BIODIVERSITY MANAGEMENT PLAN

Wollar Solar Farm

June 2020

Project Number: 20-070

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TABLE OF CONTENTS

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

AC	Alternating Current
AS	Australian Standard
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BCD	*Biodiversity Conservation Division (part of DPIE)*
Biosecurity Act	*Biosecurity Act 2015* (NSW)
BMP	Biodiversity Management Plan
CCP	Community Consultation Plan
CEEC	Critically Endangered Ecological Community
CoC	Conditions of Consent
Cwth	Commonwealth
DECCW	Refer to OEH
DPIE	(NSW) Department of Planning, Industry and Environment (incorporates BCD formerly known as OEH)
EEC	Endangered ecological community – as defined under relevant law applying to the proposal
EIS	Environmental Impact Statement
EMS	Environmental Management Strategy
EPC	Engineering, Procurement' and Construction
EPBC Act	(Cwth) *Environment Protection and Biodiversity Conservation Act 1999*
EP&A Act	(NSW) *Environmental Planning and Assessment Act 1979*
ESCP	Erosion and Sediment Control Plan
EWMS	Environmental Work Method Statements
FM Act	(NSW) *Fisheries Management Act 1994*
GCMP	Groundcover Management Plan
ha	hectares
HBT	Hollow Bearing Tree
HSEQ	Health, Safety, Environment and Quality Control
km	kilometres
kV	kilovolt
LEP	Local Environment Plan
LGA	Local Government Area

m	Metres
MW	Megawatt
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
NSW	New South Wales
OEH	(NSW) Office of Environment and Heritage, formerly Department of Environment, Climate Change and Water
PCT	Plant Community Type
PV	photovoltaic
SSD	State Significant Development
TARP	Trigger, Action Response Plan
TEC	Threatened Ecological Community
TIA	Traffic Impact Assessment

1. INTRODUCTION

1.1. PURPOSE AND OBJECTIVES

Wollar Solar Farm received planning approval on 24 February 2020 for the construction and operation of a 290-megawatt (MW) capacity alternating current (AC) photovoltaic (PV) solar farm. The Wollar Solar Farm proposal would be located on a rural property approximately 7 kilometres (km) south of Wollar village.

This Biodiversity Management Plan (BMP) has been prepared to address the requirements of the mitigation and management measures listed in the *Wollar Solar Farm Environmental Impact Statement* (EIS) (NGH Environmental, 2019), Submissions Report (NGH Environmental, 2020), the Amendment Report (NGH Environmental, 2019) and the Conditions of Consent (CoC) from the New South Wales, Minister for Planning. Additionally, it considers legislation, policies and guidelines applicable to biodiversity management.

The BMP has been prepared using the *Draft Post Approval Guideline for Environmental Management Plans* (DPE 2018) as a guide in its preparation.

The purpose of this BMP is to provide a framework for the management of biodiversity issues during all stages of construction and operation of the project. Some management measures are only applicable during the construction period, while others continue throughout operation, as summarised in Table 1-1.

Table 1-1 Timeframe of environmental management measures.

Construction	Operation
Ground disturbance	N/A
Vegetation clearance	N/A
Re-use of resources protocol	N/A
Unplanned Threatened Species Finds	
Weed and Pest Management	
Vehicle Hygiene	
Vegetation Constraint Management	
Groundcover Management	

Implementing this BMP will ensure that the Project Team meets the project requirements in a systematic manner and continually improves its performance.

This draft was provided to the Biodiversity Conservation Division (BCD for review on the 25/05/2020. Their comments were addressed including clear quantitative performance criteria and weed cover targets. The NSW Department of Planning, Industry and Environment (DPIE) approved this BMP XX/XX/XXXX

1.2. THE PROJECT

The scope of works under the contract includes all works necessary to design, construct, test, commission, energise, decommission, and train staff in the operation of an up to 290 MW AC solar farm as well as road upgrades identified in Appendix 4 of the CoC. The general layout of the development is shown in Figure 1-1.

The construction period of the solar farm will last for 12 to 18 months from the commencement of site establishment work. Construction hours will be limited to Monday to Friday 7am to 6pm, and Saturday 8am to 1pm. Night works are not anticipated to occur.

1.2.1. Development Staging

The Development will be staged, with public road upgrades as described by CoC Schedule 3 Condition 8 (refer to table 2-3 of the EMS), to occur as Stage 1 prior to any construction being undertaken for the Solar Farm and the primary access of Barigan Road. The stages are defined as follows:

1. Stage 1 – Road upgrades/maintenance works on Barigan Road as required for the Northern Access.
2. Stage 2 – Construction of the Northern Access between Barigan Road and the Solar Farm site.
3. Stage 3 – Construction of the main Solar Farm including establishment of internal access tracks, excavated concrete footings for inverters, buildings and switch station, pile-driven solar module mounts, solar panels, substation and any ancillary infrastructure.
4. Stage 4 - Road upgrades/maintenance works on Barigan Road, south of the Northern Access, and Maree Road, as required for the Southern Access Option. Note that this stage may not be required to be undertaken for the project.

The stages are shown in Figure 1-2.

This BMP applies to stages 1, 2 and 3 of construction and also stage 4 should it be undertaken.

Specific to Stage 1, prior to construction, widening would be undertaken along Barigan Road in accordance with the swept path assessment and access design provided in the Addendum Traffic Impact Assessment (TIA) (Amber, 2019). Sealing of Barigan Road in areas proposed for heavy vehicle use during construction and widening would be undertaken along Barigan Road in accordance with the swept path assessment and access design providing in the Addendum TIA will be undertaken.

Upon completion of the public road upgrades, the roads will be operated and maintained by Mid-Western Regional Council.

Specific to Stages 2-4, work is expected to be undertaken by an EPC contractor (contractor yet to be appointed at time of writing this BMP).

1.2.2. Contracting Structure

The Wollar Solar Farm will be delivered through the following contracts:

1. Contract between WSD and MWRC or a reputable civil company for upgrades to Barigan Road in accordance with CoC Schedule 3 Condition 8 (the Public Road Upgrade Contract) (Stage 1). Expected award May 2020.
2. Contract between WSD and Transgrid for construction of an on-site 33/330kV substation and connection of that substation to the existing electricity network (Stage 3).
3. Contract between WSD and an EPC Contractor for the remainder of the works, including the design and construction of the solar array (the EPC Contract) (Stage 3). Expected Award August 2020.

Stage 2 works, being the construction of the Northern Access Track, will either be undertaken by Transgrid or the EPC Contractor.

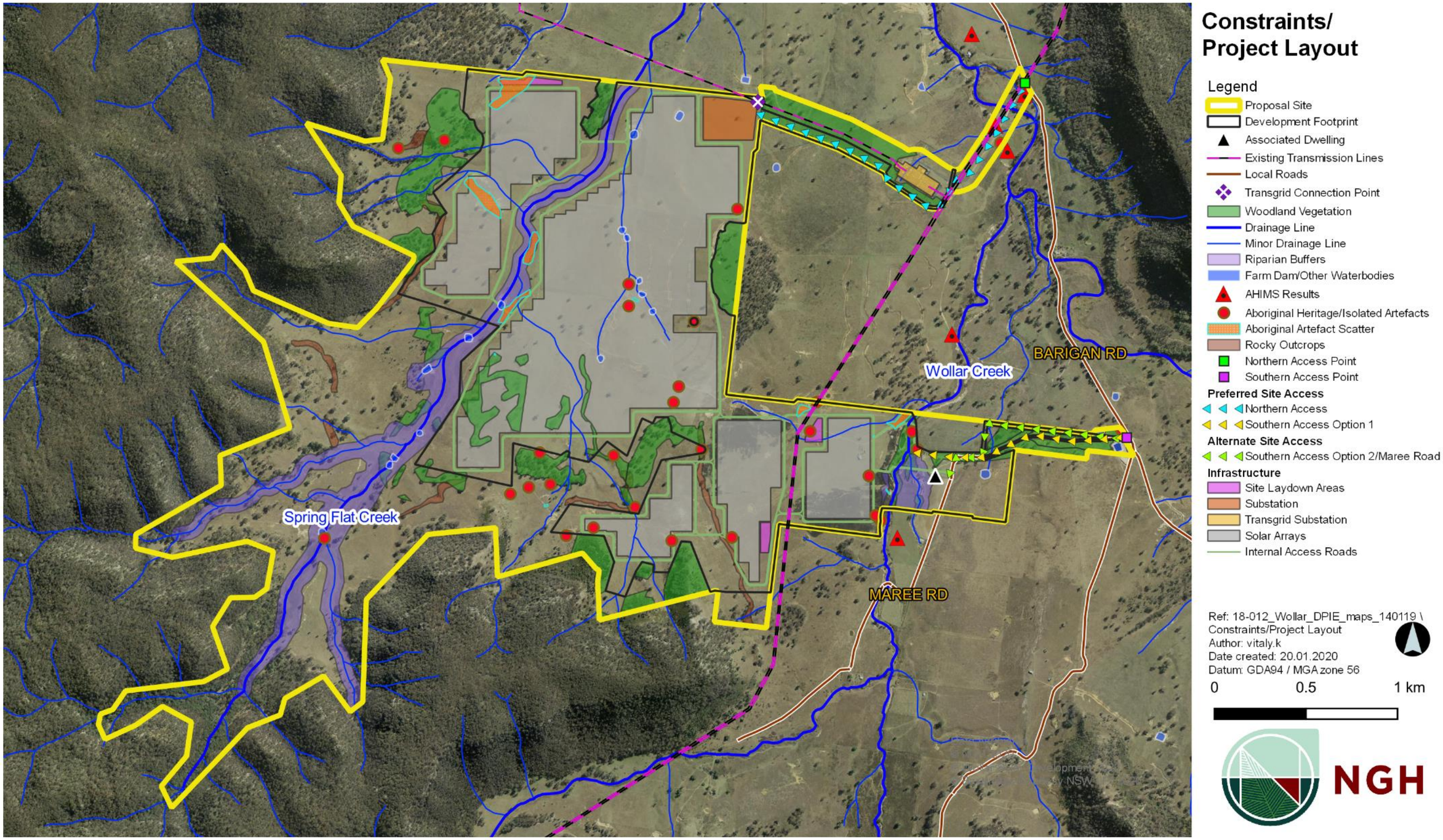
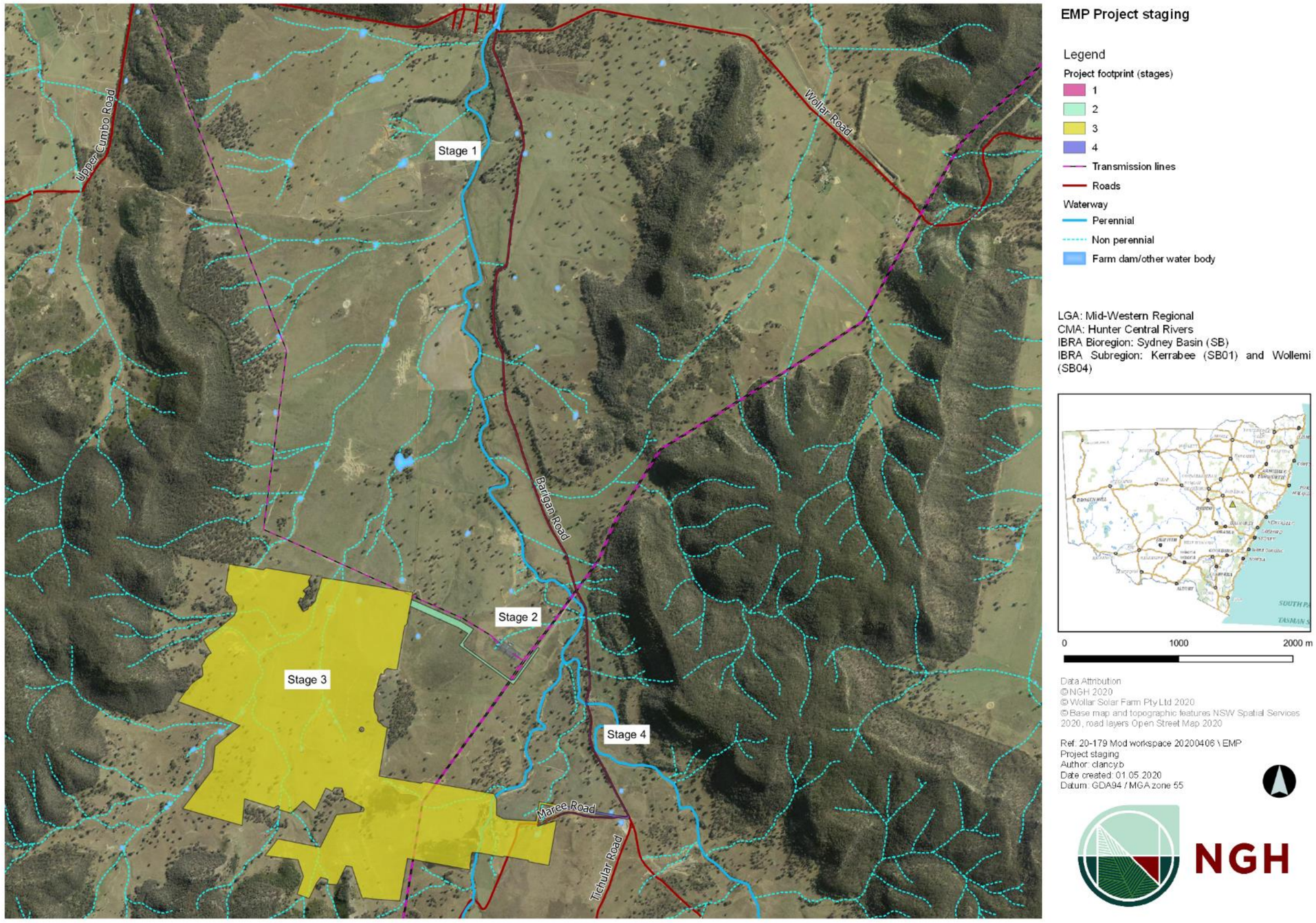


Figure 1-1 General layout of development



EMP Project staging

Legend

Project footprint (stages)
- 1
- 2
- 3
- 4

Transmission lines

Roads

Waterway
- Perennial
- Non perennial

Farm dam/other water body

LGA: Mid-Western Regional
CMA: Hunter Central Rivers
IBRA Bioregion: Sydney Basin (SB)
IBRA Subregion: Kerrabee (SB01) and Wollemi (SB04)

0 1000 2000 m

Ref: 20-179 Mod workspace 20200408 \ EMP
Project staging
Author: clancy.b
Date created: 01.05.2020
Datum: GDA94 / MGA zone 55

NGH

Figure 1-2 Project Stages: 1-4

1.3. ENVIRONMENTAL MANAGEMENT SYSTEMS OVERVIEW

The BMP is part of the Project's overall Environmental Management Strategy (EMS). Mitigation and management measures identified in this BMP will be incorporated into the relevant plans and documentation of the contractors undertaking Works on site.

1.4. ENVIRONMENTAL POLICY

A copy of the Proponent's Environmental Policy is provided in the EMS.

1.5. CONTINUAL IMPROVEMENT

Management reviews are undertaken as part of the continual improvement process. The review process will be detailed in the EMS.

Continual improvement requires ongoing communication through multiple channels, as discussed in Section 10.1. Environmental management documents will undertake a continual improvement process.

1.6. CONSULTATION

Consultation was undertaken with the NSW Biodiversity Conservation Division (BCD, formerly the Office of Environment and Heritage). The draft BMP was provided for comment on the 25/05/2020. It is noted that this BMP addresses points raised by BCD for Wellington Solar Farm BMP, in order to ensure that BCD expectations are met as much as possible, for this utility scale solar farm located in the same region.

1.7. BIODIVERSITY CONSTRAINTS

As shown in Figure 1-3 and Figure 1-4, the Biodiversity Assessment Report (BDAR) describes the biodiversity constraints of the development. These constraints have been separated into those associated with the road upgrades (stage 1) and the construction of the Solar Farm (stages 2 and 3).

Stage 1

The Bush Stone-Curlew, Gang-gang Cockatoo, Barking Owl, Powerful Owl, Squirrel Glider, Brush-tailed Phascogale, Masked Owl, Koala and Large-eared Pied Bat are assumed to be present along Barigan Road[1].

Along the Barigan Road reserve, presence was also assumed for *Acacia ausfeldii, Commersonia procumbens, Monotaxis macrophylla.*

Stages 2 & 3

Parts of the Solar Farm site contains preliminary 'Important mapped areas for the Regent Honeyeater'. The Regent Honeyeater is discussed further in section 3.3.1.

Stages 1, 2 and 3 would impact 229.58 ha of remnant White Box – Yellow Box – Blakely's Red Gum Grassy Woodland (Box-gum woodland and derived native grassland) which is a TEC listed under the BC (vegetation zones 1, 2, 3, 5 and 6) and EPBC (vegetation zones 1, 2, 5 and 6) Acts.

[1] As project timing precluded appropriate seasonal survey, these species were assumed to occur and currently generate an offset, as such.

Two 4th order stream under the Strahler System (Wollar Creek and Spring Flat Creek) are present within the area of the development footprint associated with Stage 3. A 40m buffer will be applied to protect the associated riparian vegetation.

Stage 4

Consideration of stage 4 of road upgrades along Maree Road are assumed to impact up to 24.59 ha of high diversity structural Box Gum Woodland TEC listed under the BC (vegetation zone 5) and EPBC (vegetation zone 5) Acts.

The Stage 4 upgrades would include the upgrade of a causeway crossing over Wollar Creek This would impact the riparian zone around Wollar Creek.

1.7.1. Hollow Bearing Trees

Table 1-2 breaks down the hollow bearing trees with potential to be utilised by various threatened species that will be impacted by the proposal by stage.

