural environment. • Avoid or minimise Project impacts through utilisation of best industry practice and standards as best as reasonably practicable.	Y	Y	Y
Bushfire				
Project activities within bushfire prone areas	• Minimise bushfire hazards on site. • Comply with SPP 3.7 requirements.	Y	Y	Y
Community Amenity				
Community engagement	• Establish and maintain positive liaison with community.	**Y**	**Y**	**Y**
Additional traffic generation	• Minimise additional Project associated traffic as far as reasonably practicable.	**Y**	**Y**	**Y**
Changes to visual amenity	• Minimise negative changes to visual amenity as far as reasonably practicable.	**Y**		**Y**
Cultural Heritage				
Ground disturbance	• No unapproved disturbance of heritage sites.	**Y**		
Emissions / Discharge				
Air emissions	• Minimise release of air contaminants. • Minimise dust generation.	**Y**	**Y**	**Y**
Noise and vibration	• Minimise noise and vibration generation.	**Y**	**Y**	**Y**
Stormwater discharge	• Avoid or minimise run-off discharge of soil, sediment and any potential contaminants off site.	**Y**	**Y**	**Y**

Aspects	Objectives	Construction Phase	Operational Phase	Decommissioning Phase
Water Quality				
Accidental release of hydrocarbons and other chemicals	• Prevent accidental release of hazardous chemicals as far as reasonably practicable. • No discharges of hydrocarbons to Harvey River.			
Ground Disturbance	• No disturbance of ASS resulting in acidification of groundwater. • No contamination of Harvey River or Domain main drain from sedimentation. • Minimise surface and groundwater regime disturbance.	**Y**	**Y**	**Y**
Soil				
Accidental release of hydrocarbons and other chemicals	• No long-term contamination of soils attributable to the Project. • Prevent accidental release of hazardous chemicals as far as reasonably practicable.	**Y**	**Y**	**Y**
Ground Disturbance	• No acidification of the landscape from the disturbance of ASS. • Excavations will be self-draining. • Preserve or reinstate pre-existing environmental values and / or land uses.	**Y**	**Y**	**Y**
Flora and Fauna				
Removal of native vegetation, including scattered trees	• Avoid or minimise clearance of native vegetation as far as reasonably practicable. • Comply with clearing permit application requirements and conditions (as applicable). • Preserve or reinstate pre-existing environmental values and / or land uses.	**Y**	**Y**	**Y**
Introduction and / or spread of pest flora and fauna	• Prevent introduction and spread of pest flora and fauna.	**Y**	**Y**	**Y**
Physical interaction with fauna	• Avoid or minimise physical negative impacts on fauna as far as reasonably practicable.	**Y**	**Y**	**Y**

Aspects	Objectives	Construction Phase	Operational Phase	Decommissioning Phase
Waste				
Accidental release of hydrocarbons and other chemicals	• Prevent accidental release of hazardous chemicals as far as reasonably practicable.	Y	Y	Y
Generation of on-site industrial and household waste	• Minimise raw material use. • Minimise waste generation. • Maximise recycling and reuse. • Ensure safe waste disposal in compliance with relevant legislation. • No contamination of the Project area.	Y	Y	Y

2.3 Roles and Responsibilities

Overall responsibility for the environmental management of the Project lies with the Applicant, unless the Project ownership is transferred to another entity, in which case the overall responsibility for environmental management will also be transferred to the new owner.

All contractors engaged on the Project will be contractually obligated to comply with the EMP(s), including any required environmental sub-plans, and any of the Project's planning and environmental approval conditions. All personnel employed for the Project will be required to undertake work in accordance with the EMP(s) and comply with all applicable environmental laws.

Specific environmental management roles and responsibilities will be specified in the detailed EMP(s). However Table 3 provides a general outline of typical environmental responsibilities for principal organisational positions. It is to be noted that role titles may be subject to amendment, depending on future Project developments.

Table 3 Key Roles and Responsibilities

Role	Key Responsibilities
Project Manager	• Have overall responsibility for the Project's environmental performance. • Communicate clear expectations in relation to environmental management and performance standards to the Project team. • Ensure resources are provided to implement the EMP.
Environment Manager	• Assist with the development and periodic review of the detailed EMP(s). • Direct on the ground implementation of the EMP. • Arrange required environmental awareness training of Project personnel. • Ensure monitoring and reporting of environmental performance.
Project Construction Manager	• Supervise day-to-day construction management and environmental performance. • Ensure implementation of EMP requirements.
Project Operation Manager	• Supervise day-to-day operation management and environmental performance. • Ensure implementation of EMP requirements.
Project Decommissioning Manager	• Supervise day-to-day decommissioning management and environmental performance. • Ensure implementation of EMP requirements.
Other personnel including contractors	• Ensure compliance with site environmental induction requirements. • Ensure compliance with the EMP when undertaking Project works. • Report all environmental incidents immediately to the appropriate supervisor or manager.

2.4 Environmental Awareness and Training

All personnel including staff, employees, contractors and subcontractors involved in any of the Project's activities will be required to complete the following training requirements to ensure compliance with outlined environmental performance requirements as part of the induction process:

- Site environmental management training prior to commencing work.
- Job-specific Project and / or site training relevant to their role, if and where required.

Regular toolbox meetings will be held to highlight relevant environmental and safety issues, as needed.

2.5 Communication and Consultation

The Applicant will establish clear internal and external communication procedures to address environmental management and performance requirements of the Project, as well as to maintain effective community engagement. Communication and consultation procedures will be included in the regular EMP review process.

Examples of specific external stakeholder communication and consultation to be undertaken before and during construction include:

- Notification of proposed works to stakeholders within a specified area from the site, in good time.
- Notification of works relating to changes of traffic conditions to all stakeholders in accordance with traffic management requirements as outlined in the detailed EMP(s) or a Traffic Management Plan.

2.6 Contractor Management

The Applicant will assign a Project role (e.g. Project Manager) to the overall responsibility for the management of all contractors. The Applicant will also assign roles (e.g. Project Construction Manager) with responsibility for on-the-ground contractor management and ensuring contractor compliance with the EMP(s) and any environmental sub-plans.

Responsibilities may include, but are not limited to:

- Provide Project, site and environmental management induction and training of all contractors prior to commencement of any works.
- Ensure contractors are aware of all applicable environmental obligations.
- Oversee contractors' respective EMP implementation.
- Track and report contractor environmental performance.

Contractor management approaches and requirements will be reviewed regularly and adjustments incorporated into the detailed EMP(s).

2.7 Monitoring and Auditing

A regular site monitoring schedule will be established to verify that EMP and environmental regulatory requirements are met and controls are in place and functioning effectively. Any issues, concerns and recorded non-conformances identified through monitoring will be addressed through regular revision of established, or implementation of additional, site management measures.

Works and contractor performance will be verified through regular environmental audits, conducted by suitably qualified auditors. Audits will coincide with phases of works that comprise the greatest environmental risk.

2.8 Record Keeping and Reporting

Environmental performance monitoring and audit reporting will be prepared and submitted regularly to an identified Project management member of staff.

All identified environment related non-conformances identified during audits will be documented as incidents in accordance with Section 2.9 of this PEMP and be submitted with the reporting.

All monitoring and auditing documentation will be handled in line with established document control procedures. If and where required, the findings of environmental performance, monitoring and audits will be reported to external stakeholders.

2.9 Complaint and Incident Investigation and Response

All Project-associated environmental complaints will be captured and responded to in a timely and adequate manner.

A complaint management approach will be established, comprising of the following key components:

- Complaints Register, which will be maintained for the Project, recording all steps of the complaints handling process.
- Complaint reporting and management procedures to be followed, including:
  - Opening of an incident in the register.
  - Description of the complaint.
  - Coordination of responses, including corrective actions (see Section 2.10), to address complaints.
  - Planned follow-up actions, including monitoring of actions, to address the source of the complaint and verify its resolution.
  - Closure of incident, once all actions have been completed.