Table 1-2 Hollow Bearing trees impacted by proposal

Stage	Number of HBTs to be impacted
Stage 1	34
Stage 2	0
Stage 3	9
Stage 4	22

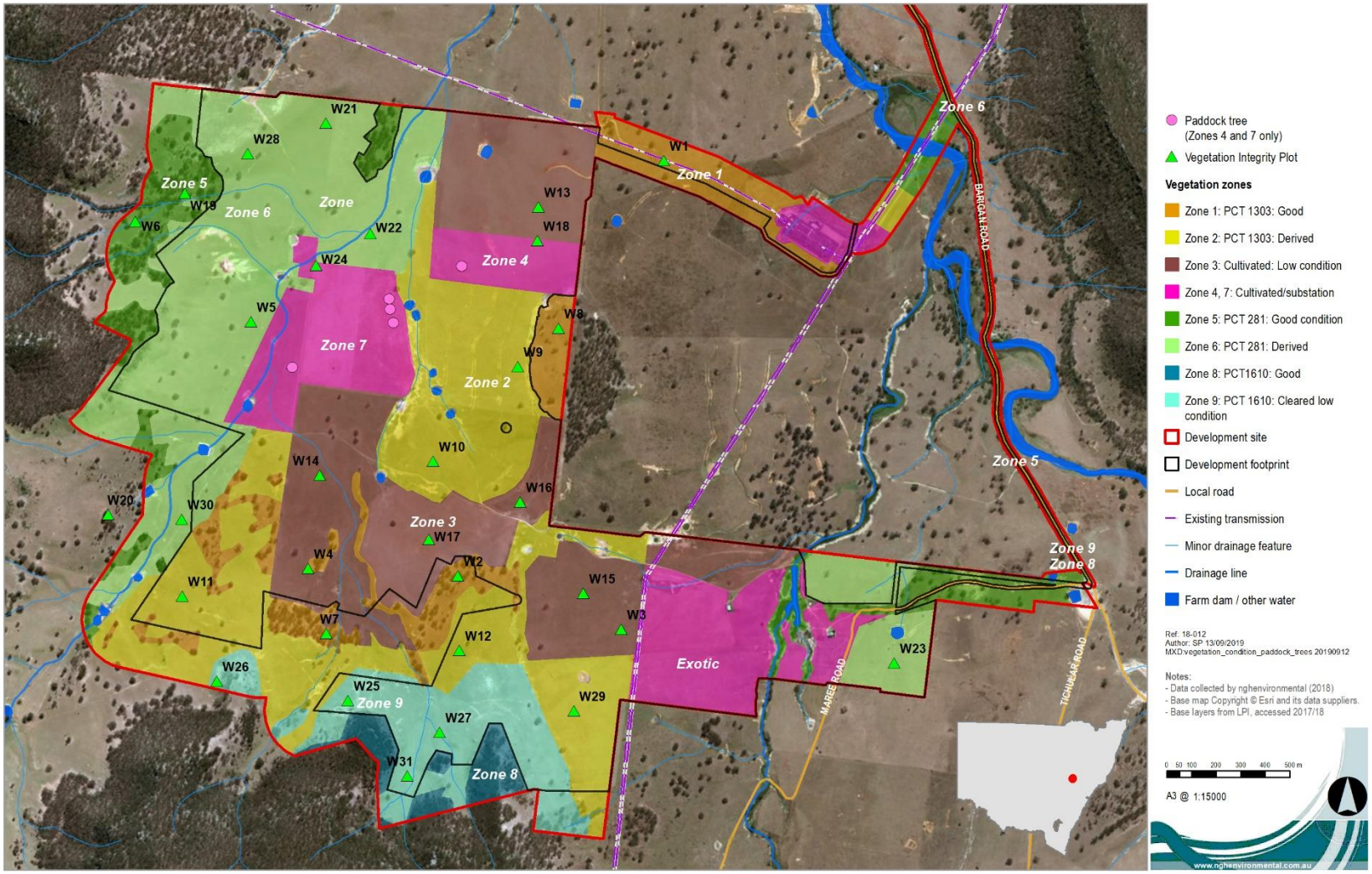


Figure 1-3 Site map 1 showing biodiversity PCTs

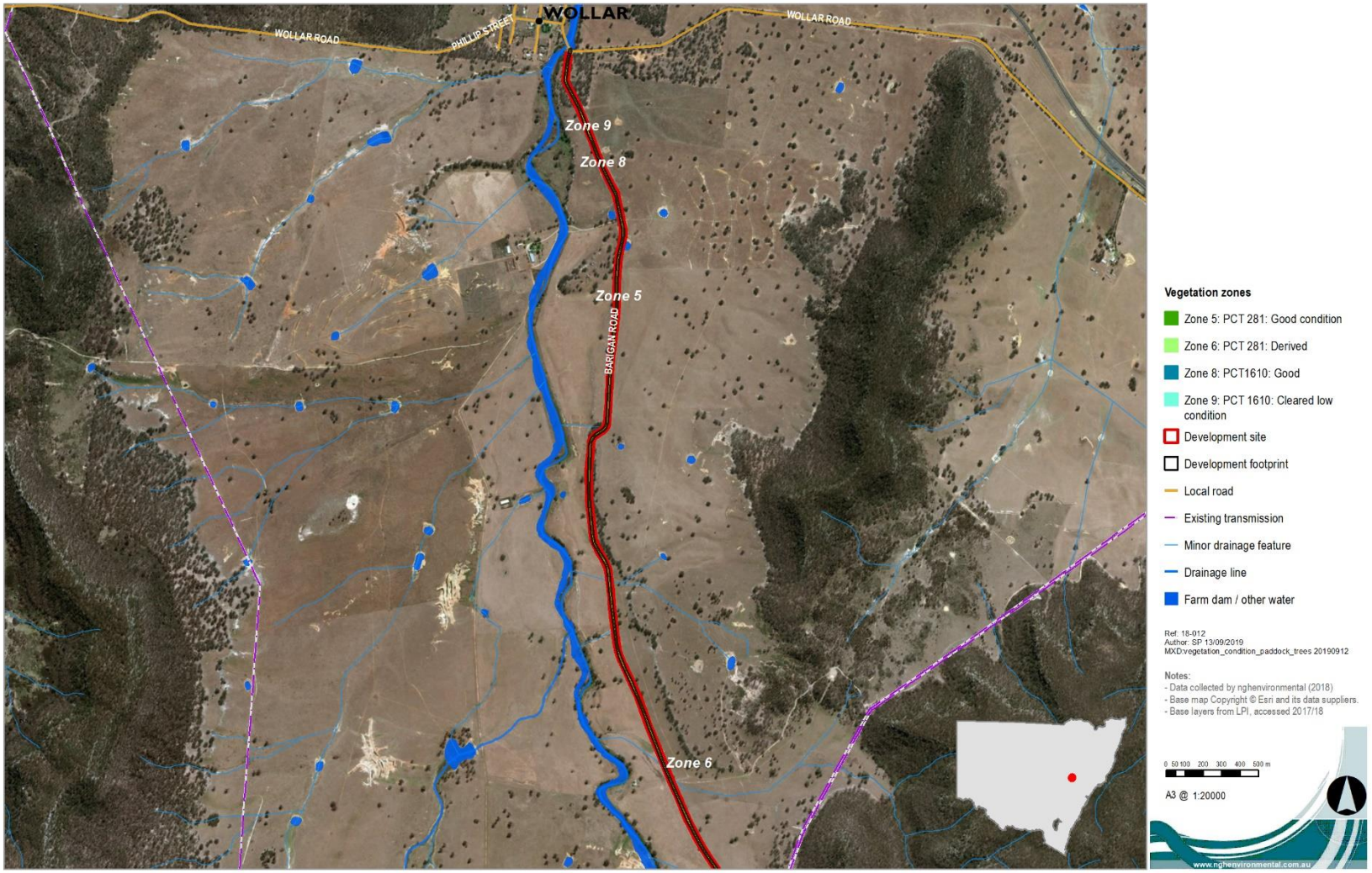


Figure 1-4 Site map 2 showing biodiversity PCTs

2. PLANNING

2.1. LEGISLATIVE AND OTHER ENVIRONMENTAL MANAGEMENT REQUIREMENTS

2.1.1. Legislation

Legislation relevant to biodiversity management includes:

- *Environmental Planning and Assessment Act 1979* (EP&A Act).
- *National Parks and Wildlife Act 1974* (NPW Act).
- *Biodiversity Conservation Act 2016* (BC Act).
- *Protection of the Environment Operations Act 1997* (POEO Act).
- *Fisheries Management Act 1994* (FM Act).
- *Biosecurity Act 2015.*
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Relevant provisions of the above legislation are explained in the register of legal and other requirements included in Appendix C of the EMS.

2.1.2. Guidelines and Standards

The main guidelines, specifications and policy documents relevant to this BMP include:

- NSW National Parks & Wildlife Service. 2001. *Policy for the Translocation of Threatened Fauna in NSW: Policy and Procedure Statement No. 9* Threatened Species Unit, Hurstville NSW.
- Relevant recovery plans, priority action statements and best practice guidelines.
- DECCW. 2008. Hygiene protocol for the control of disease in frogs.
- Australian Standard AS 4373 Pruning of Amenity Trees.
- Australian Standard AS 4970 – 2009 Protection of Trees.

2.1.3. Environmental Registers

A sample of typical registers required for the Project is contained in Appendix A The registers are maintained as checklists. The registers will be reviewed at regular intervals e.g. during management reviews and updated with any applicable changes. Any changes made to the registers will be communicated to the wider team where necessary through toolbox talks, specific training and other methods detailed in Section 9.2.

2.1.4. Conditions of Consent and Compliance Tracking

Preparation of a BMP, prior to the commencement of the development is a requirement of Schedule 3, condition 14 of the CoC.

14. Prior to commencing the development, the Applicant must prepare a Biodiversity Management Plan for the development in consultation with BCD, and to the satisfaction of the Secretary in writing. This plan must:

a) include a description of the measures that would be implemented for:
   - *protecting vegetation and fauna habitat outside the approved disturbance areas;*
   - *managing the remnant vegetation and fauna habitat on site;*

- *minimising clearing and avoiding unnecessary disturbance of vegetation that is associated with the construction and operation of the development;*
- *minimising the impacts to fauna on site and implementing fauna management protocols;*
- *avoiding the removal of hollow-bearing trees during spring to avoid the main breeding period for hollow-dependent fauna;*
- *rehabilitating and revegetating temporary disturbance areas with species that are endemic to the area;*
- *maximising the salvage of vegetative and soil resources within the approved disturbance area for beneficial reuse in the enhancement or the rehabilitation of the site; and*
- *controlling weeds, feral pests and pathogens; and*

b) *include details of who would be responsible for monitoring, reviewing and implementing the plan, and timeframes for completion of actions.*

Following the Secretary's approval, the Applicant must implement the Biodiversity Management Plan.

Note: If the biodiversity credits are retired via a Biodiversity Stewardship Agreement, then the Biodiversity Management Plan does not need to include any of the matters that are covered under the Biodiversity Stewardship Agreement.

This BMP meets this requirement.

Each of the requirements of the biodiversity conditions as well as commitments from the EIS, Submissions Report and Amendment Report and where they are addressed are detailed in Table 2-1 and Table 2-2 below.

Table 2-1 Compliance requirements from the CoC and where they are addressed in this plan.

Condition requirement (CoC)	Report/Section	Stage	When to implement	Responsibility
Land Management				
Schedule 3 condition 11 The Applicant must maintain the agricultural land capability of the site, including: (a) establishing the ground cover of the site within 3 months following completion of any construction or upgrading; (b) properly maintaining the ground cover with appropriate perennial species and weed management; and maintaining grazing within the development footprint, where practicable, unless the Secretary agrees otherwise in writing.	Appendix A	Stage 3	Construction Operation	Proponent and all Contractors
Vegetation Clearance				
Schedule 3 condition 12 The Applicant must not clear any native vegetation or fauna habitat located outside the approved disturbance areas described in the EIS.	Section 1.1 Section 7.1 Section 7.2	Stage 1 Stage 2 Stage 3 Stage 4	Pre-construction Construction	Proponent and all Contractors
Biodiversity Offsets				
Schedule 3 condition 13 Prior to commencing development under this consent, the Applicant must retire biodiversity credits of a number and class specified in Table 1 and Table 2 below, to the satisfaction of BCD, unless the Secretary agrees otherwise in writing. The retirement of these credits must be carried out in accordance with the *NSW Biodiversity Offsets Scheme* and can be achieved by:	Section 10.2	Stage 1 Stage 2 Stage 3 Stage 4	Pre-construction	Proponent

<table>
<tr><th>Condition requirement (CoC)</th><th>Report/Section</th><th>Stage</th><th>When to implement</th><th>Responsibility</th></tr>
<tr><td>
c) acquiring or retiring ‘biodiversity credits’ within the meaning of the *Biodiversity Conservation Act 2016;*
d) making payments into an offset fund that has been developed by the NSW Government; or
e) funding a biodiversity conservation action that benefits the entity impacted and is listed in the ancillary rules of the biodiversity offset scheme.

Table 1: Ecosystem Credit Requirements
<table>
<tr><th>***Vegetation Community***</th><th>***PCT ID***</th><th>***Credits Required***</th></tr>
<tr><td>White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion</td><td>1303</td><td>469</td></tr>
<tr><td>Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion</td><td>281</td><td>242</td></tr>
<tr><td>White Box - Black Cypress Pine shrubby woodland of the Western Slopes</td><td>1610</td><td>2</td></tr>
</table>

Table 2: Species Credit Requirements
<table>
<tr><th>***Species Credit Species***</th><th>***Credits Required***</th></tr>
<tr><td>Austfeld’s Wattle (*Acacia ausfeldii*)</td><td>34</td></tr>
<tr><td>Bush Stone-curlew (*Burhinus grallarius*)</td><td>34</td></tr>
<tr><td>Gang-gang Cockatoo (*Callocephalon fimbriatum*)</td><td>182</td></tr>
<tr><td>Large-eared Pied Bat (*Chalinolobus dwyeri*)</td><td>50</td></tr>
<tr><td>*Commersonia procumbens*</td><td>2</td></tr>
<tr><td>Large-leafed Monotaxis</td><td>34</td></tr>
</table>
</td><td></td><td></td><td></td><td></td></tr>
</table>

Condition requirement (CoC)	Report/Section	Stage	When to implement	Responsibility
(*Monotaxis macrophylla*)				
Barking Owl (*Ninox connivens*) 36 Powerful Owl (*Ninox strenua*) 36 Squirrel Glider (*Petaurus norfolcensis*) 34 Brush-tailed Phascogale (*Phascogale tapoatafa*) 32 Koala (*Phascolarctos cinereus*) 34 Masked Owl (*Tyto novaehollandiae*) 36 Note: Any residual impact on EPBC Act listed threatened species and ecological communities must be offset in accordance with an offset process endorsed by DAWE.				
Biodiversity Management Plan				
Schedule 3 condition 14 Prior to commencing the development, the Applicant must prepare a Biodiversity Management Plan for the development in consultation with BCD, and to the satisfaction of the Secretary in writing. This plan must: a) include a description of the measures that would be implemented for: i. protecting vegetation and fauna habitat outside the approved disturbance areas; *ii.* managing the remnant vegetation and fauna habitat on site; iii. minimising clearing and avoiding unnecessary disturbance of vegetation that is associated with the construction and operation of the development; iv. minimising the impacts to fauna on site and implementing fauna management protocols;	General - Sections 1.1, 5.1, 7, 8, and 9 Point (a) (i) - Section 7.7 Point (a) (ii) - Sections 7.5, 7.6, 7.7, 8 and 9 Point (a) (iii) - Sections 7.2.1, 7.2.2 and 7.2.4 Point (a) (iv) - Section 7.4	Stage 1 Stage 2 Stage 3 Stage 4	Pre-construction (prepare plan) Construction (implement plan) Operation (implement plan)	Proponent for preparation of the plan. All contractors for adhering to the plan.

Condition requirement (CoC)	Report/Section	Stage	When to implement	Responsibility
v. avoiding the removal of hollow-bearing trees during spring to avoid the main breeding period for hollow-dependent fauna; vi. rehabilitating and revegetating temporary disturbance areas with species that are endemic to the area; vii. maximising the salvage of vegetative and soil resources within the approved disturbance area for beneficial reuse in the enhancement or the rehabilitation of the site; and viii. controlling weeds, feral pests and pathogens; and b) include details of who would be responsible for monitoring, reviewing and implementing the plan, and timeframes for completion of actions. Following the Secretary's approval, the Applicant must implement the Biodiversity Management Plan. *Note: If the biodiversity credits are retired via a Biodiversity Stewardship Agreement, then the Biodiversity Management Plan does not need to include any of the matters that are covered under the Biodiversity Stewardship Agreement.*	Point (a) (v) - Sections 7.2.3 and 7.2.6 Point (a) (vi) - Appendix A Point (a) (vii) - Section 7.3) Point (a) (viii) - Section 7.5 Point (b) - Section 9			

Table 2-2 Compliance requirements from the EIS, Submissions Report and Amendment Report and where they are addressed in this plan

Condition requirement	Report/Section	Stage	Responsibility	Report
Biodiversity				
• Hollow-bearing trees would not be removed during breeding season (spring to summer) for threatened hollow dependant fauna. • If clearing outside of this period cannot be achieved, pre-clearing surveys would be undertaken to ensure no impacts to fauna would occur	Section 7.2.2, Section 7.2.6	Stage 1 Stage 2 Stage 3 Stage 4	Proponent and all Contractors	EIS section 7.1.5

Condition requirement	Report/Section	Stage	Responsibility	Report
A tree clearing procedure would be implemented to minimise harm to resident fauna.	Section 7.2	Stage 1 Stage 2 Stage 3 Stage 4	Proponent and all Contractors	EIS section 7.1.5
Procedure for relocation of habitat features to adjacent area for habitat enhancement would be implemented.	Section 7.3	Stage 1 Stage 2 Stage 3 Stage 4	Proponent and all Contractors	EIS section 7.1.5
• Approved clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing. • No stockpiling or storage within dripline of any mature trees. • Access and laydown in areas of Box-Gum Woodland TEC will be minimised to reduce impacts. • Exclusion fencing and signage or similar would be installed around habitat to be retained.	Section 5.1	Stage 1 Stage 2 Stage 3 Stage 4	Proponent will ensure all Contractors meet requirements	EIS section 7.1.5
• Avoid Night Works where possible • Direct lights away from vegetation	Section 5.1	Stage 1/ Stage 2 Stage 3 Stage 4	Proponent will ensure all Contractors meet requirements	EIS section 7.1.5
A Weed Management procedure would be developed for the proposal to prevent and minimise the spread of weeds. This would include: • Management protocol for declared priority weeds under the Biosecurity Act 2015 during and after construction • Weed hygiene protocol in relation to plant, machinery, and fill • Any occurrences of pathogens such as Myrtle Rust and Phytophthora would be monitored, treated, and reported.	Section 7.5	Stage 1 Stage 2 Stage 3 Stage 4	Proponent will ensure all Contractors develop and implement Weed Management procedure and meet this requirement	EIS section 7.1.5

Condition requirement	Report/Section	Stage	Responsibility	Report
• The weed management procedure would be incorporated into the Biodiversity Management Plan.				
Site induction and toolbox talks for ecologically sensitive areas would be undertaken.	Section 9.2	Stage 1 Stage 2 Stage 3 Stage 4	Proponent will ensure all Contractors meet requirements	EIS section 7.1.5
• Awareness training during site inductions regarding enforcing site speed limits. • Site speed limits to be enforced to minimise fauna strike.	Section 9.2	Stage 1 Stage 2 Stage 3 Stage 4	Proponent will ensure all Contractors meet requirements	EIS section 7.1.5
Dust management would be implemented as follows: • Daily monitoring of dust generated by construction activities • Construction would cease if dust observed being blown from site until control measures were implemented • All activities relating to the proposal would be undertaken with the objective of preventing visible dust emissions from the development site	Section 7.7.3	Stage 1 Stage 2 Stage 3 Stage 4	Proponent will ensure all Contractors monitor dust and meet requirements	EIS section 9.2
The Applicant must minimise the dust generated by the development.	Section 7.7.3	Stage 1 Stage 2 Stage 3 Stage 4	Proponent will ensure all Contractors meet requirements	EIS section 9.2
The two main tributaries (Wollar Creek and Spring Flat Creek) would not be altered by the proposal with the exception for the construction of crossings for the internal access roads and for the installation of underground cables. The design and construction of the waterway crossings would need to consider the requirements of the following publications:	Section 5.1, Section 7.7.4	Stage 3	Proponent will ensure all Contractors meet requirements	Section 8.2.2

Condition requirement	Report/Section	Stage	Responsibility	Report
• Why do fish need to cross the road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003). • Policy and Guidelines for Fish Friendly Waterway Crossings (NSW DPI, 2003). • Guidelines for Watercourse Crossings on Waterfront Land (NSW DPI, 2012). • Guidelines for Laying Pipes and Cable in Watercourses on Waterfront Land (NSW DPI, 2012). Given the waterway is categorised as a 4th order stream under the Strahler System, a 40m buffer would apply and crossings would need to be in the form of bridges or culverts.				

2.2. OBJECTIVES AND TARGETS

2.2.1. Objectives

Construction

The key objective of the BMP during construction is to ensure that the impacts of the project construction on biodiversity are managed and are within the scope permitted by the planning approval.

To achieve this objective, the Proponent will:

- Ensure appropriate controls and procedures are implemented during construction activities to avoid (where necessary) or minimise potential adverse impacts to biodiversity values in the footprint of the project (Figure 1-2)
- Ensure appropriate measures are implemented to address the mitigation measures detailed in the EIS, Amendment Report, Submissions Report, BDAR and CoCs.
- Ensure appropriate measures are implemented to comply with all relevant legislation and other requirements as described in Section 2.1 and Section 8 of this BMP.

Operation

The key objective of the BMP during operation is to ensure that the impacts of the project on biodiversity are managed and the condition of site biodiversity values maintained over the lifetime of the project.

To achieve this objective, the Proponent will:

- Ensure appropriate controls and procedures are maintained during operation to manage potential adverse impacts to biodiversity values in the footprint of the project
- Protect areas outside the project impact areas (but within the site boundaries).
- Ensure the project continues to comply with all relevant legislation and other requirements.

2.2.2. Targets

As a means of assessing environmental performance during construction of the Project, environmental objectives and targets have been established. These objectives and targets have been developed with consideration of key issues identified through the environmental assessment and risk assessment process.

The targets are incorporated into relevant environmental management plans.

The performance of the Project against the objectives and targets will be documented in the Project construction compliance reports and at least on a monthly basis as part of the management review.

Environmental objectives and targets for the Project are provided in Table 2-3 below. These are broader environmental objectives and targets that are partially covered by the BMP but are also met by other documents such as the EMS.

Table 2-3 Environmental objectives and targets

Objective	Target	Measurement Tool
Construction of the Project in accordance with environmental approvals and relevant licences.	Compliance with statutory approvals	Audits, construction compliance reporting, management review
Construction of the Project in accordance with approved environmental management plans	Compliance with EMS and Project management plans Compliance with relevant environmental procedures	Audits, construction compliance reporting, management review
Compliance with all legal requirements	No regulatory infringements (penalty infringement notices or prosecutions) No formal regulatory warning	Audits, construction compliance reporting, management review
Implement a comprehensive EMS that meets the legislative requirements and compliance with the EIS, Amendment report, Submissions Report and CoCs.	Address non-conformances and corrective actions within specific timeframes	Audits, management review
Engage with the affected and broader community, minimise complaints and respond to any complaints within a suitable timeframe	Disseminate regular Project updates and other information through the Project website and other tools identified by the Community Consultation Plan (CCP). Record and respond to complaints within the timeframe specified in the CCP	Review complaints register, construction compliance report, audits
Continuously improve environmental performance	Develop and implement a program of ongoing environmental training Capture lessons learnt from environmental incidents to minimise repeat issues Encourage and reward innovation and effort throughout the workforce.	Construction compliance report, management review, audits

3. EXISTING ENVIRONMENT

3.1. SOILS

The development site is in the Upper Goulburn Valleys and Escarpment Landscape. This landscape as described by Mitchell, 2002 is distinguished by steep hills and escarpments with rock outcrops on a mix of quartz sandstone, lithic sandstone and conglomerate and shale, making up harsh texture-contrast soils

3.2. FLORA

The development site is agricultural land comprising of cleared areas (primarily cultivated land where there is evidence of past ploughing/cultivation and where infrastructure is located (i.e. the substation and farm buildings) and native vegetation (predominantly grassy woodland on the Wollar Valley flats).

The development footprint is 463 hectares, with 367 hectares comprising of native vegetation. The project would impact up to:

- 24.59 hectares of high diversity structural woodland,
- 342.92 hectares of derived grasslands and cultivated low condition areas.

Of these areas:

- 340.31 hectares of vegetation meets the NSW EEC criteria; most (92%) in degraded condition that does not generate offsets under the Biodiversity Assessment Methodology (BAM).
- 229.58 hectares of vegetation that meets the Commonwealth criteria for Critically Endangered Ecological Communities; most (89%) in degraded condition.

In addition to the 367 hectares of native vegetation areas above, the development footprint also contains 5 paddock trees (assessed under BAM).

Road upgrades for stage 1 are assessed assuming a worst-case scenario for disturbance along Barigan road limited to a 12 metre wide corridor of impact. Species polygons with a 100 metre buffer applied to each HBT was applied where vegetation zones were relevant.

Stage 4 impacts are assessed assuming a worst-case scenario for disturbance along Maree Road limited to a zone of 7 metres x 1 kilometre.

3.2.1. Vegetation Communities

Three Plant Community Types (PCTs) were identified within the development site:

- White Box – Grey Gum – Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion, White Box - Grey Gum - Kurrajong grassy woodland on northern Capertee Valley, Sydney Basin Bioregion (PCT 1303)
- Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion (PCT 281), and
- White Box - Black Cypress Pine shrubby woodland of the Western Slopes (PCT 1610).

The locations of these PCTs are shown in Figure 6-1 and Figure 6-2.

A description of each PCT is given below.

White Box – Grey Gum – Kurrajong grassy woodland PCT 1303

This Box Gum Woodland occurs on lower slopes of the Wollar Valley and is generally associated with a north westerly aspect. It has been subjected to past disturbances caused by land clearing and farming practises. *Eucalyptus albens* was dominant over the landscape with lesser dominant *E. moluccana*. Groundcover species diversity was high with the most prevalent groundcover species being *Bothriochloa macra*. This PCT, although not known to occur in Kerrabee Subregion is the best PCT match based on site observations, plot data, landscape setting and soils. PCT 1303 occurs within Capertee Valley which occurs on Narrabeen Sandstone geology of which Wollar Valley has very similar traits.

Rough-Barked Apple – red gum – Yellow Box Woodland PCT 281

This Box Gum Woodland occurs on the Wollar Valley and is generally associated with Spring Flat Creek. It has been subjected to past disturbances caused by land clearing and farming practises. *Angophora floribunda* was dominant over the landscape with equal numbers of *Eucalyptus blakelyi* and lesser dominant *Eucalyptus melliodora*. Groundcover species diversity was high with the most prevalent groundcover species being *Microlaena stipoides* and *Bothriochloa macra*. This PCT is known to occur in Kerrabee Subregion and was the best PCT match based on site observations and comparison to plot data

White Box – Black Cyprus Pine Shrubby Woodland PCT 1610

This PCT occurs on the steeper foothills of the Wollar Valley above a distinct sandstone escarpment. The lower parts of this PCT have been subjected to past land clearing and farming practises. *Eucalyptus albens* was the dominant tree with disturbed areas being dominated by thick regeneration of *Callitris endlicheri* and *Acacia ixiophylla*. Groundcover species diversity was high with the prevalence of *Calotis lappulacea*, *Vittadinia cuneata* and *Bothricholoa macra*, *Themeda australis* and Austros*tipa sp*. This PCT is known to occur in Kerrabee Subregion and was the best PCT match based on site observations during field survey.

3.3. FAUNA

The Bush Stone-Curlew, Gang-gang Cockatoo, Barking Owl, Powerful Owl, Squirrel Glider, Brush-tailed Phascogale, Masked Owl, Koala and Large-eared Pied Bat are assumed to be present within timbered PCTs (zones 5 and 8 in Figure 1-4) along Barigan Road.

The Large-eared Pied Bat, Eastern Bentwing-bat and Eastern Cave Bat were recorded via ultrasonic detection within the solar farm site. Surveys did not detect these species within the solar farm site, however species may utilise fringing vegetation within lower slopes surrounding development site.

Regent Honeyeater habitat is mapped within the Solar Farm Site. The Regent Honeyeater is discussed in more detail in section 3.3.1.

Stage 1 of the development would impact 56 trees inside Barigan road reserve containing suitable hollows which may be utilised for various threatened species.

Stage 3 of the development would impact 9 trees containing suitable hollows which may be utilised for various threatened species.

One tree with hollows was recorded within the Maree Road reserve (Stage 4) which may be utilised by various threatened species.

3.3.1. Regent Honeyeater

Areas mapped as Regent Honeyeater habitat are present within the proposal site. Amendments to the development footprint originally proposed in the Preliminary Environmental Assessment were undertaken for

the EIS to avoid mapped areas for the Regent Honeyeater and prior to February 2020, the assessment under BAM purposefully avoided development within 'important areas mapping' for Regent Honeyeater. Since this time, updates to important areas mapping for Regent Honeyeater (Figure 3-1 and Figure 3-2) was able to be downloaded where additional areas of mapping now exist. Several areas of the 'important areas mapping' now intersects the approved footprint. BCD clarified that further assessment of important areas mapping was not needed within areas allocated for the Solar Panel array and Barigan Road as there will be no change to the footprint in this area and therefore does not need further assessment under Ch 10.2 of the BAM, with initial Assessments of Significance (AoS) concluding a significant impact was unlikely given the proposal would not;

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

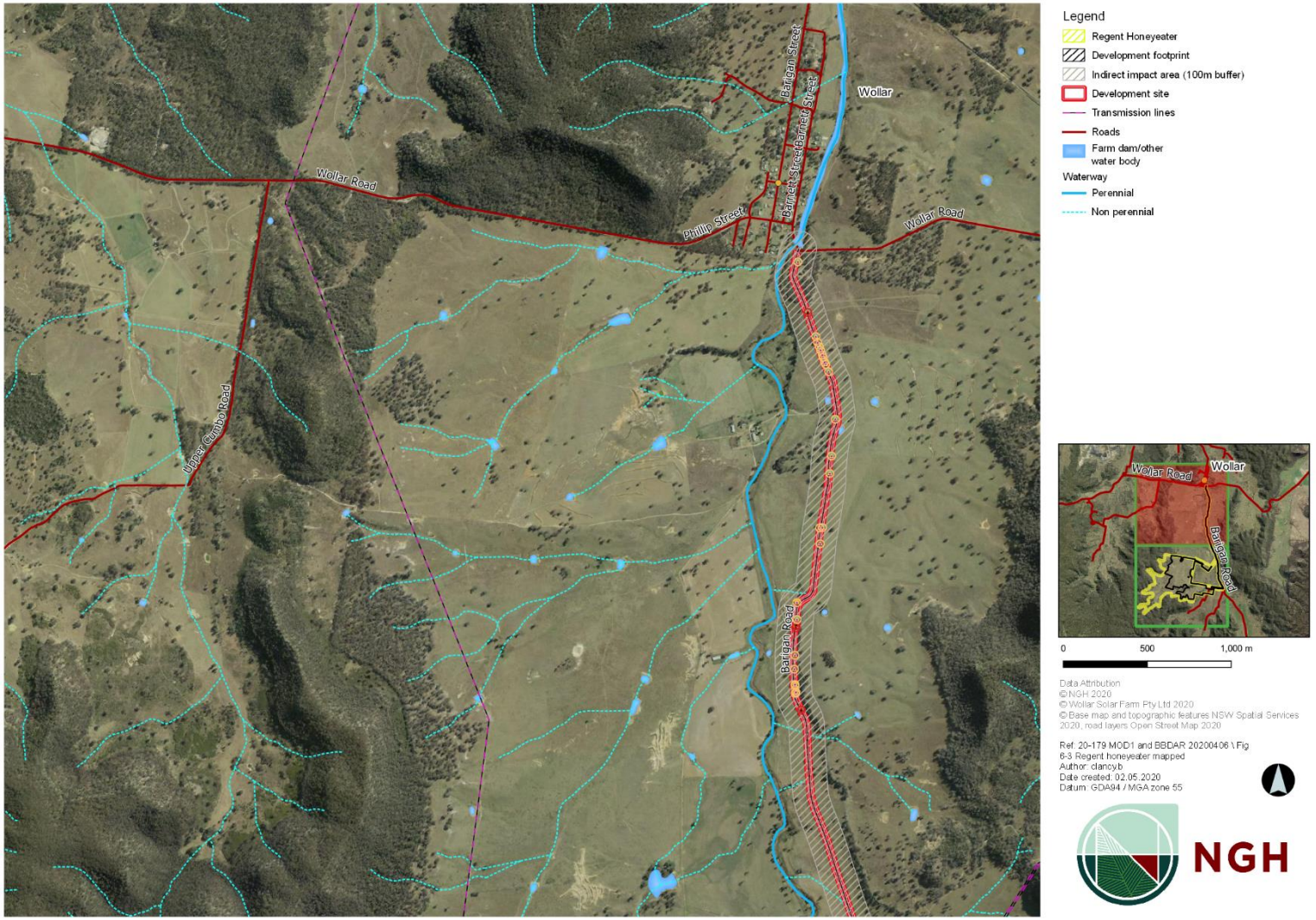


Figure 3-1 Updated mapped Regent Honeyeater habitat in relation to the project

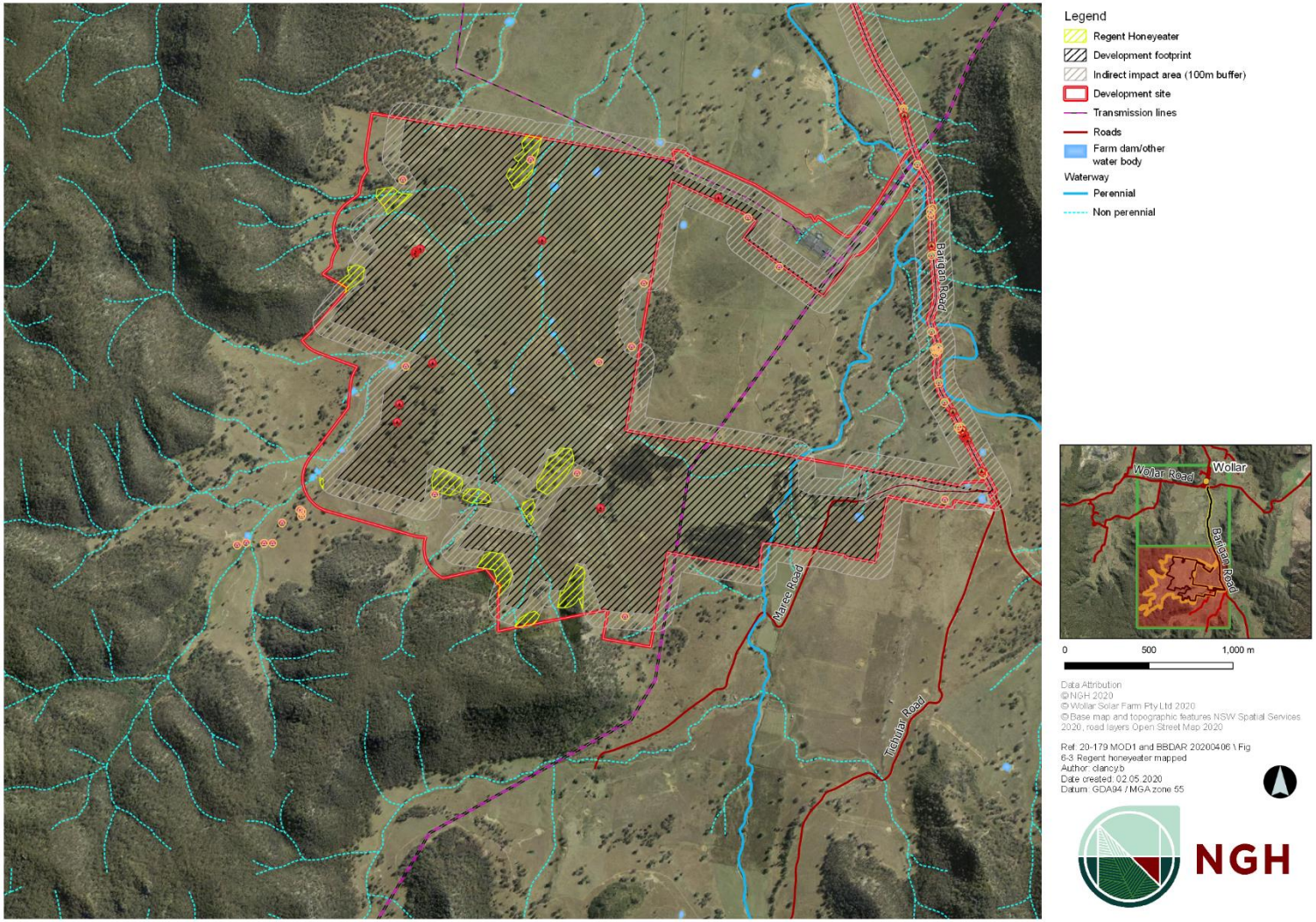


Figure 3-2 Updated mapped Regent Honeyeater habitat in relation to the project

3.4. WEEDS AND PESTS

3.4.1. Pest Species

Opportunistic surveys undertaken in May 2018 identified the following pest species to be present within the project footprint.

- Rabbits
- Feral Pigs
- Foxes

3.4.2. Weed Species

80 exotic flora species were recorded within the development footprint. These species and their zones are listed in Table 3-1.

Table 3-1 Exotic flora species observed within the proposal site for the road upgrades

Common Name	Scientific Name	Status	Zone
Common Thornapple	*Datura stramonium*	-	1
Khaki Weed	*Alternanthera pungens*	-	1, 2
Mallow	*Malva spp.*	-	1
Paspalum	*Paspalum dilatatum*	-	1, 2
Sandspurry	*Spergularia rubra*	-	1
A Bindweed	*Convolvulus spp.*	-	1, 2
A Fleabane	*Conyza spp.*	-	1
Yellow Hawkweed	*Tolpis barbata*	-	1, 2, 3
A Medic	*Medicago spp.*	-	2
White Clover	*Trifolium repens*	-	2, 3
-	*Rytidosperma spp.*	-	2
Flax	*Linum usitatissimum*	-	2
Rat's-tail Fescue	*Vulpia spp.*	-	2
Sweet Briar	*Rosa rubiginosa*	-	2

Common Name	Scientific Name	Status	Zone
Prickly Sowthistle	*Sonchus asper*	-	3
Narrow-leaved Cotton	*Gomphocarpus fruticosus*	-	3
Patterson's Curse	*Echium plantagineum*	-	3
Shepherd's Purse	*Capsella bursa-pastoris*	-	3
Brassica	*Brassica spp.*	-	4, 7
Lucerne	*Medicago sativa*	-	2, 3, 4, 8
-	*Silene spp.*	-	2, 3, 4, 8, 9
Perennial Ryegrass	*Lolium perenne*	-	1, 2, 3, 4, 6, 7
Long Storksbill	*Erodium botrys*	-	1, 2, 3, 4, 5, 6
Saffron Thistle	*Carthamus lanatus*	-	1, 2, 3, 4, 5, 6, 8, 9
Barley Grass	*Hordeum leporinum*	-	2, 3, 4, 5, 6, 7
Phalaris	*Phalaris aquatica*	-	1, 4
Common Peppercress	*Lepidium africanum*	-	1, 2, 3, 4
Small Flowered Mallow	*Malva Parviflora*	-	2, 3, 4, 5, 8
Skeleton Weed	*Chandrilla juncea*	-	2, 3, 4, 5, 6, 8
Wireweed	*Polygonum aviculare*	-	2, 4, 6, 9
Scarlet Pimpernel	*Lysimachia arvensis*	-	1, 2, 3, 4, 5, 6, 7, 8, 9
-	*Geranium spp.*	-	5
Four-leaved Allseed	*Polycarpon tetraphyllum*	-	5
Spear Thistle	*Cirsium vulgare*	-	2, 3, 5
Flaxleaf Fleabane	*Conyza bonariensis*	-	1, 2, 5, 6
Red-flowered Mallow	*Modiola caroliniana*	-	1, 2, 3, 5, 6, 7, 8, 9

Common Name	Scientific Name	Status	Zone
Chilean Whitlow Wort	*Paronychia brasiliana*	-	1, 2, 3, 5, 8
Black-berry Nightshade	*Solanum nigrum*	-	1, 5
Bathurst Burr	*Xanthium spinosum*	-	5, 6, 7
Common Sowthistle	*Sonchus oleraceus*	-	1, 2, 3, 5, 6
Capeweed	*Arctotheca calendula*	-	2, 3, 5, 6, 8
St Johns Wort	*Hypercium perforatum*	*This plant should not be sold in parts of NSW* (Department of Primary Industries, 2020)	2, 3, 5, 8
Dandelion	*Taraxacum officinale*	-	2, 3, 5, 6, 8
Twiggy Mullein	*Verbascum virgatum*	-	5
-	*Oxalis thompsoniae*	-	5
A Finger Grass	*Digitaria spp.*	-	5
Soft Brome	*Bromus Hordeaceus*	-	2, 3, 6, 7
Catsear	*Hypochaeris radicata*	-	1, 2, 3, 5, 6, 7, 8
Maltese Cockspur	*Centaurea melitensis*	-	2, 8
Vervain	*Salvia verbenaca*	-	8
Shivery Grass	*Briza minor*	-	
Wild Oats	*Avena fatua*	-	7
-	*Onopordum spp.*	-	7
Winter Grass	*Poa annua*	-	7
Slender Celery	*Cyclospermum leptohyllum*	-	2, 3, 6, 8
-	*Cirisium spp.*	-	6, 8

Common Name	Scientific Name	Status	Zone
-	*Verbascum spp.*	-	8
Roughtail	*Rostaria pumila*	-	5, 8
Hop Clover	*Trifolium campestre*	-	3, 6, 8
-	*Linum spp.*	-	2, 3, 5, 8
Rough Dog's Tail	*Cynosurus echinatus*	-	5
Common Peppercress	*Lepidium africanum*	-	1, 5, 6
St Barnabys Thistle	*Centaurea solstiitalis*	-	6
Prairie Grass	*Bromus catharticus*	-	6, 7
Lamb's Tongue	*Plantago lanceolata*	-	1, 2, 3, 6, 7
Urochloa Grass	*Urochloa panicoides*	-	6, 7
Goose Grass	*Eleusine tristachya*	-	1, 2, 3, 6, 7
Purpletop	*Verbena bonariensis*	-	1, 3, 6
Dwarf Marigold	*Schkuhria pinnata var. abrotanoides*	-	1, 2, 6, 9
-	*Xanthium spp.*	-	6
Sheep Sorrel	*Acetosella vulgaris*	-	6
Subterranean Clover	*Trifolium subterraneum*	-	2, 3, 6, 8
Stinkgrass	*Eragrostis cilianensis*	-	1, 6
A Finger Grass	*Digitaria spp.*	-	6
Common Crowfoot	*Erodium cictuarium*	-	1, 2, 3, 6, 7, 8
Haresfoot Clover	*Trifolium arvense*	-	1, 2, 3, 5, 6, 8
Clustered clover	*Trifolium glomeratum*	-	1, 2, 3, 5, 6, 8, 9
Yellow Suckling Clover	*Trifolium dubium*	-	2, 3, 5, 6, 8

Common Name	Scientific Name	Status	Zone
Barnyard Grass	*Echinochloa crus-galli*	-	1, 2, 3, 6, 9
Proliferous Pink	*Ptrorhagia nantteuilii*	-	1, 2, 3, 5, 6, 7, 8, 9

4. ENVIRONMENTAL ASPECTS AND IMPACTS

The construction and operation phases of the project have the potential to impact biodiversity values at the site in ways that cannot be avoided. This would occur through direct impacts such as habitat clearance, and indirect impacts including shading, weed ingress, soil and water contamination, and generation of excessive dust, light, or noise.