An environmental incident management approach will also be established, comprising of the following key elements:

- Environment Incident Register, which will be maintained for the duration of the Project and will be updated regularly to ensure actions are completed and that controls are effective.
- Incident reporting and management procedures to be followed, including:
  - Opening of an incident in the register.
  - Description of the incident.
  - An evaluation of the level of impact and corrective action (see Section 2.10) taken or proposed.
  - Assigning follow-up actions to be undertaken, where required, to prevent recurrence of the non-conformance.
  - Monitoring of the progress and status of follow-up actions.
  - Closing of incident, once all planned follow-up actions have been completed and the incident has been resolved.

Environmental incidents associated with Project works may be identified through a variety of sources, including workplace observations, environmental monitoring and audits, review of environmental monitoring data, and / or stakeholder complaints.

Incident notification and response coordination will be undertaken in line with company procedures. Environmental incidents will be investigated and managed in accordance with the Project's incident management procedures to ensure that appropriate actions are taken. Where safe to do so, identified hazards will be contained immediately. Safety of the public and the Project workforce will be the first priority when interacting with environmental incidents.

To evaluate incidents more efficiently and respond appropriately, an incident classification will be established. Significant incidents may include those that have resulted in serious injury, significant property damage, offsite environmental release or involvement of the environmental regulators (DWER) and will be reported to Project management as soon as practicable. All incidents, associated with Project works, will be captured and responded to in a respective timely and adequate manner.

2.10 Corrective Actions

Corrective action procedures will be developed to address all environmental incidents and non-conformances with the EMP. All corrective actions to be undertaken will be specified within the environmental monitoring reports or audit reports, as applicable. Each corrective action will be assigned to a person responsible, as well as a target date for completion. Each corrective action will be re-visited in the following periodic monitoring event / audit to verify conformance.

2.11 Emergency Preparedness and Response

Emergency response is required when an unplanned incident occurs which has or has the potential to have a detrimental impact on the environment or human health (e.g. chemical spills, bushfire).

A site-specific Emergency Response Plan will be developed prior to construction. All personnel will be inducted into the use of emergency procedures and provided emergency contact numbers via respective inductions. All incidents and details of corrective actions will be recorded as per the procedure outlined in Section 2.8.

3.0 Detailed Environmental Management Plans

3.1 Overview

The detailed EMP(s), including any required sub-plans, will be developed by the Applicant and/or its contractors, prior to the start of site construction works, addressing approval conditions and ensuring alignment with the overarching environmental framework contained in this PEMP. Detailed EMPs and sub-plans required by the Project's planning permit will be subject to endorsement by Waroona Shire Council.

The detailed EMP(s) will be the primary mechanism for implementation of environmental management for the Project. Depending on the conditions of approval, the EMP(s) may also contain detailed sub-plans addressing specific environmental aspects and risks. Separate EMPs may be prepared addressing the various stages or phases of the Project, or an overarching EMP addressing all phases may be prepared, subject to review and revision prior to the start of each phase.

3.2 Content and Structure

Table 4 presents the key content and structure proposed for the detailed EMP(s).

Table 4 General EMP Structure

Structure	Content	Correlating PEMP Section
Introduction and Background	Detailed Project description and general overview of Project key environmental issues.	1.2
Environmental approval & planning permit conditions	Identification of planning permit and environmental approval conditions relevant to the EMP and where these conditions are addressed in the document.	
Regulatory Framework	Review and outline of applicable regulatory framework.	2.1
Objectives	Overarching environmental objectives for the Project.	2.2, 3.3
Risk assessment	Identification and assessment of Project environmental aspects and risks.	2.2
Measures to manage key risks	Detailed management measures for each key risk, including timeframes to meet objectives.	3.3
Performance Indicators	Definition and description of required level of performance to meet either environmental, regulatory or company Project standards.	2.2, 3.3
Roles and responsibilities	Description and assignment of Project roles and responsibilities.	2.3
Training	Outline of specific environmental awareness and competence-based training required for Project workforce.	2.4
Monitoring, auditing, reporting	Outline of specific monitoring, auditing and reporting requirements within Project company, community, regulators and other stakeholders.	2.7, 2.8

Structure	Content	Correlating PEMP Section
Internal and external communications	Outline of specific procedures and requirements within Project company, community, regulators and other stakeholders.	2.5
Incident and emergency response	Outline of specific procedures and requirements within Project company, community, regulators and other stakeholders.	2.9, 2.10, 2.11

3.3 Preliminary Objectives and Management Strategies

A general outline of preliminary objectives and environmental management strategies to be addressed in the detailed EMP(s) are provided in Table 5.

3.4 Review and Continual Improvement

This PEMP and detailed EMP(s) are considered live documents and will regularly be reviewed and improved if and when required.

3.5 Additional Documentation

A variety of detailed issues, as and where identified in the Project approval conditions or through the development of the detailed EMPs, may be addressed separately through more detailed environmental sub-plans. This intends to provide comprehensive direction and guidance to Project staff, employees and contractors. Detailed sub-plans potentially include:

- Flora and Vegetation Management Plan
- Fauna Management Plan
- Water Management Plan
- Soil Management Plan
- ASS Dewatering Management Plan
- Traffic Management Plan
- Hazardous Materials Management Plan
- Waste Management Plan
- Weed Management Plan
- Heritage Management Plan
- Decommissioning and Rehabilitation Plan.

If required, the relevant plans will be finalised prior to the start of the Project activities.

Table 5 Preliminary Environmental Management Strategies

Objectives	Management strategies	Construction Phase	Operation Phase	Decommissioning Phase
Project Approach				
Comply with all relevant environmental laws, regulations, policies and guidelines	• Review and implement all relevant laws, regulations, policies, standards and guidelines through performance targets and environmental objectives.	Y	Y	Y
Safeguard human health, local amenity and natural environment	• Focus on safeguarding priorities in all relevant Project decisions as best as reasonably practicable.	Y	Y	Y
Avoid or minimise Project impacts through utilisation of best industry practice and standards as much as reasonably practicable	• Review and implement latest industry standards and guidelines in all phases of the Project as best as reasonably practicable.	Y	Y	Y
Bushfire				
Minimise bushfire hazards on site	• Appropriately train Project personnel in bushfire prevention and management and emergency response. • Implement and maintain appropriate site access tracks. • Liaise with DFES during high fire danger periods, if necessary.	Y	Y	Y
Community amenity				
Establish and maintain positive liaison with community	• Consult with nearby communities (Harvey and Binningup) regularly and continuously throughout Project lifecycle, provide regular updates and obtain public feedback, specifically in relation to environmental matters.	Y	Y	Y
Minimise additional Project associated traffic as far as reasonably practicable	• Where feasible, manage the construction, operation and decommissioning programs to reduce traffic generation (in line with the Traffic Impact Assessment). • Utilise accredited traffic control services contractors. • Implement the incident reporting system, allowing implementation of traffic improvement measures.	Y	Y	Y

Objectives	Management strategies	Construction Phase	Operation Phase	Decommissioning Phase
Minimise negative changes to visual amenity as far as reasonably practicable	• Limit vegetation clearing and establish landscaping if required to minimise visual impacts. • Remove equipment from site as soon as practicable. • Implement glint and glare assessment findings (to be incorporated).	**Y**	**Y**	**Y**
Heritage				
Prevent disturbance of heritage sites, items and values	• Implement management measures of the unexpected finds procedure, including "Stop work", and unexpected finds management and reporting procedures in the event heritage items or values are uncovered during construction.	**Y**		
Emissions / Discharge				
Minimise release of air contaminants as far as reasonably practicable	• Where feasible, utilise latest technology, to minimise release of pollutants.	**Y**	**Y**	**Y**
Minimise dust generation	• Avoid or minimise ground disturbance, soil movement and other dust-producing activities. • Utilise water or wetting agent on any exposed areas, including unpaved roads and laydown areas. • Utilise wind breaks and silt fencing. • Undertake flexible management of speed limits in accordance with road and wind conditions.	**Y**	**Y**	**Y**
Minimise noise and vibration generation as far as reasonably practicable	• No scheduled Project construction, maintenance and decommissioning activities to occur during night time, Sundays or public holidays unless prior approval has been granted by relevant regulatory body. • Shut off / throttle down any vehicles or equipment not in use. • Where reasonably practicable, utilise latest noise reduction equipment and technology.	**Y**	**Y**	**Y**
Avoid and minimise run-off discharge of soil, sediment and any potential contaminants	• Implement best industry practice for sediment and erosion management, including minimising ground disturbance, implementing erosion and sediment controls, strategic stockpile location selection, stabilisation of stockpiles etc. • Ensure revegetation or stabilisation of disturbed areas as soon as reasonably practicable.	**Y**	**Y**	**Y**