Key aspects of the Wollar Solar Farm that could result in impacts to biodiversity have been described in Table 4-1.

Table 4-1 Potential biodiversity impacts as a result of the project

Impact	Frequency	Duration	Consequence
Direct Impacts			
Habitat clearance for permanent and temporary construction facilities (e.g. access tracks, road upgrades to support vehicles)	Regular	Construction	• Direct loss of native flora and fauna habitat including hollow-bearing trees. • Injury and mortality to fauna during clearing of fauna habitat. • Introduction and spread of noxious weeds and pathogens. • Disturbance to fallen timber, dead wood and bush rock.
Removal of habitat features e.g. HBTs	Rare	Construction	• Direct loss of native fauna habitat • Injury and mortality to fauna during clearing of habitat features.
Indirect Impacts			
Inadvertent impacts on adjacent habitat or vegetation	Rare	Construction	• Direct loss of flora and fauna habitat • Injury and mortality to fauna during clearing of fauna habitat and habitat trees • Disturbance to stags, fallen timber and bush rock • Increased edge effects.
Reduced viability of adjacent habitat due to edge effects	Constant	Operational	• Further degradation of TECs

Impact	Frequency	Duration	Consequence
			• Loss of native flora and fauna habitat.
Reduced viability of adjacent habitat due to noise, dust or light spill	Rare	Construction Operation	• May alter fauna activities and/or movements • Loss of foraging or breeding habitat • Inhibit the function of plant species, soils and dams
Transport of weeds and pathogens from the site to adjacent vegetation	Irregular	Construction Operation	• Degradation of TEC onsite through future weed invasion.
Increased risk of starvation, exposure and loss of shade or shelter	Rare	Construction Operation	• Loss of foraging habitat
Loss of breeding habitats	Constant	Construction	• Loss of potential breeding habitat.
Potential increase in pest animal populations	Regular	Operation	• Solar arrays may provide potential habitat for pest species like rabbits and foxes to take refuge under panels.
Shading impacts on groundcover beneath the arrays	Ongoing	Operation	• Change in species and abundance, in a worst case leading to bare areas susceptible to erosion or weed ingress.
Bush rock removal and disturbance	One off	Construction	• Loss of potential breeding habitat

5. WORK SCHEDULES

5.1. CONSTRUCTION AND OPERATION ACTIVITIES

Table 5-1 describes the potential disturbance and mitigation measures associated with different construction phases of the project. Table 5-2 describes the potential disturbance and mitigation measures during operational phases. Note that there can be multiple phases within the different stages of the development (per Section 1.2.1).

Table 5-1 Schedule of construction works

Project phase	Potential disturbance	Key actions and mitigation	Performance target
Construction Works	• Disturbance to native groundcover from vehicle movements. • Disturbance and removal of fauna habitat including woody debris. • Spread of weeds. • Collision with wildlife causing injury or death • Spills from vehicles, plant, and storage facilities. • Pollution of waterways or native vegetation.	• Prior to the commencement of work, a physical vegetation clearing boundary at the approved clearing limit is to be clearly demarcated and implemented (exclusion zone). The delineation of such a boundary may include the use of temporary fencing, flagging tape, para-webbing etc. Buffer zones required around Riparian zones for 4th order waterways will also be demarcated • No works would occur inside the exclusion zones. • Stockpiling materials and equipment and parking vehicles will be avoided within the dripline (extent of foliage cover) of any native tree. • Stockpiles and storage will occur only on designated direct disturbance areas. • Wash and inspect plant and vehicles as per Vehicle Hygiene Procedure. • Pre-clearing surveys will be carried out by an ecologist and will include general fauna	• No disturbance to biodiversity outside the approved construction footprint. • Minimise disturbance to biodiversity in the proposal site. • Retain existing native riparian vegetation to the greatest extent possible in an undamaged and unaltered condition. • Protect exclusion zones (areas outside proposal site) from adverse impacts during construction. • Weeds (where weeds exceed 10% of the groundcover) and pests are controlled. • Speed limits will be enforced. • No native fauna mortalities during construction. • No works causing light or noise impacts occurring near exclusion zones at night.

Project phase	Potential disturbance	Key actions and mitigation	Performance target
		surveys, general tree hollow inspections and dam/waterway inspections. Habitat trees to be retained will be clearly marked with flagging tape. • Hollow-bearing trees within the development site would be cleared between October and January to avoid Gang-gang Cockatoo breeding. • If clearing within this period cannot be achieved, pre-clearing surveys of hollows and nests would be undertaken to ensure individual animals are not impacted. No clearing of any tree supporting an active nest of Gang-gang Cockatoos would occur as per the commitments in the BDAR. • Include awareness training in site inductions regarding site speed limits. Site speed limits to be enforced. • Avoid night works. • Direct lights away from vegetation. • Noise-emitting plant will be oriented so that noise will be directed away from exclusion zones wherever possible. • When not in use, vehicles and plant will not be left idling near exclusion zones but will be switched off whenever possible. • Install and maintain erosion and sediment controls.	
Road Upgrades Stage 1)	• See Potential Disturbances listed for “Construction Works”	• See Key actions and mitigations listed for “Construction Works”	• See performance targets listed for “Construction Works”

Project phase	Potential disturbance	Key actions and mitigation	Performance target
Construction site set up (stages 2 & 3)	• See Potential Disturbances listed for "Construction Works" • Disturbance of native fauna by light or noise at night.	• See Key actions and mitigations listed for "Construction Works" • Where night works are undertaken, work must not take place within 100 m of exclusion zones.	• See performance targets listed for "Construction Works"
Internal access construction (stages 2 & 3)	• See Potential Disturbances listed for "Construction Works"	• See Key actions and mitigations listed for "Construction Works" • Stockpiling and storage of materials and machinery will occur only on designated direct disturbance areas. • Carry out refuelling of plant and equipment, chemical storage and decanting off site or at least 50 m away from farm dams in impervious bunds. • Ensure that dry and wet spill kits are readily available.	• See performance targets listed for "Construction Works" • No pollution or siltation of aquatic ecosystems, wetlands, endangered ecological communities or threatened species habitat.
Construction of solar farm infrastructure (stages 2 & 3)	• See Potential Disturbances listed for "Construction Works"	• See Key actions and mitigations listed for "Construction Works" • Implement ground disturbance permit procedure before any clearing activity. • Implement Vegetation Clearance Procedure for vegetation removal. • Record clearing and ground disturbance via spatial mapping. • Provide awareness training during site inductions and toolbox talks – emphasise the importance of native habitat. • Machinery, trucks and equipment will be restricted to designated parking areas.	• See performance targets listed for "Construction Works" • Survey weed abundance in exclusion zones seasonally during construction and use as basis for implementing seasonal targeted weed control measures in each zone. • Survey weed abundance across the project site seasonally during construction and use to implement targeted weed control measures to control weed infestations. • Targeted weed control measures to be implemented for any seasonal weed

Project phase	Potential disturbance	Key actions and mitigation	Performance target
		• Topsoil will be salvaged where possible within the approved disturbance area and stockpiled for beneficial reuse in the enhancement or the rehabilitation of the site, as per the Weed Management Procedure (section 7.5.1). • Carry out refuelling of plant and equipment, chemical storage and decanting off site or at least 50 m away from farm dams in impervious bunds. • Ensure that dry and wet spill kits are readily available.	• No pollution or siltation of aquatic ecosystems, wetlands, endangered ecological communities or threatened species habitat.
Removal of temporary construction equipment (stages 2 & 3)	• See Potential Disturbances listed for "Construction Works" • Disturbance to existing native fauna from lights and noise. • Disturbance of groundcover from stockpiles.	• Machinery, trucks and equipment will be restricted to designated parking areas. No parking on roadside vegetation will occur. • Stockpiles and storage of materials and machinery will avoid the dripline (extent of foliage cover) of any native tree. • Stockpiles and storage will occur only on designated direct disturbance areas. • Direct any lighting away from vegetation. • Plant and vehicles will be inspected and washed as per Traffic Management Procedure. • Install and maintain ERSED controls.	• Weeds (where weeds exceed 10% of the groundcover) and pests are controlled. • Speed limits will be enforced. • No native fauna mortalities during construction. • No pollution or siltation of aquatic ecosystems, wetlands, endangered ecological communities or threatened species habitat. • Protect exclusion zones from adverse impacts during construction.
Revegetation (stages 2 & 3)	• Loss of groundcover • Spread of weeds	• Restore the ground cover of the site as soon as practicable, but within 3 months of completing any construction or upgrades, using suitable species. • Restore and maintain the ground cover with appropriate perennial species as much as practical. • Manage weeds within this ground cover.	• Rehabilitate all disturbed areas not required for the operation of the solar farm. • Revegetation of disturbed areas meets targets in the Ground Cover Management Plan • Native species will used be for revegetation where practicable.

Table 5-2 Schedule of operational works

Project phase	Potential disturbance	Key actions and mitigation	Performance target
Operation and Maintenance (stage 1)	• Loss of groundcover. • Spread of weeds. • Decline in vegetation condition of exclusion zones.	• Mid-Western Regional Council will be handed back control of the roads • Mid-Western Regional Council will maintain the road in accordance with their internal procedures	• Groundcover, weed management and vegetation maintained to a standard similar to equivalent Council road reserves in the area
Operation and Maintenance (stages 2 & 3)	• Loss of groundcover from shading impacts. • Spread of weeds. • Disturbance to native groundcover from vehicle movements. • Collision with wildlife causing injury or death. • Disturbance of native fauna by light or noise at night. • Decline in vegetation condition of exclusion zones.	• Maintain ground cover with appropriate perennial species. • Manage weeds within ground cover. • Manage weeds within exclusion zones. • Vehicles will be inspected and washed as per Vehicle Hygiene Procedure. • Machinery, trucks and equipment will be restricted to designated parking areas. No parking on roadside vegetation will occur. • Include awareness training in site inductions regarding site speed limits. • Site speed limits to be enforced. • Avoid night works. • Where night works cannot be avoided, work must not take place within 100 m of exclusion zones. • Direct lights away from vegetation. • Noise-emitting plant will be oriented so that noise will be directed away	• Revegetation of disturbed areas meets targets in the Ground Cover Management Plan • No disturbance to biodiversity outside the approved operational footprint. • Minimise disturbance to biodiversity in the project area. • No native fauna mortality or injury during operation. • No pollution or siltation of aquatic ecosystems, wetlands, endangered ecological communities or threatened species habitat. • Maintain or improve the baseline vegetation condition class of exclusion zones throughout the operation period. • Survey and map weed abundance in exclusion zones annually during operation, and use as basis for implementing annual targeted weed control measures in each zone. • No increase in weed abundance in exclusion zones from baseline levels at end of operation period. • Annually survey and map weed distribution across the project site and use to implement targeted weed control measures.

Project phase	Potential disturbance	Key actions and mitigation	Performance target
		from exclusion zones wherever possible. • When not in use, vehicles and plant will not be left idling near exclusion zones, but will be switched off whenever possible.	• Demonstrate reduced weed distribution annually by at least 50% in mapped infestation areas. • Targeted weed control measures to be implemented for any seasonal weed outbreaks within a year of discovery. • No increase in distribution of weeds from baseline in the project site at end of operation period. • No new invasive weeds recorded in project area compared to baseline surveys at end of operation period.

6. ENVIRONMENTAL MANAGEMENT ZONES

The Project was broken down into the following zones for the purposes of biodiversity management[2]:

1. Zone 1 (PCT 1303 in good condition)
2. Zone 2 (PCT 1303 derived grassland)
3. Zone 3 (cultivated land in low condition)
4. Zone 4 & 7 (cultivated land/substation)
5. Zone 5 (PCT 281 in good condition).
6. Zone 6 (PCT 281 derived grassland)
7. Zone 8 (PCT 1610 good condition)
8. Zone 9 (PCT 1610 (cleared, low condition)

These zones are described below and their location is shown on Figure 6-1 and Figure 6-2. These zones are referred to in the management protocols and procedures described in Section 7 and summarised in Section 6.1.

6.1. MANAGEMENT ZONES

Zone 1 - PCT 1303 White Box – Grey Gum

This zone totals an area of direct impact for the Solar Farm of 16.46ha. This woodland is a TEC under EPBC and BC Act.

Zone 2 - PCT 1303 Derived Native Grassland

This zone totals an area of direct impact for the Solar Farm of 102.30ha. This woodland is a TEC under EPBC and BC Act.

Zone 3 - PCT 1303 Cultivated Low Condition

This zone totals an area of direct impact for the Solar Farm of 110.72ha. Though degraded, still classified as a TEC under the BC Act.

Zone 4 – Cultivated Land (exotic)

This zone totals an area of direct impact for the Solar Farm and road upgrades of 12.83ha. There is zero area of indirect impact.

Zone 5 – PCT 281 Box Gum Woodland

This zone is in good condition, totalling an area of direct impact for the Solar Farm and road upgrades of 7.99ha. There is zero area of indirect impact. This zone requires ecosystem credits.

Zone 6 – PCT 281 Derived Native Grassland

This zone is in moderate condition, totalling an area of direct impact for the Solar Farm and road upgrades of 102.83ha. There is zero area of indirect impact.

[2] Note: The substation and area labelled ‘exotic’ (shaded pink) in Figure 6-1 were not assessed under the BAM for the BDAR, and as such this area totalling approximately 52 hectares is not included in the Management Zones.

Zone 7 - PCT 281 Exotic Groundcover

This zone totals an area of direct impact for the Solar Farm of 31.64ha. There is zero area of indirect impact.

Zone 8 – PCT 1610 White Box – Black Cypress

This zone is in good condition, totalling an area of direct impact for the Solar Farm and road upgrades of 0.14ha. There is zero area of indirect impact. This zone requires ecosystem credits.

Zone 9 – PCT 1610 White Box – Black Cypress

This zone is in low condition, totalling an area of direct impact for the Solar Farm and road upgrades of 27.07ha. There is zero area of indirect impact

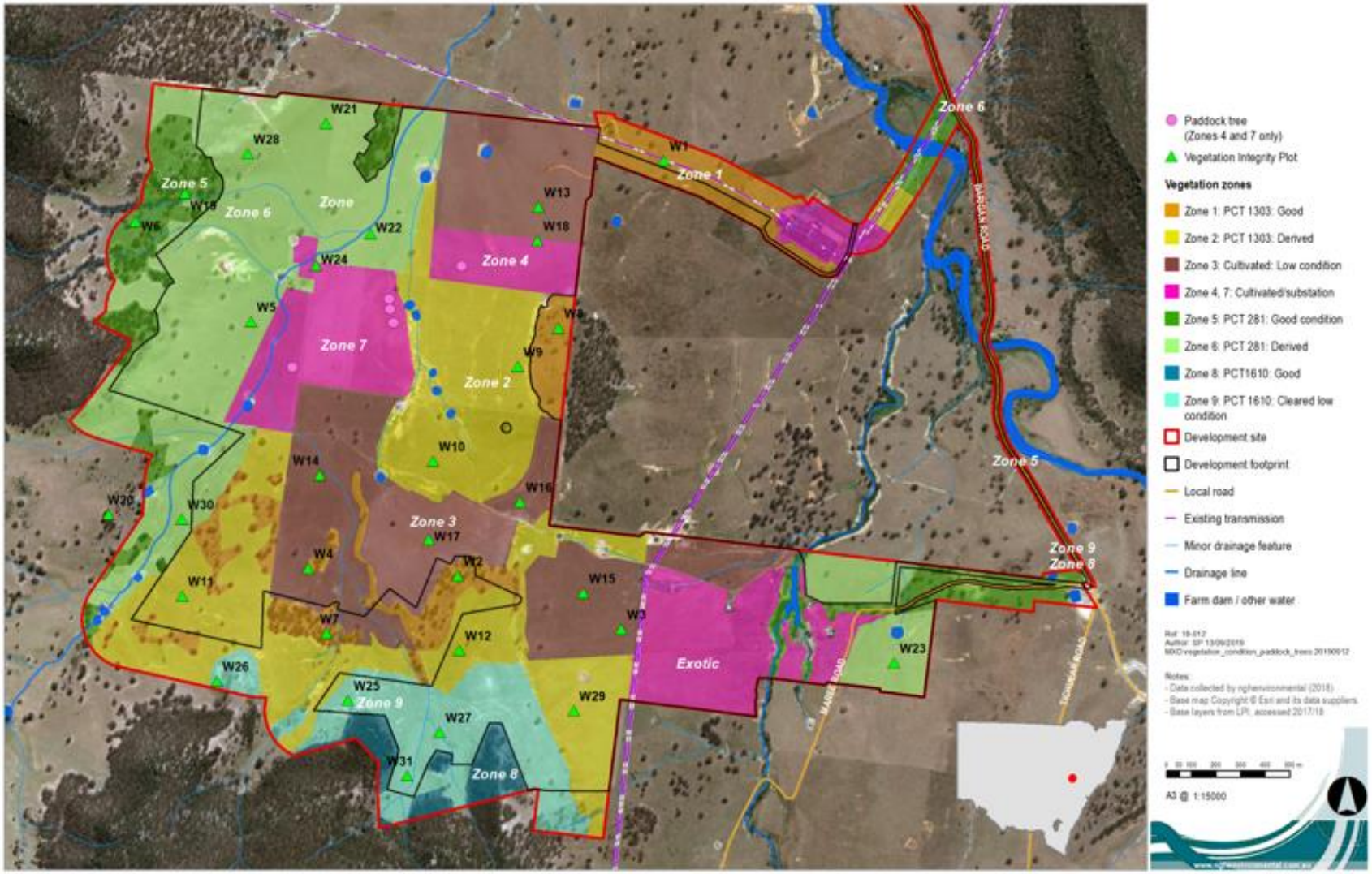


Figure 6-1 Vegetation zones, PCTs and representative vegetation integrity plots for development site (Map 1)

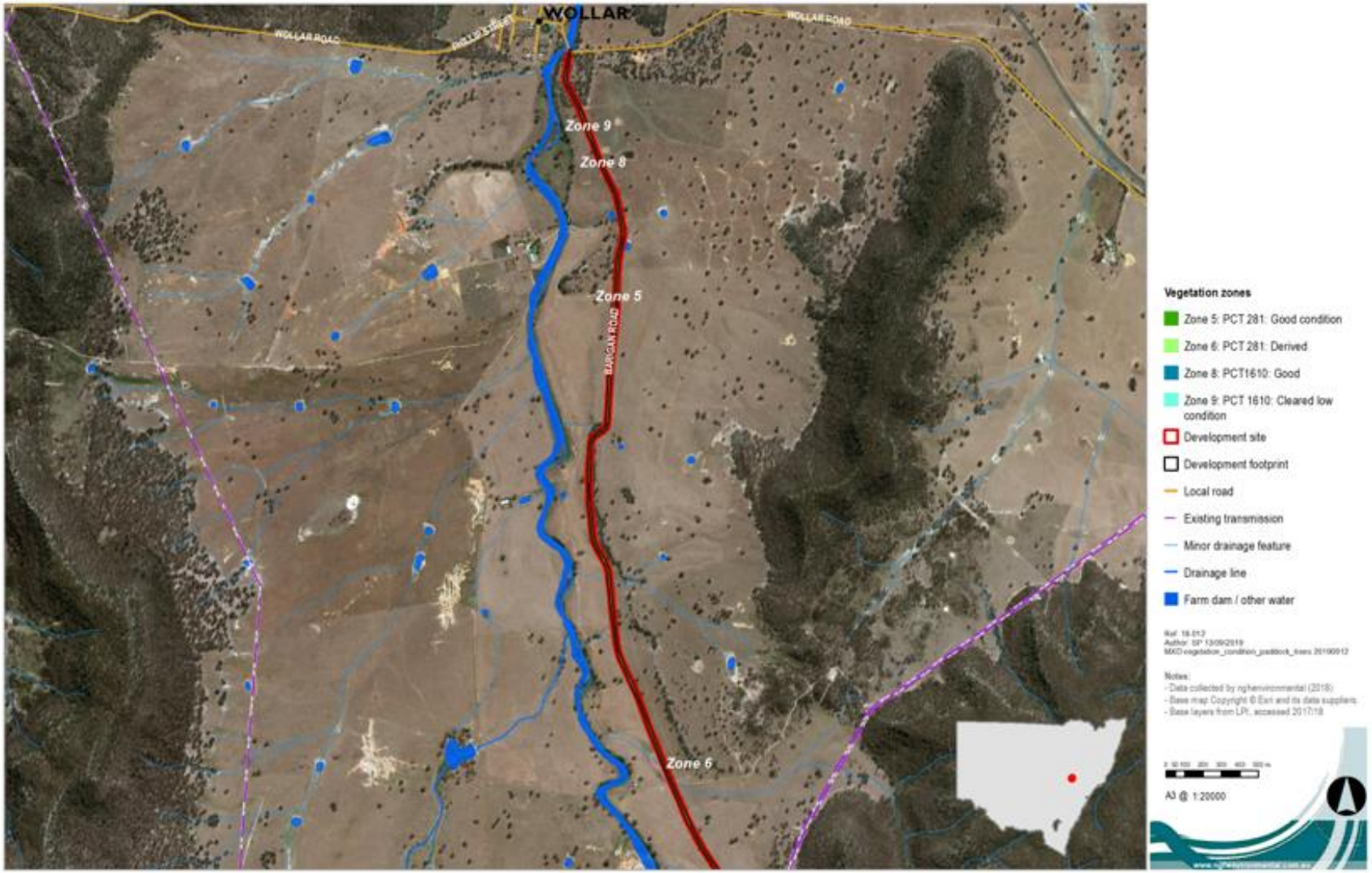


Figure 6-2 Vegetation zones, PCTs and representative vegetation integrity plots for development site (Map 2)

7. ENVIRONMENTAL MANAGEMENT PROTOCOLS AND PROCEDURES

The following protocols and procedures have been developed to manage the impacts of the project on biodiversity. Table 7-1 below summarises the phase of the project to which the protocol/procedure applies.

Table 7-1 Summary of protocols and their applicability to stages of the development.

Protocol	Construction	Stage	Operation	Stage
7.1 Ground Disturbance Protocol	*Yes*	*1, 2, 3 & 4*	*NA*	*N/A*
7.2 Vegetation Clearance Protocol	*Yes*	*1, 2, 3 & 4*	*NA*	*N/A*
7.3 Re-use of Resources Protocol	*Yes*	*1, 2, 3 & 4*	*NA*	*N/A*
7.4 Threatened Species Finds Procedure	*Yes*	*1, 2, 3 & 4*	*Yes*	*2 & 3*
7.5 Weed and Pest Management Protocol	*Yes*	*1, 2, 3 & 4*	*Yes*	*2 & 3*
7.6 Vehicle Hygiene Protocol	*Yes*	*1, 2, 3 & 4*	*Yes*	*2 & 3*
7.7 Vegetation Constraints Management Protocol	*Yes*	*1, 2, 3 & 4*	*Yes*	*2 & 3*
7.8 Noise, Light and Dust Management	*Yes*	*1, 2, 3 & 4*	*Yes*	*2 & 3*
Appendix A Groundcover Management Plan	*Yes*	*1, 2, 3 & 4*	*Yes*	*2 & 3*

Each of these protocols/procedures is described in detail in this section below (and Appendix A).

Risks to fauna from vehicle collision have also been identified however this is managed through the implementation of speed limits which is covered in the project's Traffic Management Plan and will be included in the EPC's Safety Plan. Monitoring of fauna fatalities has been included as part of this BMP in Section 9 with appropriate triggers and responses included.

Table 8-1 provides a summary of the key performance criteria for the protocols and procedures detailed in this BMP and triggers for corrective actions. The actions to be implemented should the trigger arise are also described.

7.1. GROUND DISTURBANCE PROTOCOL

A ground disturbance permit process will be implemented during construction of road upgrades. The ground disturbance permit process is integral to communicate the distinction between vegetation protection areas and the ground disturbance footprints in which construction contractors will be working. This process is also vital to enable the construction contractor to track and control vegetation clearing on a daily, weekly, and monthly basis.

The ground disturbance permit process is managed by the Health, Safety, Environment and Quality Control (HSEQ) Manager or equivalent and is summarised below.

- Contractors are informed in their contract and site induction that all ground disturbing activities require them to obtain a ground disturbance permit prior to undertaking the work.

- The ground disturbance permit must be submitted to the HSEQ Manager before the work is undertaken.
- The HSEQ Manager will compare the proposed ground disturbance area to the project road upgrade footprint detailed in the approved detailed design.
- A pre-clearing survey (Section 7.2.2) will be conducted prior to confirm the location and extent of the proposed clearing and confirm this is within the assessed area.
- The HSEQ Manager will either issue the permit unamended or contact the contractor for further clarification.
- Once the permit has been issued, the construction contractor may undertake ground works as per their contract.
- Once the work has been completed (date specified in the permit), the HSEQ Manager will inspect the site, request any additional clean up or remediation activities and sign-off that the conditions of the permit have been met. This will include as a minimum, temporary groundcover to prevent erosion and reduce the potential for weed invasion.
- The HSEQ Manager will then record the disturbed area as part of a running total disturbed area for the Project.

An example of the ground disturbance permit form is provided in Appendix B.1

7.2. VEGETATION CLEARANCE PROCEDURE

The vegetation clearance procedure will be implemented for vegetation clearance during construction.

7.2.1. Monitoring Total Clearing Footprint

Vegetation clearance is only permitted in the areas identified in the BDAR 2019. Any additional clearance required will first require a project modification.

Prior to vegetation clearing, the HSEQ Manager will digitally capture and display clearance boundaries within the site. Survey teams and GIS databases will be used to inform and record vegetation clearing and site rehabilitation.

The cumulative amount of vegetation cleared will be progressively monitored by the HSEQ Manager. Prior to undertaking any vegetation clearing, this value will be compared to the total approved area to be cleared.

Demarcation of the development footprint is the responsibility of the construction contractor and will be determined by them. Typical measures will include:

- Use of temporary fencing
- Flag tape or rope

7.2.2. Pre-clearing Surveys

Pre-clearing surveys will be carried out by an Ecologist prior to any vegetation clearing. The following pre-clearing surveys will be carried out when habitat trees are to be removed, including hollow-bearing trees and other woody vegetation:

- Identifying any potential breeding/roosting habitat
- Recording number, location and type of tree hollows present for use during hollow-bearing tree removal
- Clearly marking habitat trees with flagging tape and demarcating area to be cleared

- Remove any hollow bearing trees outside of Spring and Gang-gang Cockatoo breeding season (i.e. between October and January). If clearing outside of this period cannot be achieved, pre-clearing surveys would be undertaken to ensure no impacts to fauna would occur.

The results of these surveys will be provided to site staff (including equipment operators) involved in vegetation clearing, through site inductions, toolbox talks, and targeted training (Section 9.2), as well as through the issuing of ground clearance permits (Section 7.1).

7.2.3. General Process

When undertaking vegetation clearing, the process shown in Figure 7-1 will be followed to minimise the area of disturbance and the amount of vegetation to be cleared.

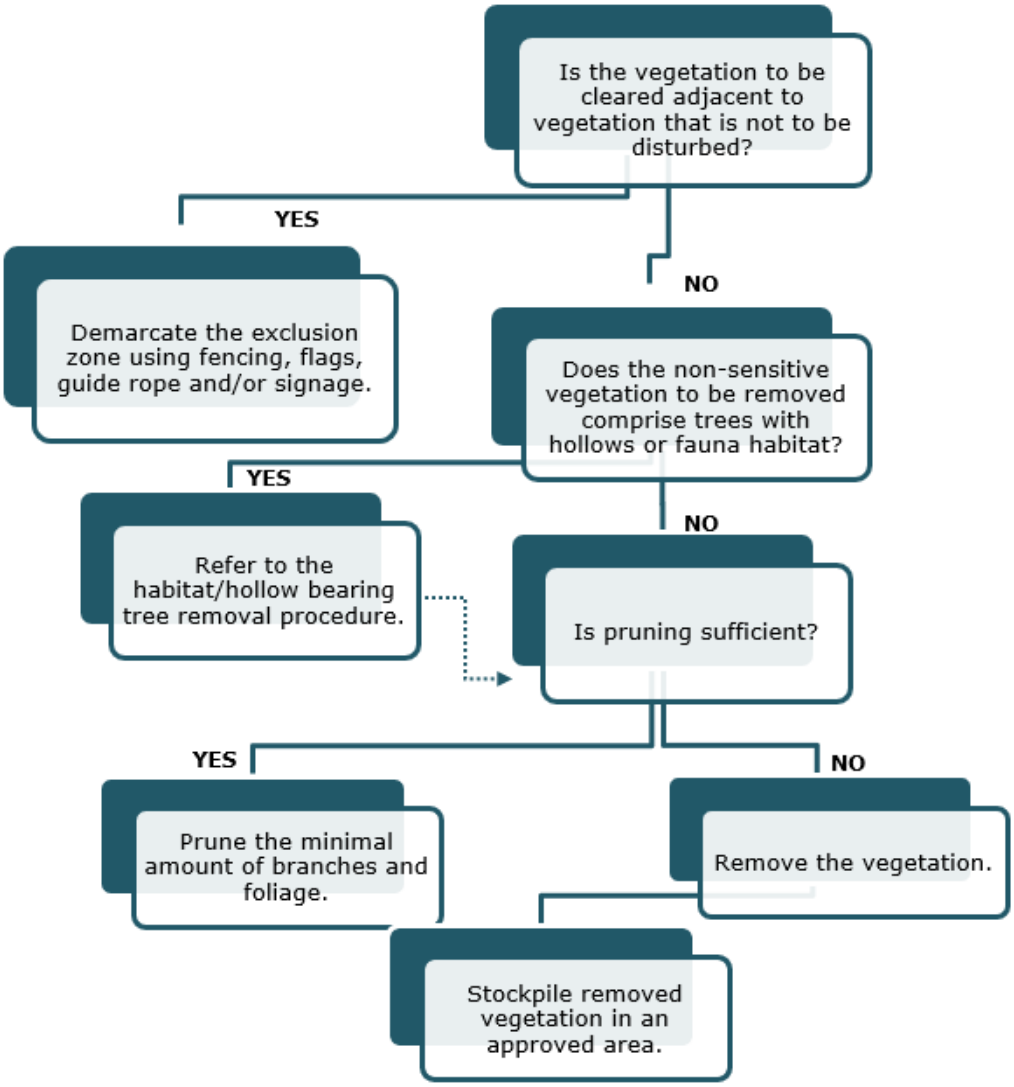


Figure 7-1 Vegetation clearance protocol

7.2.4. Clearing Near Exclusion Zones

Exclusion zones containing vegetation must be protected from any project impacts. Prior to construction commencing, vegetation in these areas will be protected by exclusion fencing and signage (e.g. Figure 7-2 and Figure 7-3). These areas will be communicated to site staff (including equipment operators) through site inductions, toolbox talks and targeted training prior to works taking place in the vicinity. A vegetation exclusion zone will be established between vegetation constraints and protective fencing (no closer than the dripline of the vegetation) to ensure that vegetation constraints are not impacted accidentally. Additional exclusion fencing will define the boundary between vegetation to be removed and vegetation to be retained. Vegetation removal in these areas will be conducted with chainsaws rather than machinery to ensure minimal disturbance.

Figure 7-2 Example of exclusion zone signage

Figure 7-3 Example of exclusion zone fencing

Following any vegetation clearing in the vicinity of a biodiversity constraint which is not to be impacted, the HSEQ Manager will conduct an inspection of the area to confirm that the constraint has not been impacted.

7.2.5. Lopping, Pruning and Trimming Procedure

Heavy machinery will not be used for pruning or trimming. Appropriate tools to use are loppers, chain saws and vehicle mounted saws.

In the first instance, hollow bearing limbs will be retained. If this is not possible the hollow bearing limb will be inspected by the Contractor Ecologist / suitably qualified expert and placed in adjacent undisturbed vegetation to provide fauna habitat. If an adjacent area is not suitable, the ecologist will provide advice on placement of the hollow bearing limb. Tree limbs are to be removed using the three-cut method as shown below in
Figure 7-4

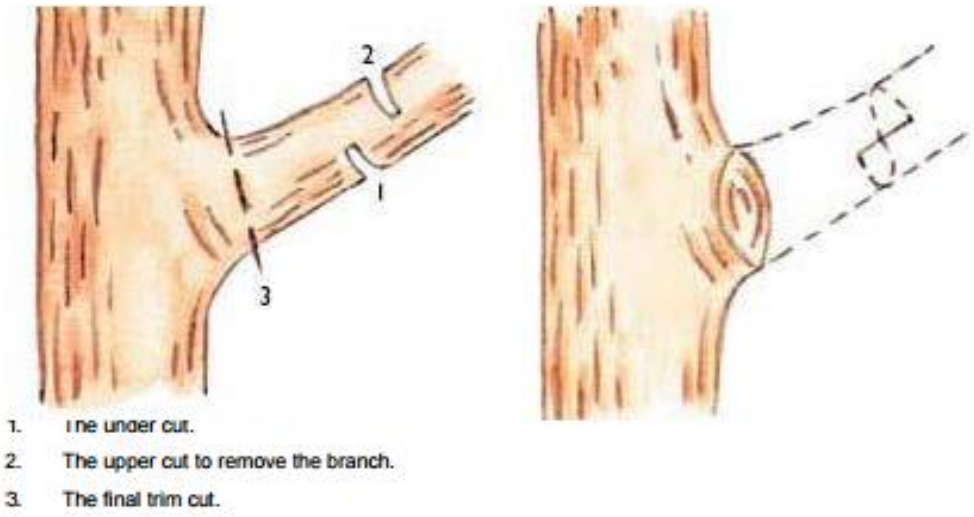


Figure 7-4 Three-cut method of removing branches

7.2.6. Hollow Bearing Tree Removal Procedure

Hollow-bearing trees are an important habitat feature for a variety of native animals such as possums, gliders, birds and bats. Before clearing any hollow-bearing or habitat trees, it is important to consider if animals are present. Hollow-bearing trees would not be removed during Spring, when breeding is at it's peak for most species. If clearing outside of this period cannot be achieved, pre-clearing surveys would be undertaken to ensure no impacts to fauna would occur. The following procedure (Figure 7-5) is a guide to give animals an opportunity to escape a hollow-bearing tree prior to it being removed.

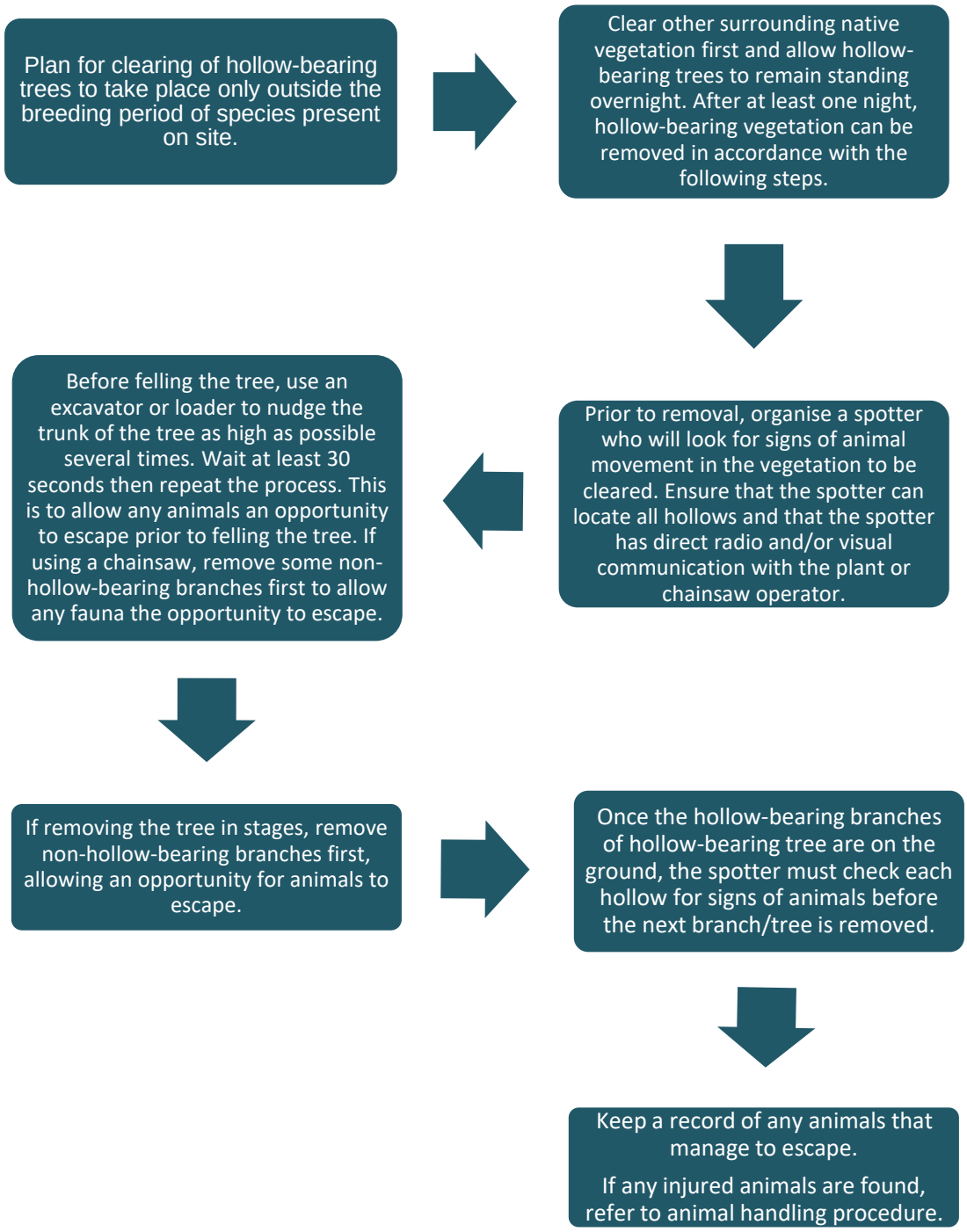


Figure 7-5 Hollow bearing tree removal procedure

7.2.7. Removal of Trees Outside the Approved Clearing Limits

The approved clearing limit is the line between the vegetation to be removed and the vegetation to be retained. It will be shown on all design plans as required. Some construction activities will require tree removal or trimming that has not been included in the design.