Objectives	Management strategies	Construction Phase	Operation Phase	Decommissioning Phase
Flora and Fauna				
Avoid or minimise clearance of native vegetation as far as reasonably practicable	• Avoid and minimise vegetation clearing as far as reasonably practicable. • Undertake clearance activities only with environmental regulator and Council approval (permits as applicable). • Supervise clearance activities.	**Y**		
Offset unavoidable Project associated vegetation loss	• Follow all regulatory requirements including obtaining native vegetation offsets as required (if applicable).	**Y**		
Preserve or reinstate Project pre-existing environmental values and / or land uses	• Limit disturbance to the Project footprint and minimise disturbance within the Project footprint to the extent reasonably practicable. • Develop and implement a post Project rehabilitation plan, including but not limited to: - Removal and disposal of above ground infrastructure components, in compliance with applicable regulatory framework and best industry practice. - Management of infrastructure components that cannot be removed without significant disturbance in compliance with applicable regulatory framework and best industry practice. - Refill of excavated areas with clean compatible material. - Rehabilitation of compacted areas and implementation of vegetation reinstatement program, in agreement with land owners.	**Y**		**Y**
Prevent introduction and spread of pest flora and fauna	• Develop and implement robust weed management and monitoring procedures.	**Y**	**Y**	**Y**
Avoid or minimise physical negative impacts on fauna as far as reasonably practicable	• Implement speed restrictions for on-site traffic, in line with the Solar Farm Traffic Impact Assessment outcomes. • Undertake fauna management in compliance with requirements of the *Biodiversity Conservation Act 2016*. • Avoid and minimise clearing potential Black Cockatoo breeding trees and Black Cockatoo foraging habitat as far as reasonably practicable.	**Y**	**Y**	**Y**

Objectives	Management strategies	Construction Phase	Operation Phase	Decommissioning Phase
Physical environment				
Minimise soil and ground disturbance	• Limit Project works to footprint of the site. • Implement excavation strategies minimising disturbance. • Ensure reinstatement and revegetation of disturbed areas as soon as reasonably practicable.	Y	Y	Y
Minimise surface and ground water regime disturbance	• Maintain natural contours and drainage patterns where practicable. • Implement best industry practice for sediment and erosion management. • Revegetate disturbed areas as soon as reasonably practicable.	Y		Y
No disturbance of ASS resulting in acidification of groundwater or landscape	• Undertake the Project in accordance with DWER ASS investigation and management requirements. • Comply with approval conditions and requirements of the ASSDMP (if required).	Y	Y	Y
Waste				
Prevent accidental release of hazardous chemicals as far as reasonably practicable	• Minimise of chemicals used and stored on site. • Ensure storage infrastructure for onsite chemicals will be in accordance with relevant regulatory requirements standards and guidelines. • Develop site specific chemical storage, handling and emergency response procedures, in accordance with relevant regulatory requirements, standards and guidelines.	Y	Y	Y
Minimise raw material use	• Where feasible, implement measures to minimise raw material use and excess, including specific purchasing and construction, operation and decommissioning techniques strategies.	Y	Y	Y
Minimise waste generation	• Where feasible, implement measures to minimise waste generation including preference for material re-use, recycling and treatment, prior to disposal.	Y	Y	Y
Maximise recycling and reuse	• Where feasible, implement recycling and reuse measures for the Project, including waste disposal separation, utilisation of recyclable and reusable materials.	Y	Y	Y
Ensure safe waste disposal in compliance with relevant legislation	• Ensure provision of bins for adequate waste disposal. • Utilise licensed waste contractor for waste disposal.	Y	Y	Y

4.0 References

AECOM Australia Pty Ltd (AECOM), 2019a. *Waroona Solar Farm Desktop Vegetation, Flora and Fauna Assessment and Reconnaissance Survey*. January 2019.

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SE Waroona Development Pty Ltd
09-Aug-2019

AECOM Imagine it. Delivered.

Waroona Solar Farm

Glint and Glare Assessment

Waroona Solar Farm

Glint and Glare Assessment

Client: SE Waroona Development Pty Ltd

ABN: 34 630 130 433

Prepared by

AECOM Australia Pty Ltd
Level 21, 420 George Street, Sydney NSW 2000, PO Box Q410, QVB Post Office NSW 1230, Australia
T +61 2 8934 0000 F +61 2 8934 0001 www.aecom.com
ABN 20 093 846 925

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Appendix A
Discussion of Results A

Appendix B
GlareGauge Report B

1.0 Introduction

1.1 Background

AECOM Australia Pty Ltd (AECOM) has been commissioned by SE Waroona Development Pty Ltd (the Client) to provide supporting information for a planning permit application which relates to the proposed development of a photovoltaic solar farm in Waroona, Western Australia. The proposed development will be called the Waroona Solar Farm (the Project). The Project is located approximately 120km south of Perth at Landwehr Road, Waroona (the Site).

As part of the planning permit application a Glint and Glare assessment must be undertaken to determine the likely impact of glint and glare from the proposed development on nearby sensitive receptors and identify appropriate, feasible and reasonable mitigation strategies if required.

The objectives of this study are as follows:

- Conduct a glare potential analysis of the proposed Waroona Solar Farm based on a single axis tracking system;
- Identify potential glare impacts at nominated observation points near the Project, and;
- Recommend improvements or mitigation options available to the Client to reduce glare issues that may impact the public.

This report details the key inputs, methodology and the results of this glare assessment.

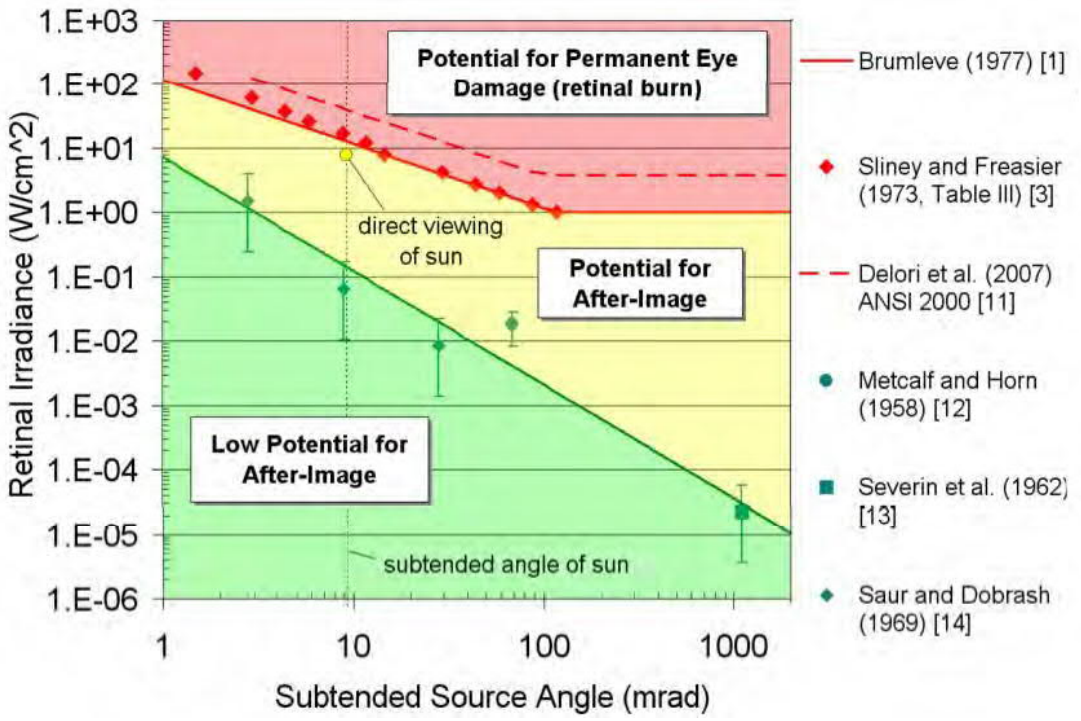
1.2 Glint and glare from solar panels

Glint and glare (referred to collectively in this report as glare) are caused by a significant contrast between a light source and background illuminance. Glare occurs over a continuous period while glint is a brief flash of light. Glint and glare can be hazardous when they affect critical operations like aviation. Aside from causing discomfort to the viewer, glare can be a source of distraction and can leave after-images in the viewer's vision.