Where additional impacts to trees are required, the following process will be followed:

1. The Site Manager will notify the HSEQ Manager of the location and need for the tree impact via the ground disturbance permit process
2. The HSEQ Manager will assess that the tree (or other vegetation type) is not heritage listed, part of an EEC, a habitat tree, nominated for retention or protected under relevant legislation and is legally able to be removed and/or trimmed. Alternatives to removing the tree will also be investigated at this stage.
3. The HSEQ Manager will consult a heritage specialist if heritage significance is suspected.
4. The Supervisor will await written confirmation from the HSEQ Manager prior to restarting works around the tree(s).

7.3. RE-USE OF RESOURCES

7.3.1. Re-use of Coarse Woody Debris (CWD)

Within the solar farm area felled timber from greater than 200 mm and less than 600 mm in diameter will be used as CWD for habitat enhancement and to maximise the salvage of resources within the disturbance area for beneficial reuse. CWD can be used to enhance habitat values in existing vegetation and rehabilitated areas including derived native grassland (either in offset areas or areas adjoining impacted areas). CWD can provide:

- Habitat for micro-invertebrates.
- Habitat for macro-invertebrates.
- Habitat for vertebrates using fallen timber for shelter, e.g. skinks, geckoes, dunnarts.
- Habitat for vertebrates using fallen timber for foraging, e.g. treecreepers, robins.
- A source of nutrients, microorganisms for native vegetation.
- Increased habitat complexity.

CWD will be placed as discrete logs rather than in piles to reduce fire risk and potential for use as shelter by feral animals such as foxes and rabbits. The density of CWD must take into account existing fallen timber. Removal, transportation, and placement of CWD will be carried out in a manner that minimises disturbance to native vegetation, including the canopy, trees, shrubs, standing dead timber, fallen timber, and groundcover, as well as topsoil.

Felled timber greater than 600 mm in diameter (primarily tree trunks) will be used as CWD where practicable or left on site where it is too large to transport.

Felled timber between 10 and 200 mm in diameter will be chipped and used for disturbed area rehabilitation.

Where timber is felled within road reserves it may need to be removed in accordance with the requirements of the responsible road authority.

7.3.2. Re-use of Rocks

Rocks greater than 300 mm diameter at their widest point removed during construction will be retained and relocated to areas on the advice of an Ecologist. Removal, transportation, and placement of rocks will be carried out in a manner that minimises disturbance to vegetation constraints, including the canopy, trees, shrubs, standing dead timber, fallen timber, and groundcover, as well as topsoil.

7.3.3. Re-use of Soil Resources

Topsoil will be salvaged where possible within the approved disturbance area and stockpiled for beneficial reuse in the enhancement or rehabilitation of the site, as per the Weed Management Procedure (Section 7.5).

Stockpiles and storage of materials and machinery will avoid the dripline (extent of foliage cover) of any native tree.

7.4. THREATENED SPECIES FINDS PROCEDURES

The threatened species finds procedure will be implemented whenever a threatened species is unexpectedly found throughout construction and operation across the development footprint.

Any nests found in habitat features to be removed during construction will be inspected by an Ecologist to determine whether fauna are using the nest, and whether relocation of the fauna and the nest to an adjacent area is viable.

As a general principle, any native animals found with the construction area will be avoided. Fauna will only be handled by a qualified ecologist or wildlife carer with relevant skills and experience (e.g. snake handling), and only when absolutely necessary.

Should threatened fauna, or suspected threatened fauna, be encountered, the procedure outlined in Figure 7-6 will be followed. If capture is required by an Ecologist a procedure is provided below as guidance.

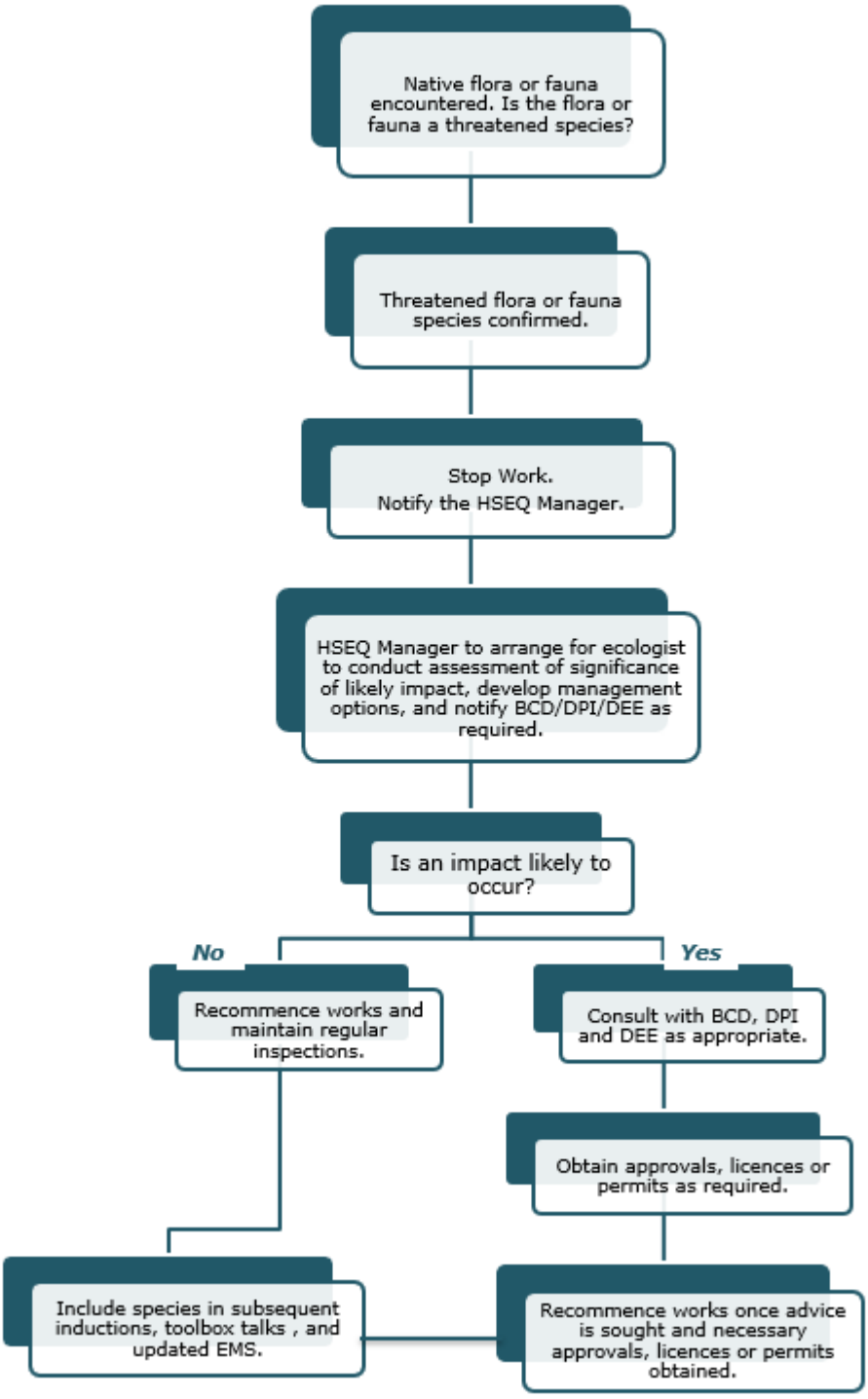


Figure 7-6 Threatened species finds protocol

Fauna Relocation Procedure (to be completed by an Ecologist)

Step 1

Remove any threat to the animal that could cause or exacerbate an injury.

Step 2

Use appropriate equipment to capture the animal. This may include:

- Frogs: disposable gloves, disinfectant on hands and equipment between animals, disposable plastic bags (one per animal, one use only).
- Mammals and birds: gloves, cloth bags/cotton pillow slips, up-to-date Australian Bat Lyssavirus vaccinations (for microbats), extendable net.

Step 3

Contain the animal to minimise stress using towels to cover them. Gently place the animal in a holding box specifically designed for holding the species (i.e. cotton bag for microbats, mesh cage for large mammals e.g. possums, soft lined enclosure for birds or hard cage for parrots). Cotton pillowslips may be used to cover mammals, or mammals may be placed inside them. Boxes will be placed in a quiet, safe, dark location (not in a vehicle unless temperature is constantly monitored). Do not give the animal food or water. If there are dependent young separated from their parents make sure they are kept warm.

Step 5

Call WIRES on 1300 556 686, who will provide advice on what to do until a trained WIRES rescuer can come to take the animal away. If you cannot contact WIRES, contact either Gulgong Veterinary Surgery (02 6374 1160) or Mudgee Vet Hospital (02 6372 2105).

Step 6

Release fauna into similar habitats, as near as possible to their capture location. Day-active fauna will be released during the day of capture. Night-active fauna will be released at or after dusk. Arboreal (tree-dwelling) fauna will be slowly released from their bag onto the trunk of a tree, with bats and gliders placed on a tree with rough or peeling bark and hollows. Hollow dependent fauna will require a nest box to be placed where they are released as temporary accommodation until they relocate to a site of their choosing.

Step 7

Details of fauna captured and relocated will be recorded in a threatened species finds register (Appendix B.2). Any injury or death of a threatened species will be reported to the HSEQ Manager.

7.5. WEED AND PEST MANAGEMENT PROTOCOL

Weeds and pests will be controlled on the solar farm site throughout construction and operation. The Site Manager or HSEQ Manager will also initiate collaboration with adjoining landholders to control animal pests and weeds that may traverse property boundaries. These initial communications will inform collaborative pest and weed management measures during construction and operation.

7.5.1. Weed Management Procedure

Weeds in this BMP are defined as non-native flora species.

Work for the Project has the potential to spread weeds through the movements of heavy machinery and light vehicles during construction, and the movements of light vehicles during operation.

Weeds will be controlled through:

- An adaptive management approach whereby management actions will be adjusted to optimise the groundcover growth addressing on-site observations.
- For more intensive infestations of weeds, the use of selective herbicides may be warranted to prevent seed set and promote weed control. The advice of an ecologist and agronomist will be sought to advise on the control of weed infestations.

A detailed weed management procedure is provided below.

Weed Inspection

During construction, the HSEQ Manager will do the following weed inspections:

- Survey weed distribution across the project site monthly
- Survey weed abundance in exclusion zones monthly.
- Targeted weed inspections prior to clearing and grubbing in the affected area.
- Survey weed distribution and abundance where a previous weed infestation has been identified.

During operation, Mid-Western Regional Council will implement their own procedures and monitoring programs for weed inspection for Stage 1 works.

Proponent would undertake a follow up inspection 6 months after the completion of the road upgrades to assess weed growth and any new infestations.

Infestations of invasive weeds will be mapped with GPS, including noting the species and degree of infestation, and capturing an image for monitoring purposes. Data collected from inspections will be used as a basis for implementing seasonal targeted weed control measures.

Weed Treatment

During construction of the project, weed control will be based on data collected from survey and inspections of the project site and of exclusion zones. Targeted weed control measures for any recorded weed outbreaks will be implemented within a fortnight of discovery. The aims of construction weed treatment include:

- Apply weed treatments to all mapped invasive weed infestation areas.
- Reduction in invasive weed distribution by at least 50% in mapped infestation area.
- No more than 10% of groundcover to be weeds in zones 1, 2, 5, 6 and 8 (no increase in baseline conditions). Zones 3, 4, 7 and 9 where existing baseline conditions of baseline vegetation is more than 10% weed groundcover would not be left in a worse condition than that prior to construction.

A general guide to weed control and management is presented above. More detailed information, including herbicide types and application rates, can be sought from the Contractor Ecologist or from the WeedWise website (http://weeds.dpi.nsw.gov.au/). Consultation with Local Land Services (LLS) will also be undertaken to ensure a coordinated approach with other landholders in the area.

The introduction and spread of weeds via vehicles and plant will be controlled by the Vehicle Hygiene Procedure provided in section 7.6.

Herbicide Application Record

Herbicide application will only be carried out by authorised personnel (i.e. ChemCert accreditation – AQF 3) in accordance with SafeWork requirements.

Herbicides will only be applied in accordance with the Safety Data Sheet (SDS) for that product.

A Herbicide Application Record (Appendix B.2) will be completed and public notifications made in accordance with relevant legislation, where herbicides are to be used in areas that could be accessed by members of the public.

Follow-up Inspection

The HSEQ Manager will ensure that a follow-up inspection is undertaken of identified weed infestation sites to ensure treatment was successful.

Weed Disposal

Where invasive weed areas are disturbed by construction activities, weeds and topsoil that may contain weed propagules will be removed and disposed of appropriately.

Where weeds cannot be effectively destroyed prior to topsoil stripping, weed contaminated topsoil will be isolated and either encapsulated by deep burying, or disposed of at an approved offsite licensed facility as directed by the HSEQ Manager.

Ongoing Management and Monitoring

Monitoring of weed infestations will occur as part of the routine environmental inspections throughout construction to determine effectiveness of management controls. The presence of any weeds and the necessary management actions will be noted on the Environmental Inspection Checklist (included in the EMS). Please note any occurrences of pathogens such as Myrtle Rust and Phytophthora would be monitored, treated, and reported as required.

7.5.2. Animal Pest Management Procedure

No animal pest species requiring specific control measures were recorded during site surveys. However, some may be present at the site. Monitoring of animal pests and signs of their activity will occur as part of routine inspections during construction, and operation. A suitably qualified person will traverse the site to identify if vertebrate pests are present, including the following species as a minimum:

- European Rabbit
- European Hare
- Red Fox
- Feral Cat

The following data would be recorded and used to determine the need for pest animal control measures:

- Number and location of any tracks, traces or sightings
- Whether the level of activity is negligible, minimal, moderate or high.

If any are identified that are required to be controlled, the appropriate management actions listed at https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/pest-animals-in-nsw will be implemented, and noted on the Environmental Inspection Checklist.

Pesticide Application Record

As with herbicide applications, pesticides will only be administered by authorised personnel with ChemCert accreditation – AQF 3 and in accordance label instructions. A Pesticide Application Record (Appendix B.4) will be completed and public notifications made in accordance with relevant legislation, where pesticides are to be used in areas that could be accessed by members of the public. Only pesticides registered for use near water may be used near any waterways.

7.6. VEHICLE HYGIENE PROCEDURE

7.6.1. Vehicle Plant and Equipment Movement

Vehicle hygiene procedures will be implemented for any vehicle that enters the development site during construction which is likely to come into contact with the natural ground or weeds. The procedures include:

- Inspection upon arrivals in laydown area.

- Removal of dirt and/or plant matter from newly arrived vehicles at a designated washdown area by trained site personnel.
- Washing and inspection prior to vehicles being given the all clear to enter indirect disturbance areas.
- Inspection and washing after leaving indirect disturbance areas and prior to leaving the site.
- Inspections and washdowns will be recorded on a Vehicle Hygiene Register. An example is shown in Appendix B.5 .

Any water from the washdown area will be managed in accordance with the ESCP.

7.7. VEGETATION CONSTRAINT MANAGEMENT

7.7.1. Management Areas

Exclusion zones outside the approved disturbance areas will be managed throughout construction and operation to protect them from any impacts from the project.

The aim of vegetation constraint management is for the condition of this vegetation to be maintained or improved during the lifetime of the project.

The following target has been established:

- Maintain or improve the condition of vegetation in exclusion zones throughout construction and operation of the project including vegetation connectivity.

7.7.2. Management Actions

Vegetation Constraints

Exclusion zones will be demarcated prior to clearing in accordance with the Vegetation Clearance Procedure (Section 7.2), at no closer than the dripline around terrestrial exclusion zones. These zones will be demarcated to ensure that vegetation is not impacted accidentally. This may consist of star pickets at 4 to 5 m intervals with a strand of plain wire and flagging tape. The location of exclusion areas will be communicated to site staff (including equipment operators) through site inductions, toolbox talks and targeted training prior to works taking place in the vicinity.

Indirect impacts on vegetation constraints will be reduced by:

- Avoiding vehicle or plant access within exclusion zones.
- Where night works cannot be avoided, work must not take place within 100 m of exclusion zones.
- Directing lights away from exclusion zones.
- Noise-emitting plant will be oriented so that noise will be directed away from exclusion zones.
- When not in use, vehicles and plant will not be left idling near exclusion zones but will be switched off whenever possible.
- Reducing the use of machinery and vehicles within areas of EEC where possible (noting that solar farm infrastructure will cover the majority of the Development Footprint). In areas where clearing is required under existing overhead transmission lines should be undertaken using chainsaws where possible. Once access tracks are establish these should be utilised to traverse the site as much as possible.

Weed Management

There is a risk of weed encroachment during construction and operation from infested areas into exclusion zones, and potentially from exclusion zones into disturbed areas following groundcover rehabilitation. To manage these risks, weed management as described in Section 7.5 will include monitoring exclusion zones and implementing weed control measures as required throughout construction and operation.

Weeds in the exclusion zones will be controlled in accordance with the Weed Management Procedure (Section 7.5).

Response to Decline in Condition

If a quantitative assessment of vegetation constraint condition determines the need for an additional management response, actions may include but are not limited to:

- Erect permanent fencing to exclude stock and human/vehicle access.
- Targeted weed or pest control.
- Groundcover rehabilitation and shrub/tree plantings for habitat enhancement.

Fauna Connectivity

Maintain connectivity of vegetation to be retained, this will involve the installation of fences with no barbed wire on the top strand and/or the use of fauna crossing structures to enable arboreal fauna movement across roadways.

7.7.3. Noise, Light and Dust Management

Construction will avoid night work where possible. If night works are required lights will be directed away from vegetation. The EMS will detail further noise and light controls. Adaptive dust monitoring programs will be detailed in the EMS.

7.7.4. Riparian Zones around 4th Order Waterways

For Stage 3 construction works a 40m buffer zone from the bank of the waterway will be demarcated (per Section 7.2.1) to protect the riparian vegetation around the two 4th order stream under the Strahler System, within the development footprint (Wollar Creek and Spring Flat Creek). The EPC contractor will be responsible for demarcating this area.

Construction within the buffer zone will be avoided with the exception of the construction of crossings for the internal access roads and for the installation of underground cables. If Stage 4 of the development is undertaken the existing crossing over Wollar Creek will be upgraded. The design and construction of the waterway crossings (in the form of bridges or culverts) will need to consider the requirements of the following publications:

- Why do fish need to cross the road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003).
- Policy and Guidelines for Fish Friendly Waterway Crossings (NSW DPI, 2003).
- Guidelines for Watercourse Crossings on Waterfront Land (NSW DPI, 2012).
- Guidelines for Laying Pipes and Cable in Watercourses on Waterfront Land (NSW DPI, 2012).

8. PERFORMANCE CRITERIA, TRIGGERS AND RESPONSES

Table 8-1 below provides a summary of the key performance criteria and triggers for corrective actions. The actions to be implemented should the trigger arise are also described. This combined with the monitoring described in Section 9.3 forms the Trigger, Action Response Plan (TARP) for the Project. The monitoring triggers have been used to inform the triggers for protocols and procedures that require monitoring in Table 8-1.

Table 8-1 Summary of performance criteria, triggers for actions and responses for environmental management protocols associated with the project

Management Protocol	Performance Criteria	Risk of not achieving performance criteria	Trigger for additional actions	Action Proposed
Ground disturbance protocol (section 7.1)	• Ground disturbance permit process implemented prior to construction. • Remediation activities completed and conditions of the permit met. • Final disturbed area recorded.	Low – Standard construction procedure that contractor will be familiar with.	• Permit not obtained. • Remediation activities not completed. • Final disturbance area not recorded.	• Escalate matters above the HSEQ Manager to ensure compliance with this BMP.
Vegetation clearance procedure (section 7.2)	• No more than 463.28ha of vegetation impact within management zones (16.46ha zone 1, 102.3ha zone 2, 110.72ha zone 3, 12.83 zone 4, 7.99ha zone 5, 102.83ha zone 6, 31.64ha zone 7, 0.14ha zone 8 and 27.07ha zone 9). • Pre-clearance surveys conducted. • No impacts on exclusion zones. • Establishing ground cover as soon as possible to prevent erosion and weed invasion (groundcover to achieve seed set of at least 80% cover).	Low – Clearing area will be clearly demarcated prior to clearing commencing. Pre-clearance requirements are detailed in this BMP. Exclusion areas will be clearly identified.	• Pre-clearance surveys not completed. • Clearing outside of approved clearing areas. • Clearing of trees not identified for removal.	• Clearing works will not commence until required surveys are completed. • If clearing occurs outside of marked clearing areas or of marked trees, works will cease immediately and advice sought from BCD as to whether further assessment/approval requirements are applicable.

Management Protocol	Performance Criteria	Risk of not achieving performance criteria	Trigger for additional actions	Action Proposed
Re-use of resources protocol (section 7.3)	• Coarse Woody Debris, Rocks and Topsoil (as described in Section 6.1) removed during construction are retained. • Retained resources are relocated appropriately into exclusion zones for habitat.	Low – Standard construction practice.	• Resources stockpiled and not relocated.	• Resources to be relocated immediately under the Guidance of a Ecologist to ensure minimal damage to the exclusion zone.
Unplanned Threatened Species Finds Procedure (section 7.4)	• Threatened Species Finds Procedure followed if threatened species found. • No harm to threatened species.	Moderate – Not all personnel on site will have the skill to be able to identify threatened species.	• Threatened species found to be present (living or dead) that was not previously identified.	• Prepare and implement an education program for personnel working on site to increase awareness of threatened species that may be encountered.
Weed and Pest Management Protocol (section 7.5).	• A general reduction in the abundance of weeds in exclusion zones during the operation period, with groundcover to be less than 10% weeds in appropriate zones as per section 7.5.1. • New invasive weeds detected in proposal site are controlled during operation as per the weed management procedure (7.5.1). • Pest animal populations maintained at a low level of activity.	Low to moderate – Weed abundance is highly dependent on seasonal conditions and the amount of seed stored within the seed bank. Similarly, Pest animal abundance is seasonally variable and influenced by external factors such as management by adjacent landholders. However, weeds and pests are manageable with appropriate	• Presence of weeds detected during monitoring. • New weed species on site detected during monitoring. • Moderate or High levels of observed pest animal activity.	• Eliminate weed species as soon as practicable in accordance with recommended control methods and timing. • Increase targeted weed or pest animal control measures (Section 7.5). • Seek additional advice from Local Land Services and adhere to recommendations.

Management Protocol	Performance Criteria	Risk of not achieving performance criteria	Trigger for additional actions	Action Proposed
		treatment applied in a coordinated approach by trained personnel.		
Vehicle Hygiene Procedure (section 7.6)	• Vehicle hygiene procedures implemented for all vehicles.	Low – Standard site procedure.	• Vehicle hygiene procedures not being implemented.	• To be raised with HSQE managemen on site. Ensure it is included in site inductions, toolbox talks etc and that staff responsible are implementing th procedure.
Vegetation Constraint Management (section 7.7)	• Maintain or improve the condition of vegetation in exclusion zones throughout construction and operation of the project. • Quarterly surveys of weed abundance in exclusion zones and use as basis for implementing targeted weed control measures in each zone throughout construction and operation. • A general reduction in weed abundance in exclusion zones throughout the operational period, with groundcover to be less than 10% weeds in appropriate zones.	Moderate – Condition of vegetation in general is highly dependent on climatic conditions and is variable from year to year. Active management measures can be implemented to improve the condition of vegetation in exclusion zones with a reasonable degree of confidence of success.	• Decline in exclusion area condition as evidenced by monitoring. • Weed abundance not decreasing within exclusion zones. • Moderate to high pest animal activity recorded in exclusion zones.	• Investigation into reason for decline by suitable qualified person(s). Recommendations following investigation to be followed which may include but not be limited to: • Erect permanent fencing to exclude stock and human/vehicle access. • Targeted weed or pest control. • Groundcover rehabilitation and shrub/tree plantings for habitat enhancement.
Groundcover management (Appendix A)	• Rehabilitate all disturbed areas not required for the operation of the roads. • Revegetation of disturbed areas will have 70% ground cover over 90% of disturbed areas within 12 months of establishment and maintained	Moderate – Condition of groundcover will be dependent on climatic conditions and will also be affected by other	• Groundcover below 70% cover of 90% of disturbed areas. • Weed coverage greater than 10% in zones 1,2,5,6 or 8.	• Additional watering of seeded areas. • Weeds controlled where required. • Treat soil conditions such as compaction, frequency of traffic movements, low seedbank storage,

Management Protocol	Performance Criteria	Risk of not achieving performance criteria	Trigger for additional actions	Action Proposed
	throughout operation until contract completion. • Native species will be used for revegetation wherever practicable in areas identified as native grassland as well as exotic vegetation. • Targeted weed control measures will be implemented if weed cover exceeds 10% of groundcover in appropriate zones or if weeds are detected in appropriate zones. • Native species will be used for revegetation where practicable in areas identified as native grassland as well as exotic vegetation. • Failed vegetation patches greater than 5 m^2 will be revegetated. • Scours greater than 50 mm deep and 100 m long will be revegetated. • Ground cover will achieve seed set across at least 80% of area in 12 months.	management measures such as weed treatment. Success of sowing and seed set will also be dependent on climatic conditions and other variables.	• Presence of priority weeds. • Failed vegetation patches greater than 5 m^2. • Scours greater than 50 mm deep and 100 m long • Ground seed set below 80% of area after 12 months.	lack of soil moisture and nutrient imbalance. • Seek additional advice from an agronomist if seed set is not occurring.

9. COMPLIANCE MANAGEMENT

9.1. ROLES AND RESPONSIBILITIES

The Project Team's organisational structure and overall roles and responsibilities are outlined in the EMS. The Environmental Management Team includes the roles and responsibilities identified in Table 9-1 below.

Table 9-1 Roles and responsibilities – Environmental Management Team

Role	Responsibility	Authority
Contractor Project Manager	• Ensure resources are made available to enable works to comply with EMS and other environmental management requirements. • Ensure that all procedures are followed adequately. • Ensure appropriate approvals and licences are held. • Ensure all staff and contractors are aware of environmental compliance requirements and environmental controls. • Responsible for reporting pollution incidents.	• Order Stop-work for an activity that may cause material or environmental harm. • Release of environmental hold points, if required.
Contractor Health Safety and Environment and Quality Manager (HSEQ)	• Maintaining all environmental management documents. • Identifying where environmental measures are not meeting the targets and where improvements can be achieved. • Monitoring and reporting environmental compliance. • Reviewing Project environmental documents. • Reporting of pollution incidents.	• Recommend Stop-work for an activity that may cause material or environmental harm. • Release of environmental hold points, if required.
Contractor Site Manager	• Responsible for the implementation of environmental management plans. • Responsible for the induction of staff and contractors. • Responsible for all aspects of the worksite including the coordination and management of all staff and contractors.	• Order Stop-work if any items in the EMS are in danger of breach. • Approve and accept waste disposal methods requested by staff or contractors. • Approve minor changes to environmental sub-plans, including Erosion and Sediment Control Plans (ESCP).

Role	Responsibility	Authority
	• Undertake routine environmental site inspection. • Maintaining environmental records. • Receiving plant, materials and chemicals and ensuring all items are appropriately stored. • Responsible for addressing corrective actions arising from Environmental Inspections.	
Contractor Ecologist	• Supervise works being undertaken in environmentally sensitive areas. • Undertake pre-clearing surveys. • Provide advice where necessary	• Recommend Stop-work for an activity that may cause environmental harm.
All project staff: • Project Manager/Site Superintendent • Proponent and Contractor senior management • Technical Team	• Ensure contractors are working in accordance with the requirements of the EMS, as required under the EPC contract. • Undertake site visits during construction to monitor compliance with EMS requirements. • Report and raise any issues that arise that may have an environmental impact. • Report and raise the discovery of any artefacts, Aboriginal relics or places and cease work until the matter has been addressed.	• Report any issues that may have the potential to cause material or environmental harm. • Report any incidents or near-misses that may impact on the environment or breach conditions set-out in this EMS.

9.2. TRAINING

Employees, contractors and utility staff working on site will undergo site induction training relating to biodiversity issues. Targeted training in the form of toolbox talks or specific training will also be provided to personnel with a key role in biodiversity management, including vegetation clearing which will include information on the outcomes of pre-clearing surveys, constraints mapping, and digitally-captured clearance boundaries (Section 7.2). Targeted training would address the requirements of the legislative requirements (Section 2.1), and all conditions and commitments relating to biodiversity (Section 2.1.2, Section 2.1.4 and Section 8). Further details regarding staff induction and training are outlined in the EMS.

It will be emphasised to staff during toolbox talks and training that appropriate fauna management onsite is critical to the project. This includes:

- Pre clearance surveys and hollow bearing tree clearing protocols

- Driving carefully onsite and adhering to site speed limits
- Appropriate handling of fauna if required.
- Threatened species finds reporting.

9.3. MONITORING AND INSPECTION

Regular monitoring and inspections will be undertaken during construction and operation. The tables below include monitoring and inspection requirements during construction and operation (Table 9-2), with the trigger and response columns contributing to the TARP for the project

Table 9-2 Monitoring and inspection requirements during construction and operation.

Requirement	Timing	Responsibility	Trigger for additional action	Response proposed
CONSTRUCTION				
Pre-clearing inspections including checking for roosting/breeding habitat, recording tree hollows, marking habitat trees, demarcating area to be cleared, and targeted bat surveys between June and January.	Before vegetation clearing.	HSEQ Manager/Contractor Ecologist	Pre-clearing surveys not carried out or not in all areas required	Supplementary surveys undertaken
Progressive monitoring of the cumulative amount of vegetation cleared (Section 7.2.1), including inspecting exclusion zones to confirm that they have not been disturbed (Section 7.2.4). Prior to undertaking any vegetation clearing, this value will be compared to the total approved area to be cleared.	Before and after all vegetation clearing.	HSEQ Manager	Clearing outside approved clearing limits	HSEQ Manager to manage incident as required by EMS and relevant legislation/ approvals
Monitoring of high disturbance areas, groundcover, exclusion zones and boundary fence lines.	During site inspections undertaken during construction (at least monthly).	Contractor Site Manager	Damaged exclusion fencing or signage Storage or infrastructure underneath tree driplines.	Exclusion fencing/ signage replaced

Requirement	Timing	Responsibility	Trigger for additional action	Response proposed
Details of resource re-use placement	Recorded as it occurs.	Contractor Site Manager	Resources stacked, not distributed	Resources to be moved under direction of an Ecologist
Inspection of waterways.	During site inspections undertaken during construction (at least monthly).	HSEQ Manager	Evidence of siltation or pollution	Rehabilitate waterway and review spill procedures. Report where necessary.
A review of any fauna killed or injured on site. Threatened fauna mortalities will be reported to BCD and deaths of any birds from contact with fences or solar panels will be recorded. Fauna relocations due to vegetation clearing will be recorded.	During site inspections undertaken during construction (at least monthly).	HSEQ Manager	Presence of injured or deceased fauna	Report where necessary, record details of incident.
Weed and pest survey and mapping across project site (Section 7.5).	During site inspections undertaken during construction (at least monthly).	Contractor Site Manager	10% non native ground cover, or Presence of priority weeds, or New weed species on site.	Implement targeted weed and pest control measures (Section 7.5).
Quantitative assessment of condition of vegetation constraints.	Immediately following completion of construction.	HSEQ Manager	Vegetation condition declining	Investigation into reasons for decline by suitable qualified person(s) and adherence to recommendations.
Groundcover monitoring, including:	Fortnightly for first six months after establishment. 6 months after establishment.	Contractor Site Manager	Groundcover below 70% cover of 90% of disturbed areas (not including rocky areas where groundcover is not possible).	Bare patches greater than 5 m^2 will be recultivated and revegetated. Additional watering of seeded areas.

Requirement	Timing	Responsibility	Trigger for additional action	Response proposed
			Groundcover seed set below 80% of area . Presence of weeds	Weeds controlled where required. Treat soil conditions such as compaction, frequency of traffic movements, low seedbank storage, lack of soil moisture and nutrient imbalance.
OPERATION				
Monitoring of high disturbance areas, groundcover, exclusion zones and boundary fence lines, including:	Annually throughout operation	Operations Site Manager		
A review of any fauna killed or injured on site. Threatened fauna mortalities will be reported to BCD and deaths of any birds from contact with fences or solar panels will be recorded.	Annually throughout operation	Operations Site Manager	Presence of injured or dead animals	Report where necessary, record details of incident
Areas of priority weeds across project site will be mapped and controlled on a seasonal basis (Section 7.5).	Before spring, annually throughout operation	Operations Site Manager	Presence of priority weeds	Targeted weed control measures (Section 7.5)
A suitably qualified person will walk over the site to identify if vertebrate pests are present. • The following data would be recorded and used to determine the need for pest animal control measures: ○ Number and location of any tracks, traces or sightings	Annually throughout operation (August)	Operations Site Manager	Moderate or High levels of observed feral animal activity	Targeted pest animal control measures (Section 7.5.2)

Requirement	Timing	Responsibility	Trigger for additional action	Response proposed
○ Whether the level of activity is negligible, minimal, moderate or high				
Groundcover monitoring, including: • Grass cover would be monitored via a site walkover	Fortnightly for first six months after establishment. 6 months after establishment. Annually during operation (spring).	Operations Site Manager	Groundcover below 70% of 90% of disturbed areas. Groundcover seed set below 80% of area. Presence of priority weeds. Groundcover exceeding 10% weeds.	Bare patches greater than 5 m^2 will be recultivated and revegetated. Additional watering of seeded areas. Weeds controlled where required. Treat soil conditions such as compaction, frequency of traffic movements, low seedbank storage, lack of soil moisture and nutrient imbalance.

9.4. INCIDENT MANAGEMENT

All incidents will be managed in accordance with the incident response procedures contained in the EMS.

9.5. AUDITING

Audit requirements are detailed in the EMS.

9.6. REPORTING

Reporting requirements and responsibilities are outlined in the EMS.

10. REVIEW AND IMPROVEMENT

10.1. CONTINUOUS IMPROVEMENT

Continuous improvement of this BMP will be achieved by the ongoing evaluation of performance against the BMP environmental policies, objectives and targets to identify opportunities for improvement.

- The continuous improvement process will be designed to:
    - Identify areas of opportunity for improvement of environmental management and performance.
    - Determine the cause or causes of non-conformances and deficiencies.
    - Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies.
    - Verify the effectiveness of the corrective and preventative actions.
    - Document any changes in procedures resulting from process improvement.
    - Make comparisons with objectives and targets.

Review procedures are contained in the EMS.

10.2. BMP UPDATE AND AMENDMENT

This BMP may need to be revised if the construction program, scope of work, or work methods change, if the work methods are found to be ineffective, or if directed by the Proponent. This will occur as needed and in accordance with the process outlined in the EMS.

A copy of the updated BMP and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure identified in the EMS.

An extension for retirement of Biodiversity offsets has been requested by the client. The outcome of this request will determine appropriate action, and an amendment to this BMP may be required.

10.3. DOCUMENT CONTROL

Document control procedures are outlined in the EMS.

11. REFERENCES

Amber. (2019). *Wollar Solar Farm - Traffic Impact Assessment.*

Department of Primary Industries. (2020). Retrieved from NSW WeedWise: https://weeds.dpi.nsw.gov.au/

NGH Environmental. (2019). *Amendment Report - Wollar Solar Farm.*

NGH Environmental. (2019). *Environmental Impact Assessment - Wollar Solar Farm.*

NGH Environmental. (2020). *Submissions Report Wollar Solar Farm.*

APPENDIX A GROUNDCOVER MANAGEMENT PLAN

A.1 INTRODUCTION

This Groundcover Management Plan has been planned to address the requirements of the relevant conditions and commitments listed in the project Conditions of Consent (CoC) from the NSW Minister for Planning (bold points in Table 11-1). Specifically:

Table 11-1 conditions of consent relevant to the GCMP

Schedule 3 condition 11 ***The Applicant must maintain the agricultural land capability of the site, including:*** *(c)* ***establishing the ground cover of the site within 3 months following completion of any construction or upgrading;*** *(d)* ***properly maintaining the ground cover with appropriate perennial species and weed management; and*** *(e)* ***maintaining grazing within the development footprint, where practicable,*** ***unless the Secretary agrees otherwise in writing.***
Schedule 3 condition 14 *Prior to commencing the development, the Applicant must prepare a Biodiversity Management Plan for the development in consultation with BCD, and to the satisfaction of the Secretary in writing. This plan must:* ***c)*** *include a description of the measures that would be implemented for:* ***ix.*** *protecting vegetation and fauna habitat outside the approved disturbance areas;* ***x.*** ***managing the remnant vegetation and fauna habitat on site;*** ***xi.*** ***minimising clearing and avoiding unnecessary disturbance of vegetation that is associated with the construction and operation of the development;*** *xii.* *minimising the impacts to fauna on site and implementing fauna management protocols;* *xiii.* *avoiding the removal of hollow-bearing trees during spring to avoid the main breeding period for hollow-dependent fauna;* ***xiv.*** ***rehabilitating and revegetating temporary disturbance areas with species that are endemic to the area;*** *xv.* *maximising the salvage of vegetative and soil resources within the approved disturbance area for beneficial reuse in the enhancement or the rehabilitation of the site; and* ***xvi.*** ***controlling weeds, feral pests and pathogens; and*** ***d)*** ***include details of who will be responsible for monitoring, reviewing and implementing the plan, and timeframes for completion of actions.***

The overarching objective of this plan is to stabilise the soil surface, protecting it from erosion, weed infestation and a loss of soil capability. Secondly, it aims to retain as much as possible the existing native ground cover component, as this provides the best long term resilience and has great biodiversity benefits. This plan:

- Provide guidance that will assist to minimise impacts and thereby avoid extensive rehabilitation actions
- Provide clear triggers for action, regarding the need for actions

- Provide strategies that can be used to develop and maintain a resilient groundcover that will persist for the operational life of the project

It is relevant to both the construction and operation period of the project, with the timing of actions summarised in Table 11-2. It is noted that conditions will vary over the long lifetime of this project. The triggers set may need consideration of external factors, such as drought, and attention to adaptive management to meet the plan's objectives.

Table 11-2 Applicability of groundcover management activities.

	Construction	Operation
REHABILITATION TRIGGERS	**Temporary disturbance**	**Under panels**
	Exclusion zones	
GROUNDCOVER ESTABLISHMENT ACTIONS	**Ripping**	N/A
	Sowing	N/A
	Hydromulching/hydroseeding	N/A
	Fertiliser	N/A
	Drains and batters	N/A
GROUNDCOVER MAINTENANCE ACTIONS	**Monitoring**	
	Maintenance	
	Weed control	

A.2 GUIDANCE TO MINIMISE IMPACTS

General triggers for action are provided in section A.3, however, it is noted that different areas will respond differently to disturbance and rehabilitation actions and this should be considered in planning works onsite and rehabilitation strategies.

Generally, the soils present on the Wollar Solar Farm site are poorly to imperfectly drained with low to moderate fertility, highly alkaline subsoils and low plant available water holding capacity. They are subject to waterlogging. Adaptive management should be employed in response to the results obtained.

The following hierarchy should be considered to minimise the rehabilitation actions required for the project.

Table 11-3 Priorities for reducing impacts on existing groundcover.