The visual or ocular impact caused by glare is a function of the intensity of the glare source upon the retina (retinal irradiance) and the portion of a viewer's field of vision that the glare occupies (subtended source angle). This function is described in the glare hazard plot (Figure 1) which plots the risk of looking directly at the sun as a comparison.

In instances where glare is detected by the software, results of the assessment are shown graphically in the same manner.

Figure 1 Glare hazard plot illustrating ocular impact as a function of retinal irradiance and subtended source angle[1]



1.3 Civil Aviation Safety Authority requirements

The Civil Aviation Safety Regulations require that air traffic control towers are protected from glare. Through consultation with Air Services Australia (ASA) and the Civil Aviation Safety Authority (CASA), AECOM has been advised that there are no rules or regulations guiding the assessment of such glare. CASA therefore recommends that proponents of solar PV systems within or near airports follow the guidelines issued by the US Federal Aviation Administration (FAA) when making their assessments.

The FAA recommends that any proposed solar farms that are below the direct approach paths to an airport (aligned with a runway) and within a distance of around 5 nautical miles (approximately 10km) from a runway end should be referred for a specific assessment by the relevant authorities.

The FAA requires the use of Solar Glare Hazard Assessment Tool (SGHAT, currently marketed as GlareGauge) to demonstrate the impact of glare caused by PV systems proposed for installation on airports in the US[2]. CASA will typically not object to a solar farm if the glare analysis indicates that air traffic control (ATC) towers experience no glare and runway approaches experience at most "low potential for after-image" glare.

The nearest airstrip to the Project that AECOM has identified is Wheeler Field, which is located approximately 10km to the north of the Site near West Coolup. While this is outside the range recommended for assessment by the FAA, and the physical distance makes it unlikely that the solar farm will cause any significant glare issues for pilots on approach or on departure from the airstrip, AECOM has elected to account for the runway approaches out of abundant caution.

[1] Ho, C.K., Sims, C.A., Yellowhair, J., Bush, E. (2014), Solar Glare Hazard Analysis Tool (SGHAT) Technical Reference Manual), Sandia National Laboratories and US Department of Energy.
[2] Technical Guidance for Evaluating Selected Solar Technologies on Airports, 2010, Federal Aviation Administration

2.0 Site Overview

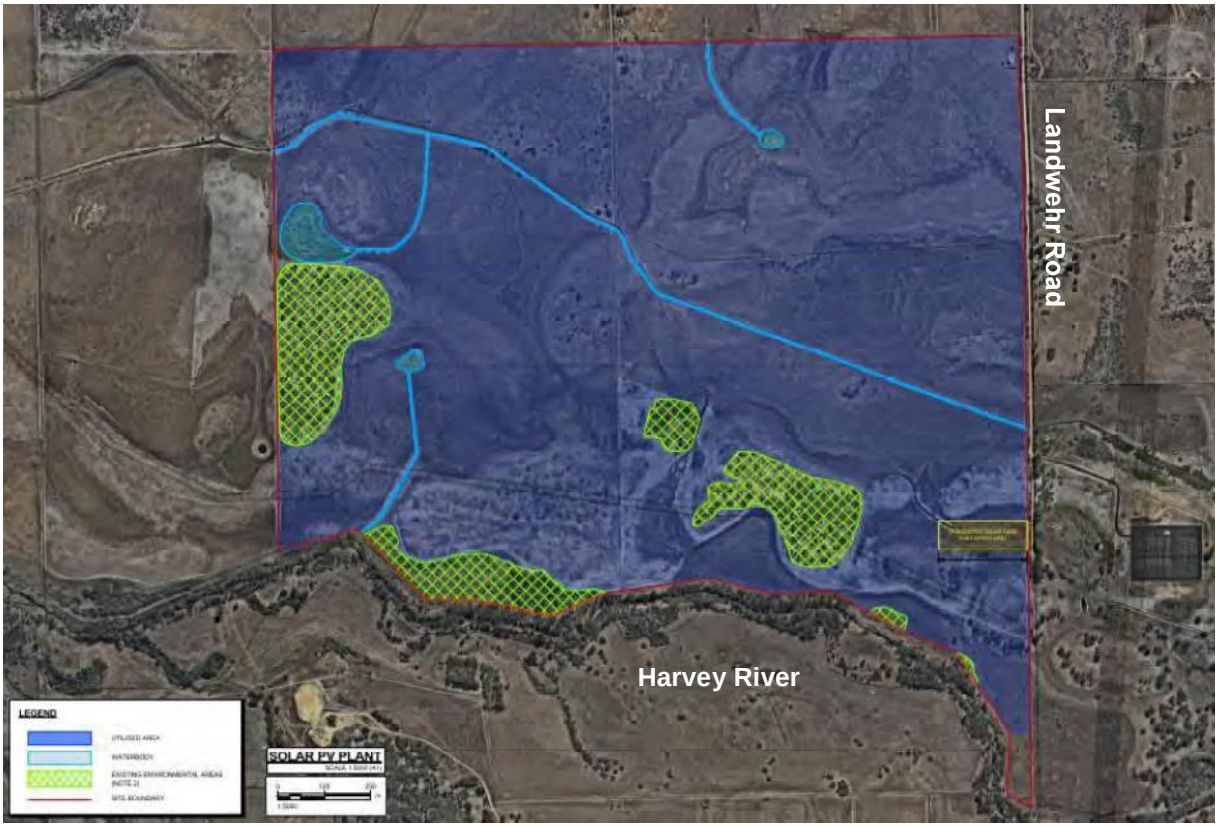
The Site is located at Landwehr Road, Waroona, approximately 120km south of Perth and 50km north of Bunbury, in the Shire of Waroona in Western Australia.

The Site is located within a rural area spanning 308 ha of pastoral land and is zoned as general farming. There is currently no registered street address. The Site is generally bound by Landwehr Road to the east, Harvey River to the south, and the northern boundary is broadly aligned with Buller Road.

Figure 2 shows the proposed development area.

Coordinates of the proposed solar farm development area are provided in the GlareGauge Report attached in Appendix B.

Figure 2 Waroona Solar Farm development area



3.0 Glare Analysis Software

3.1 Overview

AECOM has used the GlareGauge software marketed by ForgeSolar to undertake this glare analysis. GlareGauge's algorithms were developed by Sandia National Laboratories in its Solar Glare Hazard Analysis Tool (SGHAT).

GlareGauge employs an interactive Google Maps interface whereby the outline of the solar array can be manually drafted. It simulates an annual sun path based on the chosen location to calculate sun positions and vectors. GlareGauge requires a number of inputs regarding the characteristics of the solar PV systems including panel orientation, tracking type, slope and height above ground.

Glare hazard is determined based on the retinal irradiance and subtended angle described in Section 1.2. Glare hazards are defined according to the potential of the glare to impact vision as defined in Table 1.

Table 1 Glare impact definitions

Colour Coding	Glare Impact Category	Definition
Not shown on glare hazard plot	No Glare Predicted	Indicates that no glare is expected at the observation points for the site configuration.
		This category is not shown on the glare hazard plot.
Not shown on glare hazard plot	Glare beyond 50 degrees from pilot line-of-site on approach	Indicates that glare is present but will not cause a safety hazard to pilots according to recent research and flight simulator testing.
		This category is not shown on the glare hazard plot.
Green	Low potential for after image	Indicates there is glare present however only a low potential for a temporary after-image (a lingering image of the glare in the field of view).
		This category is shown green on the glare hazard plot.
Yellow	Potential for after image	Indicates that there is glare present with the potential to leave a temporary after-image of the glare.
		This hazard is shown yellow on the glare hazard plot.
Red	Potential for permanent eye damage	Indicates that there is glare present with the potential for permanent eye damage if observed.
		This hazard is shown red on the glare hazard plot.

3.2 Assumptions

Glare hazard is difficult to define and is not the same for every person. It is dependent on a number of factors including reflectance parameters (light intensity, angle of reflectance etc.), the size of the glare source and the observer's distance from it, and ocular/eye parameters (pupil diameter, distance from the pupil to the retina, etc). Therefore, the following standard assumptions (default values within GlareGauge) have been made through the course of the analysis:

- The model assumes flat reflective surfaces and that light reflected by the solar panels is specular (i.e. the angle of incidence = the angle of reflection).
- The average subtended angle of the sun as viewed from earth is ~9.3 mrad or 0.5°.
- The ocular transmission coefficient accounts for radiation that is absorbed in the eye before reaching the retina. A value of 0.5 is typical[3].

[3] Solar Glare Hazard Analysis Tool (SGHAT) User's Manual v. 2H, Clifford K. Ho, Cianan A. Sims, Julius E. Yellowhair Sandia National Laboratories Updated 22/07/2015

- Diameter of the pupil – the size impacts the amount of light entering the eye and reaching the retina. The typical value is 0.002m for daylight-adjusted eyes
- Eye focal length: This value is used to determine the projected image size on the retina for a given subtended angle of the glare source. A typical value of 0.017 m is used
- The entirety of the Site is assumed to be leased or owned by the Client for the duration of the project, thus observation points located within the Site were not considered in the modelling

3.3 Limitations

GlareGauge has the following limitations:

- The detailed geometry of the solar panel arrays is not rigorously represented, e.g. gaps between panels, detailed variations in height of the array and support structures.
- Obstacles (e.g. trees, vegetation buffers, structures or earth) between the observation points and the solar panel arrays that may obstruct observed glare are not considered. This results in a more conservative assessment.
- Directional viewpoints from each observation point are not defined. Instead the cumulative impact of the entire solar panel array on each observation point is calculated. In specific circumstances, this may lead to an overestimation of the extent of glare at a particular observation point.
- A typical clear-day solar irradiance profile (worst-case for glare) is used. The model profile has a lower irradiance level in the mornings and evenings and a maximum at solar noon. Actual irradiance levels and profile on any given day can be affected by cloud cover and other environmental factors, however this is not considered in this model.
- ForgeSolar utilises a simplified model of backtracking. Single axis trackers track the movement of the sun as it moves east to west throughout the day. Yield is maximised, and light reflection is minimised when panels are directly normal to the sun. During times of day when the sun is outside the tracking range, it is assumed that panels instantaneously revert to a pre-determined resting angle which is defined as 0° (panels assumed to lie flat). This results in a more conservative simulation of glare from the backtracking mechanism and will result in higher incidences of glare during sunset and sunrise, when the sun is at a lower angle relative to the array.

4.0 GlareGauge Inputs

The sections below detail the inputs applied by AECOM for analysis in GlareGauge. All azimuth values are relative to true north and all tilt angles relative to horizontal.

4.1 Modelling parameters

An overview of the input data used for the modelling of the sites of the Waroona Solar Farm is shown in Table 2. Site specific inputs are detailed in Section 4.2. The boundary of the system is based on the proposed development areas shown in Figure 2 and component data provided by the Client. The solar farm is in early development stage and detailed design information is not yet available. Thus, this glare assessment is based on the preliminary design and likely equipment. If any of the components and/or development area change, it is recommended that the glare potential be reanalysed.

Table 2 General PV system and Flight Path inputs for GlareGauge

Input Data	Units	Value	Comment
General Project Parameters			
Reflectivity calculations	-	Varies with incident angle	As incident angle increases, the reflectivity increases.
Reflection diffusion	-	Correlated to module surface type	Calculates the spread of the reflected beam according to the glass texturing and ARC.
Time zone	UTC	+8	WA time zone.
Peak DNI	W/m^2	1,200	AECOM estimate.
Orientation of array	degrees	0	Rows aligned in north-south direction.
Time interval	mins	1	Model interval throughout the year.
Solar panel surface material	-	Smooth glass with Anti-Reflective Coating (ARC)	As per module datasheet.
Mounting type	-	Single axis tracking	As per tracker datasheet
Flight Path Parameters			
Glide slope	degrees	3	Angle of descent of aircraft toward runway
Max downward viewing angle	degrees	30	The vertical field-of-view of the pilot
Azimuthal viewing angle	degrees	50	The left and right field-of-view of the pilot
Single Axis Tracking Parameters			
Tilt of tracking axis	degrees	0	0° = Facing upwards. Panels rotate during operation according to single axis tracking operation.
Orientation of tracking axis	degrees	0	0°= Rows aligned north-south (tracking east-west)
Offset angle of panel	degrees	0	Angle between tracking axis and panel.
Tracking Range	degrees	±55° (range of 110°)	As per tracker datasheet.
Height of panel above ground	m	2.4	Post height above ground measured to the point of rotation.

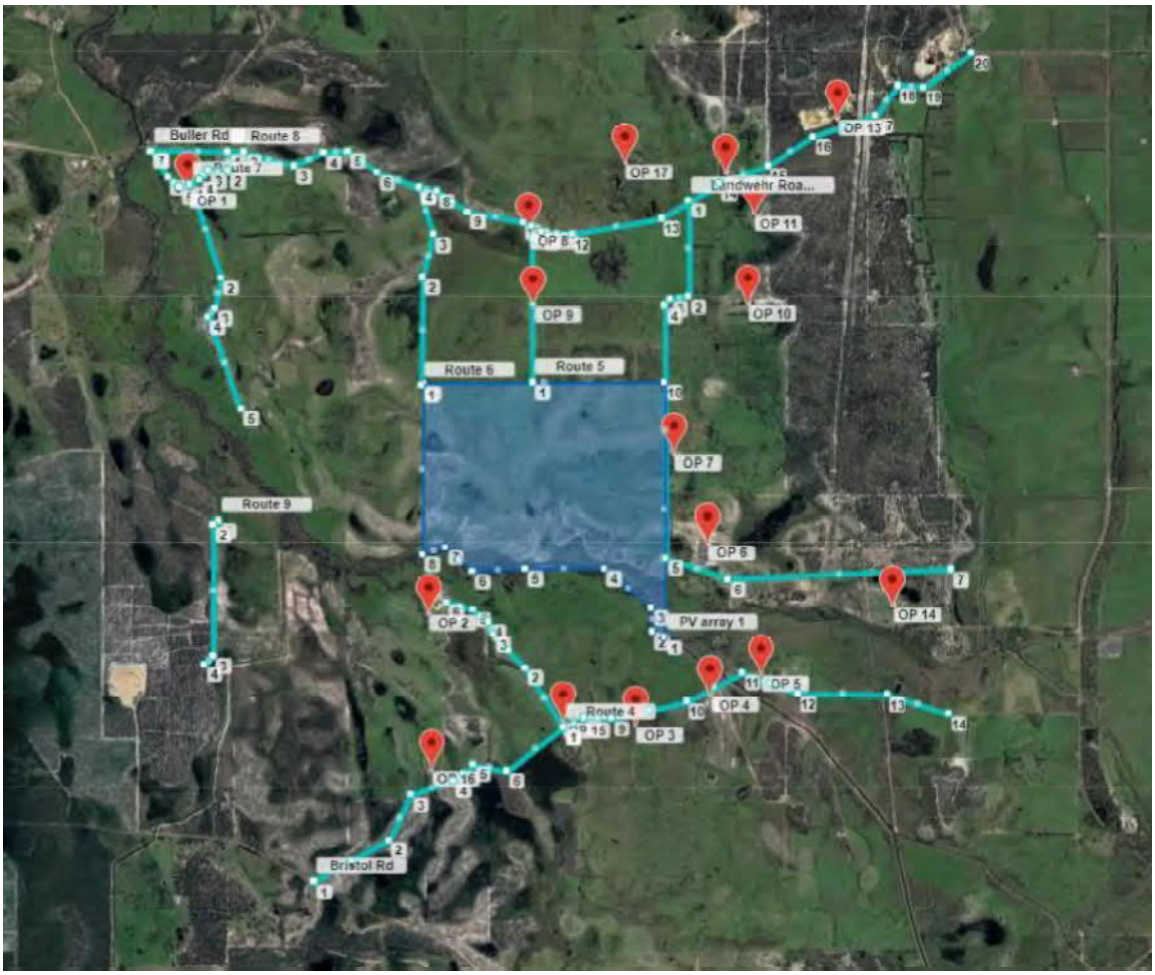
Input Data	Units	Value	Comment
Backtracking[4]	-	Yes	As per tracker datasheet
Resting angle	degrees	0°	Panels assumed to revert to an angle of 0° when the sun is outside tracking range

4.2 Flight Path, Observation Point and Route Receptor Locations

AECOM input relevant flight paths (FPs), observation points (OPs) and route receptor (RR) locations for the site into GlareGauge. These points were identified as potential areas where glare could impact the residents or drivers. Glare was assessed at each of the OPs and RRs for a height of 1.5 m above ground which is assumed to be the typical viewing height whilst standing or driving. The RRs also assume a field of view (FOV) angle of 50° to the left and right in the direction of travel. FAA research suggests that glare outside 50° FOV has no impact on the pilots; this same approach has been adopted for drivers[5].

The OPs are shown as red markers in Figure 3. Similarly, nearby roads and railways (termed route receptors, or RRs) are shown as blue lines in Figure 3. A table of OP and RR coordinates is provided in the GlareGauge Report attached in Appendix B.

Figure 3 Waroona Solar Farm glare study area

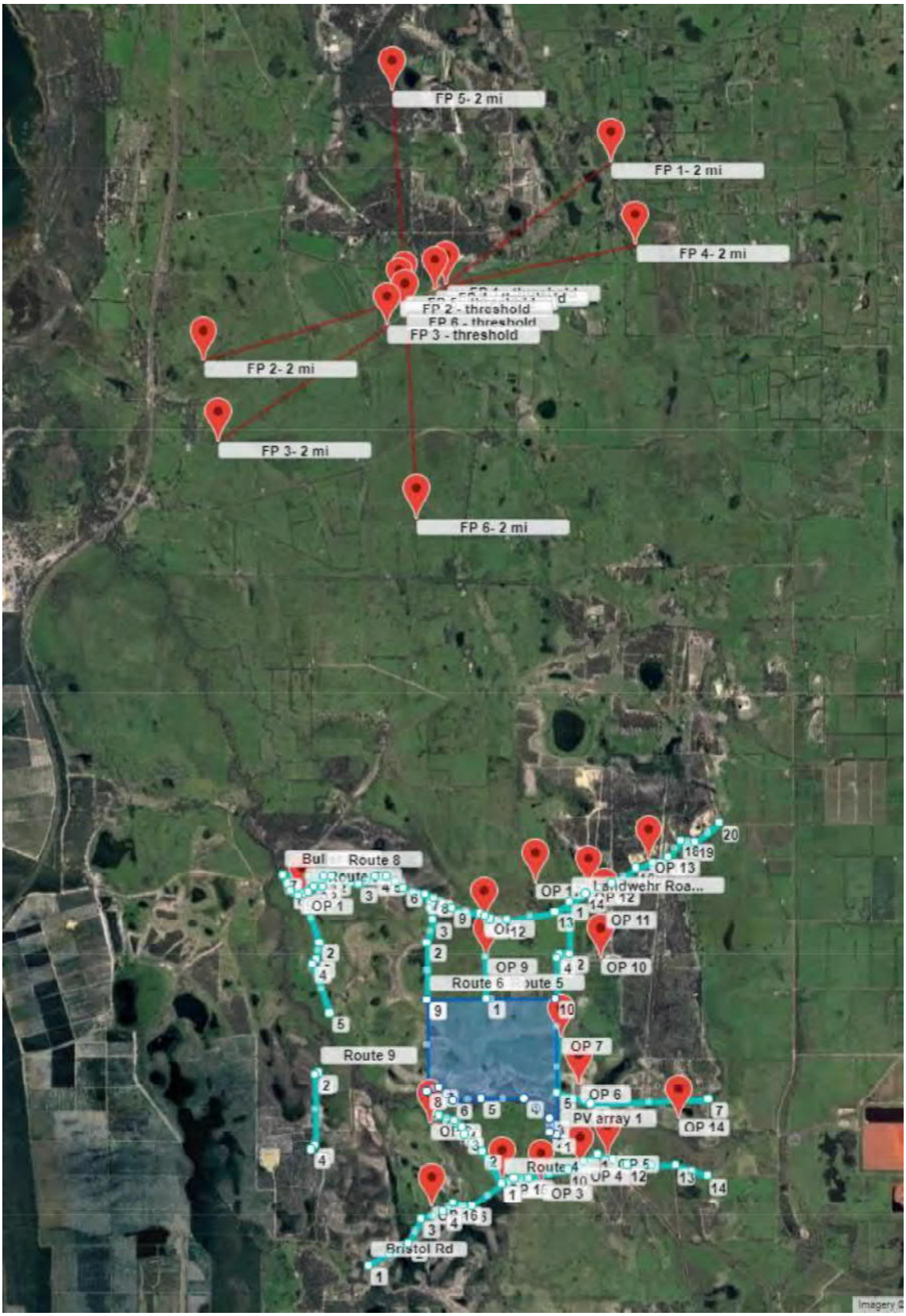


[4] Tracking systems are designed to follow the sun across the sky, maximising the total irradiance received. However, when the sun is low in the horizon, pointing the solar panels directly towards the sun results in row-to-row shading, significantly impacting performance. Backtracking is a strategy used to eliminate row to row shading during these times, whereby rather than following the sun, the trackers move back to ensure no shading occurs.

[5] Evaluation of Glare as a Hazard for General Aviation Pilots on Final Approach (Report DOT/FAA/AM-15/12). Retrieved from: https://www.faa.gov/data_research/research/med_humanfacs/oamtechreports/2010s/media/201512.pdf

The FP locations are shown relative to the site location in Figure 4.The Wheeler Field runways are approximately 10km to the north of the site.

Figure 4 Waroona Solar Farm Flight Path locations



5.0 Results

5.1 Summary of results

An overview of the results from the glare analysis, presented as **total annual minutes of glare** for each flight path, observation point and route receptor, is provided in Table 3. Yellow glare has been predicted for some of the OPs and RRs analysed. The FPs are not predicted to have any glare.

Table 3 Total annual minutes of glare for each FP, OP and RR

Observation Point/Route Receptor	Low potential for after image (min/year)	Potential for after image (min/year)	Hazard Summary
FP 1	0	0	No glare predicted
FP 2	0	0	No glare predicted
FP 3	0	0	No glare predicted
FP 4	0	0	No glare predicted
FP 5	0	0	No glare predicted
FP 6	0	0	No glare predicted
OP 1	0	811	**Yellow** Glare with potential for after image
OP 2	0	2,088	**Yellow** Glare with potential for after image
OP 3	0	0	No glare predicted
OP 4	0	60	**Yellow** Glare with potential for after image
OP 5	0	455	**Yellow** Glare with potential for after image
OP 6	0	8,258	**Yellow** Glare with potential for after image
OP 7	0	23,310	**Yellow** Glare with potential for after image
OP 8	0	0	No glare predicted
OP 9	0	12	**Yellow** Glare with potential for after image
OP 10	0	2,042	**Yellow** Glare with potential for after image
OP 11	0	152	**Yellow** Glare with potential for after image
OP 12	0	0	No glare predicted
OP 13	0	0	No glare predicted
OP 14	0	2,212	**Yellow** Glare with potential for after image
OP 15	0	0	No glare predicted
OP 16	0	0	No glare predicted
OP 17	0	0	No glare predicted
Bristol Rd	0	0	No glare predicted
Buller Rd	0	0	No glare predicted

Observation Point/Route Receptor	Low potential for after image (min/year)	Potential for after image (min/year)	Hazard Summary
Landwehr Road	0	38,560	**Yellow** Glare with potential for after image
Route 4	0	90	**Yellow** Glare with potential for after image
Route 5	0	3,240	**Yellow** Glare with potential for after image
Route 6	0	0	No glare predicted
Route 7	0	300	**Yellow** Glare with potential for after image
Route 8	0	0	No glare predicted
Route 9	0	0	No glare predicted

6.0 Recommendations

The modelling results show that for a number of OPs and RRs, observers are predicted to experience glare with moderate potential for after image during various times of the day. This section summarises the results with suggestions for glare mitigation for each OP and RR that was found to experience potential glare. These recommendations should be considered during subsequent design stages and further discussion of these findings can be found in Appendix A.

AECOM notes that the GlareGauge software is unable to account from the benefit gained from existing vegetation between the Site and the receptors experiencing glare.

AECOM further notes that glare mitigation at each OP and RR could be achieved by limiting the tilt angles of the arrays when the sun is extremely low in the sky.

Table 4 Summary of glare mitigation strategies

Observation Point/Route Receptor	Glare Hazard	Time of Day	Existing Mitigation	Suggested Mitigation
OP 1	**Yellow** Glare with potential for after image	For up to 15 minutes between 5:00AM – 6:00AM from November to early-February	Limited existing vegetation	Assess the effectiveness of existing vegetation and consider additional screening vegetation along the northern and western borders of the Site if appropriate.
OP 2	**Yellow** Glare with potential for after image	For up to 20 minutes between 5:30AM – 8:00AM from March to early-October	Existing vegetation	Assess the effectiveness of existing vegetation and consider additional screening vegetation along the southern border of the Site if appropriate.
OP 4	**Yellow** Glare with potential for after image	For up to 10 minutes between 5:00PM – 5:30PM from mid-May to late-July	Existing vegetation	Assess the effectiveness of existing vegetation and consider additional screening vegetation along the southern and eastern borders of the Site if appropriate.
OP 5	**Yellow** Glare with potential for after image	For up to 15 minutes between 5:00PM – 6:00PM from May to mid-August	Existing vegetation	Assess the effectiveness of existing vegetation and consider additional screening vegetation along the southern and eastern borders of the Site if appropriate.
OP 6	**Yellow** Glare with potential for after image	For up to 30 minutes between 4:30PM – 7:30PM depending on the time of year	Limited existing vegetation	Assess the effectiveness of existing vegetation and consider additional screening vegetation along the eastern border of the Site if appropriate.
OP 7	**Yellow** Glare with potential for after image	For up to 70 minutes between 5:00PM – 7:30PM depending on the time of year	Limited existing vegetation	Assess the effectiveness of existing vegetation and consider additional screening vegetation along the eastern border of the Site if appropriate.

Observation Point/Route Receptor	Glare Hazard	Time of Day	Existing Mitigation	Suggested Mitigation
OP 9	**Yellow** Glare with potential for after image	For up to 5 minutes between 5:00AM – 5:30AM in December	None	Consider additional screening vegetation along the northern border of the Site if appropriate.
OP 10	**Yellow** Glare with potential for after image	For up to 20 minutes between 6:00PM – 7:30PM from mid-October to late-February	Existing vegetation	Assess the effectiveness of existing vegetation and consider additional screening vegetation along the northern and eastern borders of the Site if appropriate.
OP 11	**Yellow** Glare with potential for after image	For up to 10 minutes between 7:00PM – 7:30PM from late-November to late-January	Existing vegetation	Assess the effectiveness of existing vegetation and consider additional screening vegetation along the northern and eastern borders of the Site if appropriate.
OP 14	**Yellow** Glare with potential for after image	For up to 20 minutes between 4:30PM – 7:00PM from March to mid-October	Existing vegetation	Assess the effectiveness of existing vegetation and consider additional screening vegetation along the eastern border of the Site if appropriate.
Landwehr Road	**Yellow** Glare with potential for after image	For up to 150 minutes between 3:00PM – 7:30PM depending on the time of year	None	Consider additional screening vegetation along the eastern and northern borders of the Site if appropriate.
Route 4	**Yellow** Glare with potential for after image	For up to 5 minutes between 6:00AM – 7:30AM from April to late-August	Existing vegetation	None
Route 5	**Yellow** Glare with potential for after image	For up to 45 minutes between 5:00AM – 6:30AM and up to 45 minutes between 6:00PM – 7:30PM from mid-September to mid-March	None	Consider additional screening vegetation along the northern border of the Site if appropriate.
Route 7	**Yellow** Glare with potential for after image	For up to 15 minutes between 6:00AM – 7:00AM in late-March to early-April and in September	Limited existing vegetation	Consider additional screening vegetation along the northern and western borders of the Site if appropriate.

7.0 Conclusions

The results of the glare hazard analysis identified that for Waroona Solar Farm, glare with moderate potential for after image is predicted to be experienced by several OPs as a result of the array configuration outlined in this report. No modelled flight paths experience any glare. Existing mitigation measures and proposed measures to further reduce glare were discussed for observation points and route receptors identified to be potentially affected by moderate potential hazard glare. These mitigation strategies include planting additional vegetation along the border of the development area.

The glare model developed for the Project assumes the solar arrays are installed within the development area shown in Figure 2, and the entire development area is considered a potential glare source. The model includes conservative assumptions (i.e. a high irradiance) and does not consider any existing vegetation, buildings or topographical features that may exist between the solar panel arrays and the observation points.

The GlareGauge model is unable to accurately account for the backtracking operation of the tracker. The software is able to run a simplified model of backtracking, whereby the panels are modelled to revert to a pre-determined resting angle when the angle of the sun is outside of the tracking range. This resting angle was set at 0° to maintain conservativeness.

Appendix A

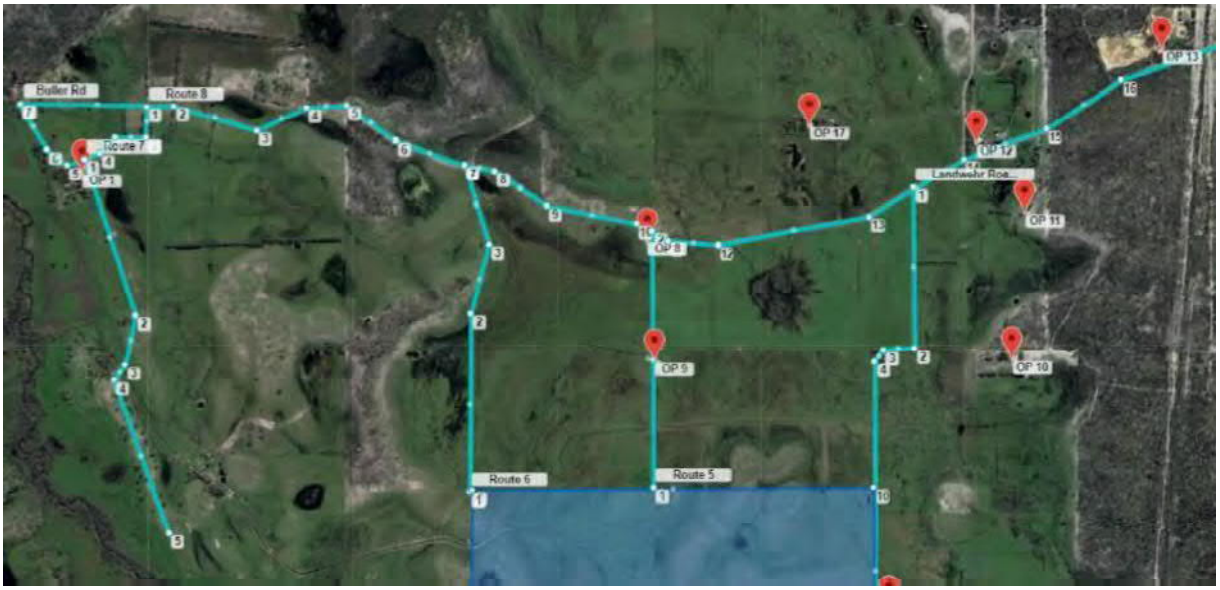
Discussion of Results

Appendix A Discussion of Results

Glare occurring north of Site boundary

The GlareGauge results show that multiple OPs and RRs located to the north of the Site will experience glare at various times throughout the year. Visual screening may be employed to minimise the glare experienced at these locations by installing fencing or mesh screens, or by planting additional vegetation along the array border. It is recommended that the existing vegetation between the northern array boundary and OP1, OP9, OP10, OP11, Landwehr Road, Route 5 and Route 7 be investigated for the effectiveness of screening the sources of glare. Where the screening is insufficient to mitigate the glare, additional screening measures should be implemented.

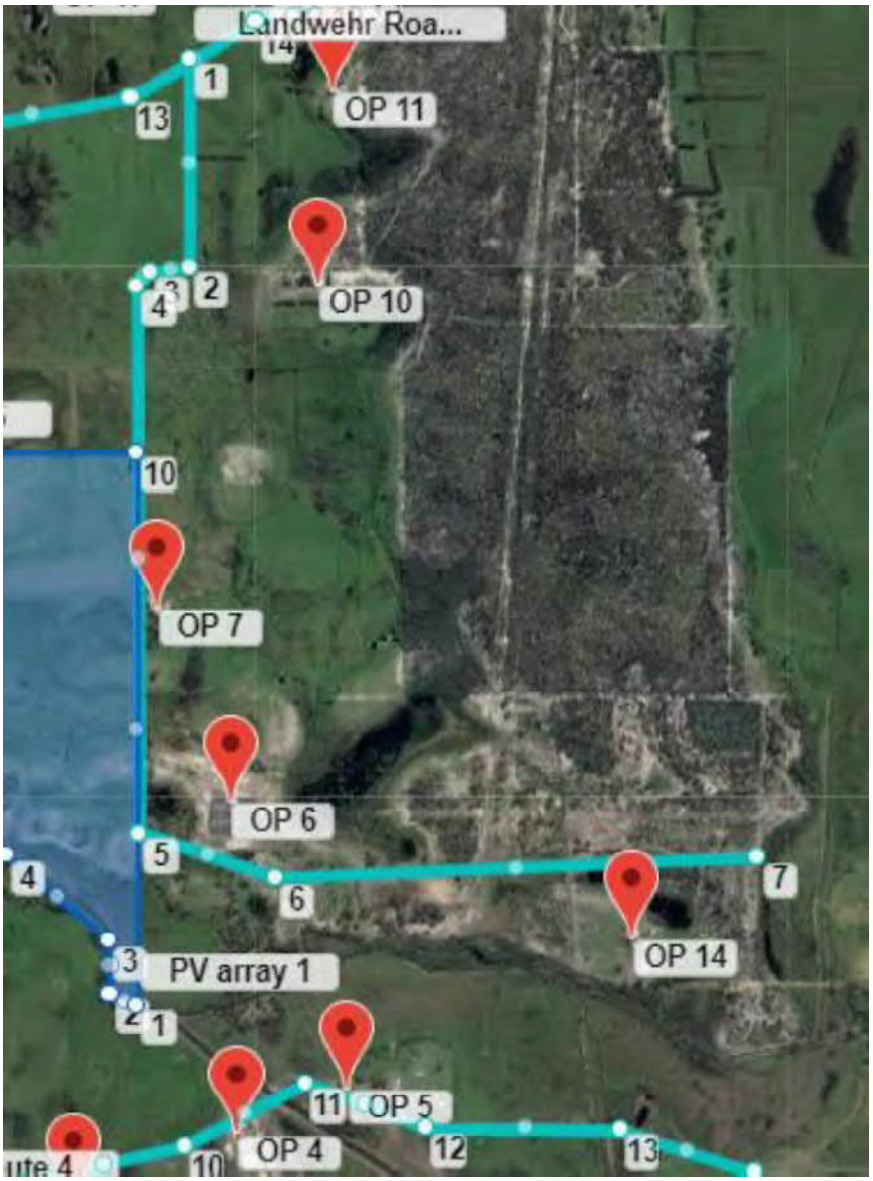
Figure 5 Waroona Solar Farm northern site boundary



Glare occurring east of Site boundary

The GlareGauge results show that multiple OPs and RRs located to the east of the Site will experience glare at various times throughout the year. As previously mentioned, visual screening may be employed to minimise the glare experienced at these locations by installing fencing or mesh screens, or by planting additional vegetation along the array border. It is recommended that the existing vegetation between the eastern array boundary and OP4, OP5, OP6, OP7, OP10, OP11, OP14 and Landwehr Road be investigated for the effectiveness of screening the sources of glare. Where the screening is insufficient to mitigate the glare, additional screening measures should be implemented.

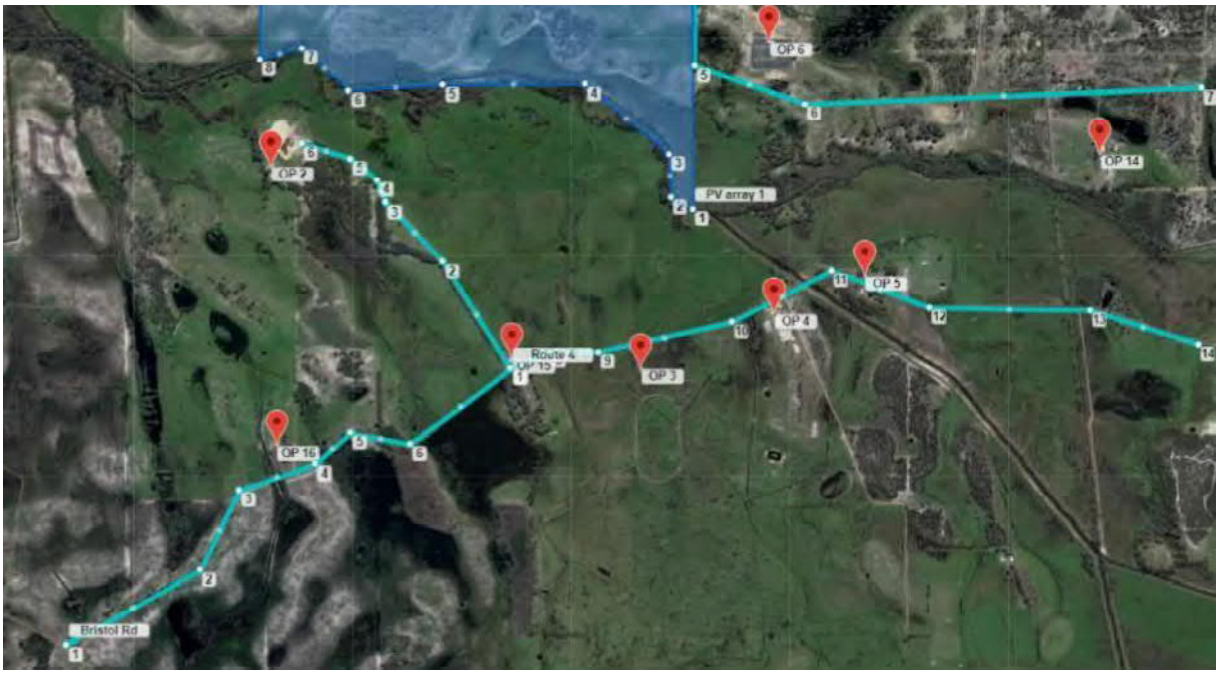
Figure 6 Waroona Solar Farm eastern site boundary



Glare occurring south of Site boundary

The GlareGauge results show that multiple OPs and RRs located to the south of the Site will experience glare at various times throughout the year. As previously mentioned, visual screening may be employed to minimise the glare experienced at these locations by installing fencing or mesh screens, or by planting additional vegetation along the array border. It is recommended that the existing vegetation between the southern array boundary and OPs 2, 4 and 5 be investigated for the effectiveness of screening the sources of glare. Where the screening is insufficient to mitigate the glare, additional screening measures should be implemented.

Figure 7 Waroona Solar Farm southern site boundary



Glare occurring west of Site boundary

The GlareGauge results show that multiple OPs and RRs located to the west of the Site will experience glare at various times throughout the year. As previously mentioned, visual screening may be employed to minimise the glare experienced at these locations by installing fencing or mesh screens, or by planting additional vegetation along the array border. It is recommended that the existing vegetation between the western array boundary and OP 1 and Route 7 be investigated for the effectiveness of screening the sources of glare. Where the screening is insufficient to mitigate the glare, additional screening measures should be implemented.

Figure 8 Waroona Solar Farm western site boundary