	Comments
Consider existing biodiversity values	
Exclusion zones	**These areas are in good condition and have good biodiversity values. They should be protected from all impacts and rehabilitation actions, where required, should be planned very carefully to manage potential for indirect adverse impacts. It is an assumption of the consent that no project impacts will occur in these areas.**
Under panel areas	**Where perennial native cover exists, this should be protected as much as possible to preserve stability and seed source for the operational phase of the project. The less impact that occurs in these areas, the less work will be required in re-establishing and maintaining cover.**
In areas with more native species composition	As above, where perennial native cover exists, this should be protected. These equate to the following zones; • **Zone 1 – PCT 1303 White Box – Grey Gum** (mix of native and exotic groundcovers) • **Zone 2 – PCT 1303 Derived Native Grassland** (mix of native and exotic groundcovers) • **Zone 3 – PCT 1303 Cultivated Low Condition** (dominated by Red Grass (***Bothriochloa macra***) with mix of exotic and native groundcover) • **Zone 5 – PCT 281 Box Gum Woodland** (diverse mix of native and exotic groundcovers) • **Zone 6 – PCT 281 Derived Native Grassland** (mix of native and exotic groundcovers) • **Zone 8 – PCT 1610 White Box – Black Cypress** (mix of native and exotic groundcovers) • **Zone 9 – PCT 1610 White Box – Black Cypress** (mix of native and exotic groundcovers) **Locations of these vegetation zones are shown in Figure 11-1 and Figure 11-2.**
Consider existing soil values	
Waterlogging	The majority of soils on the site are classified as moderation risk of waterlogging. Resulting soil compaction will make soil conditions poorer, in terms of supporting plant growth. Works in waterlogged areas should be minimised.
Salinity	The majority of soils on site are classified as 'non-sodic' and the risk of salt build-up is low. However, there were some sodic soils identified from soil survey (McMahon 2019) (Appendix D) which may pose higher risk of salt build up and discharge. This can affect plant growth. Species selection and maintenance actions may need specific input from an agronomist.

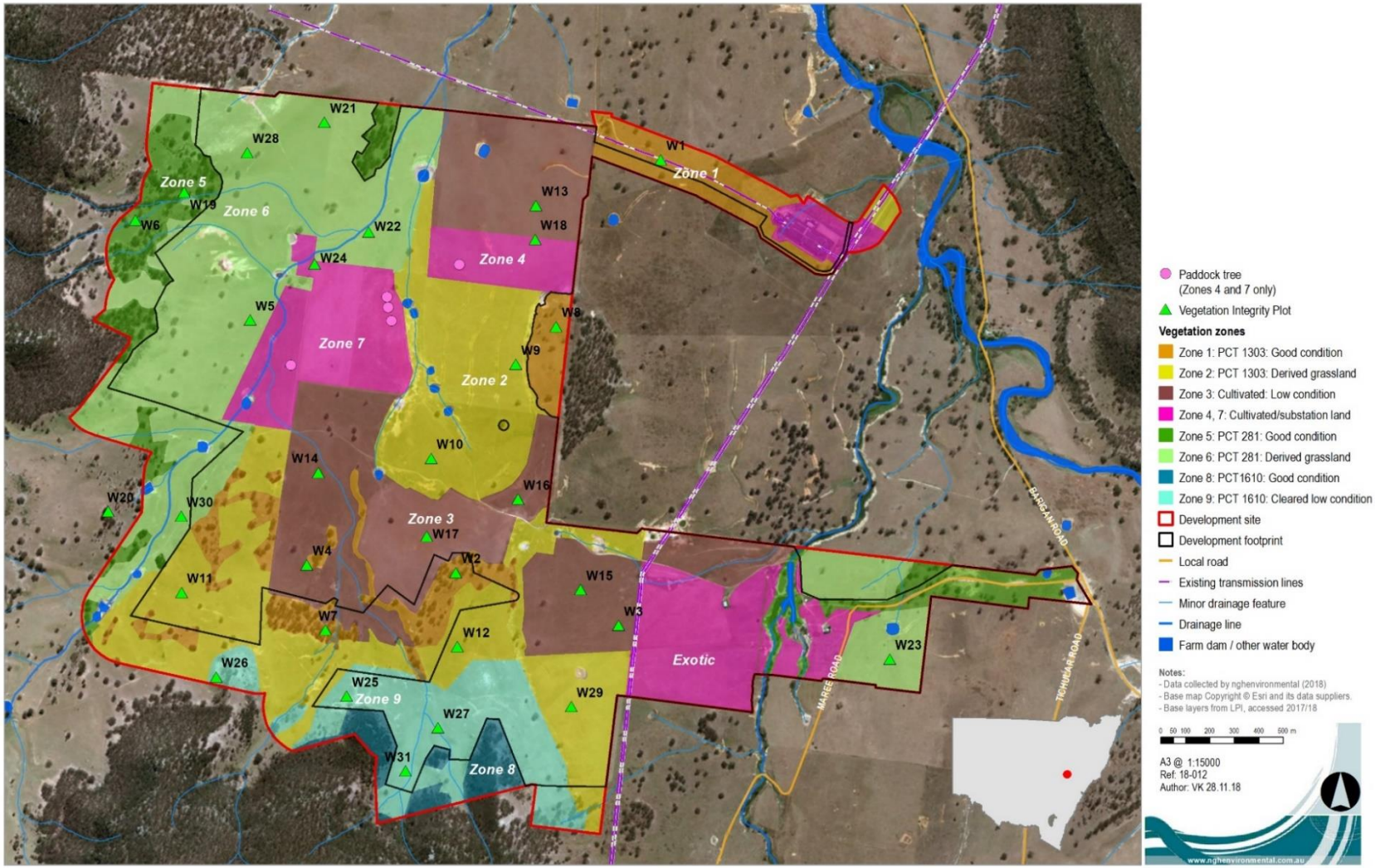


Figure 11-1 Vegetation Zones (Map 1 of 2)

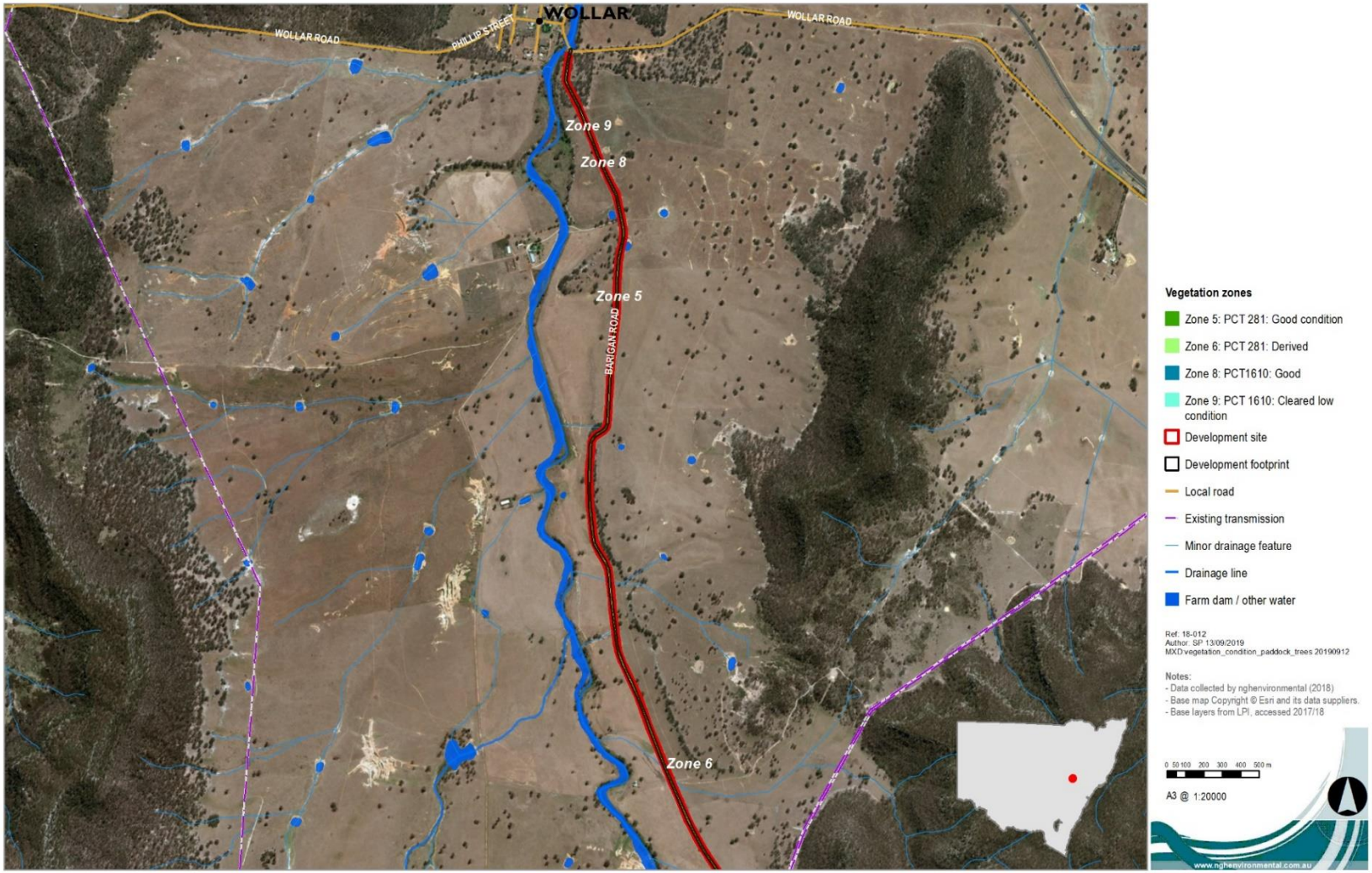


Figure 11-2 Vegetation Zones (Map 2 of 2)

A.3 REHABILITATION TRIGGERS FOR ACTION

A3.1 Temporary disturbance areas

Areas temporarily disturbed for the Project will need to be rehabilitated and revegetated as soon as practicable. Temporarily disturbed areas may include:

- Grassland mowed for piling installation.
- Temporary tracks and batters for permanent tracks
- Construction laydown areas.
- Cable trenches.

The aim of the rehabilitation and revegetation is to stabilise disturbed areas and to return it to a condition that is similar to its pre-disturbance state, meaning that native groundcover comprising vegetation plant communities are returned to these locations. In some areas where poor or no groundcover existed prior to the development (for example rocky or heavily eroded areas) it may not be possible to achieve the targets.

The following targets have been established:

- Rehabilitate all disturbed areas not required for the operation of the solar farm.
- Revegetation of disturbed areas will have 70% ground cover over 90% of disturbed areas within 12 months of establishment and maintained throughout operation until contract completion:
    - Failed vegetation patches greater than 5 m^2 will be revegetated.
    - Ground cover will achieve seed set across at least 80% of area.
    - Native species will be used for revegetation wherever practicable in areas identified as native grassland as well as exotic vegetation.
- Revegetation of disturbed areas will have 70% ground cover over 90% of disturbed areas within 12 months of establishment or corrective actions would be implemented:
    - Failed vegetation patches greater than 5 m^2 will be revegetated.
    - Scours greater than 50 mm deep and 100 m long will be revegetated.
    - Targeted weed control measures will be implemented if weed cover exceeds 10% of groundcover or if priority weeds are detected.
    - Ground cover will achieve seed set across at least 80% of area.
    - Native species will be used for revegetation.

A3.2 Areas under solar panels

Areas which will be under solar panels during operation of the Project will need to be rehabilitated and revegetated as soon as practicable. The aim of the rehabilitation and revegetation of these areas is to maintain and establish a perennial native pasture underneath the panels. In some areas where poor or no groundcover existed prior to the development (for example rocky or heavily eroded areas) it may not be possible to achieve the targets.

The following targets have been established:

- Establish perennial native pasture under solar panels prior to completion of construction.
- Revegetation of areas under solar panels will have 70% ground cover over 90% of disturbed areas within 12 months of establishment and maintained throughout operation until contract completion:
    - Failed vegetation patches greater than 5 m^2 will be revegetated.
    - Ground cover will achieve seed set across at least 80% of area.
    - Native species will be used for revegetation wherever practicable in areas identified as native grassland as well as exotic vegetation.

A.4 GROUNDCOVER ESTABLISHMENT

The following methods will be used, where necessary, in establishing or improving native perennial groundcover where required to meet the targets set out in A.2. This may be in temporary disturbance areas, areas to be protected from impacts (exclusion zones) or in areas that will be under the solar array (ideally, prior to the installation of panels). This will ensure a more resilient groundcover better able to resist weed ingress and erosion in the long term.

Not all methods will be used, the condition of the area to be rehabilitated will determine which are required to reach the target condition. Where groundcover is already at 70% over 90% of a disturbed area, revegetation works may not be necessary. However, weed management strategies described in Section 7.5 may be required if exotic weed populations are greater than 10%.

Due to climatic conditions (evaporation rates), native grassland establishment is best attempted over late autumn, winter or early spring. Wet summers are also able to maintain established perennial pasture growth in summer active species. Summer rainfall is less reliable than summer evaporation, and as such revegetation is also less reliable. Rehabilitation and revegetation will therefore commence in late summer/early autumn as temperatures decrease and evaporation rates fall.

A4.1 Ripping and topsoiling

Topsoil will be replaced on all areas from where it has been removed. Prior to the application of topsoil, compacted areas will be tined or ripped to a depth of 150 mm to loosen the surface. Areas that are not compacted will not be ripped in order to reduce soil disturbance.

Topsoil should be replaced over the surfaces, to achieve a similar depth as prior to removal (targeting 30 cm where the amount of retained topsoil from the site permits). The topsoil must be free of rocks and sticks greater than 10 mm in diameter or 500 mm in length. If the surface sets hard after rain, harrow the topsoil prior to sowing seed.

Spray any undesirable grass/weed growth on topsoil stockpiles with a knockdown herbicide before spreading topsoil. More than one application of herbicide may be required. Apply the last application of herbicide not less than 4 weeks before spreading the topsoil or as per manufacturer's instructions.

A4.2 Broadcast sowing

Undertake sowing using either:

a) A tractor drawn seed drill to place seed at a depth of 5 mm or less; or
b) A spreader followed immediately by a single pass with an unweighted diamond harrow.
c) By hand, where machinery would be a hindrance.

Where safe to do so, tractor passes with the seed drill or harrow will follow the finished surface contours. Distribute seed and fertiliser evenly over the areas to be sown at the rates specified below. Apply fertiliser concurrently with the seeding operation.

Calibrate the drill and monitor the seed and fertiliser application rates to ensure an even distribution over the areas sown, in accordance with the rates nominated. Maintain records of measurements and calculations to determine actual distribution rates for areas treated.

Dry sowing native species on small areas where machinery would be a hindrance can be achieved by mixing seed to sand at a ratio of 1:10 and spreading across the area by hand.

In areas with an existing native-dominated groundcover, the ground surface will not be disturbed before sowing unless deemed necessary by an agronomist.

A4.3 Hydromulching and hydroseeding

Carry out hydromulching / hydroseeding within 5 – 10 days of completed soil preparation or, if delayed by the weather conditions as soon as conditions permit.

Continuously agitate the slurry of seed, fertiliser, binder (60 kg/ha Guar gum), mulch, and water (35 kilolitres (kL)/ha) to maintain a uniform consistency during application. Apply the sprayed slurry uniformly over the whole surface, ensuring that all surfaces are sprayed from two directions to ensure complete coverage. Within 48 hours of application, the sprayed hydromulch layer must have a minimum thickness at any location of 5 mm when using sugar cane mulch, or 2 mm when using wood fibre or shredded paper.

Where straw (5 tonnes (t)/ha) is used for mulch, apply the straw mulch uniformly using a purpose-made blower unit. Incorporate the emulsion (bitumen) as a spray into the air stream of the mulch blower or apply it in a separate operation within 12 hours from the application of straw mulch. Within 48 hours of application, the straw mulch layer must have a minimum thickness at any location of 25 mm.

Do not apply hydroseeding/hydromulching and straw mulching if:

- Winds exceed 15 km/hr.
- Temperatures exceed 37^{o}C.
- The surface is water-logged.
- During rain periods or when rain appears imminent.

A4.4 Native grass sowing

The soils on the site are poorly to imperfectly drained with low to moderate fertility, highly alkaline subsoils and low plant available water holding capacity. Plant species need be selected that are adapted to these conditions.

A mixture of native pasture species will be used to minimise the risk of exotic weeds encroaching into exclusion zones. Only those which are likely to occur in the PCTs identified in the project area will be used. Care will be taken to ensure sufficient plant densities. Component groundcover species from either PCT 1303, PCT 281 or PCT 1610 as appropriate will be used for any direct seeding of bare ground triggering corrective action targets. Exact species and seeding rates for this Project will be determined in consultation with the district agronomist and landholder to determine what is most appropriate for the property.

Exotic species may be selected either as a cover crop or to provide long-term stability, where native vegetation is not meeting stability objectives.

A4.5 Sowing and fertiliser rate

The soils on the site are poorly to imperfectly drained with low to moderate fertility, highly alkaline subsoils and low plant available water holding capacity. The sandy surface and pale subsurface layers (where present) generally mean that nutrient content is low in these soils, as is their ability to hold onto nutrients.

Addition of gypsum may be required to alleviate dispersion risk. Increasing organic matter content with composted organics will improve fertility, assist nutrient retention and improve moisture holding capacity of these soils.

Fertiliser additions should be divided up into regular smaller applications during the growing season to limit leaching of nutrients. Dense subsoil material significantly restricts plant root extension into the subsoil. Stabilisation and revegetation targets and timeframes should be decided with reference to IECA (2008) guidelines.

Where necessary, apply pelletised poultry manure to be applied at a rate of around 250 kg/ha. Alternatively, apply Granulock® S (or similar: 16% nitrogen, 16.7% phosphorous, 12% sulphur) at around 150 kg/ha.

Consult with the district agronomist and landowner to determine pasture type and fertiliser rates suitable for each site.

A4.6 Open drains and batters steeper than 2:1

Lay the runs of the organic fibre mesh (jute mesh) along the direction of water flow or down the steep batter. In drains, slot the upstream end of the mesh into a trench 150 mm wide by 150 mm deep and pin the mesh to the base of the trench at 200 mm centres. Backfill the trench with soil and compact by foot. Lay the mesh taut and even over the soil surface without any air pockets, but do not stretch it. Overlap adjacent runs of mesh by 100 mm with the higher run overlapping the lower.

Pin the mesh along the sides of each run at 500 mm centres and along the middle of each run at 1 m centres. End overlaps must be 150 mm wide with the higher end overlapping the start of the lower and pinned at 200 mm centres.

Hydroseed or hand seed areas prior to jute matting. Spray a slow-setting anionic bitumen emulsion over the meshed surface at a rate of 0.8 to 1.0 litres (L) of undiluted residual bitumen emulsion per square metre.

A.5 GROUNDCOVER MAINTENANCE

A5.1 Monitoring

Groundcover will be monitored on a fortnightly basis for the first six months after establishment, every 6 months after establishment and annually during operation. Ground cover will be monitored using 1m x 1m quadrats placed within all treated locations to ensure cover does not fall below 70% and at 30 random locations within the development footprint. Any grazing stock would be removed from the affected area if cover falls below threshold levels and additional planting undertaken if there is no response within the following monitoring events. Including:

- Bare patches greater than 5 m^2 will be recultivated and revegetated
- Additional watering of seeded areas
- Weeds controlled where required e.g. where groundcover exceeds 10% weeds.
- Treat soil conditions such as compaction, frequency of traffic movements, low seedbank storage, lack of soil moisture and nutrient imbalance

A5.2 Maintenance

All revegetated areas will be maintained for 6 months after all sowing is complete throughout operation until contract completion. Proponent will direct where and when to water areas, by means of a fine spray, which causes minimal disturbance to seeded areas.

Dead vegetation will be cleared from areas showing poor growth or damage and all lost topsoil replaced. The area will then be recultivated and reseeded. Weeds will be controlled where required with herbicide or hand removal.

APPENDIX B TYPICAL SAMPLE REGISTERS

B.1 SAMPLE GROUND DISTRUBANCE PERMIT

Project: Wollar Solar Farm **Project No:**

Requested By:

Habitat Clearing Start Date: **Expected Completion Date:**

HABITAT CLEARING LOCATIONS – ATTACH DRAWINGS / SKETCHES IF NECESSARY

Location	Comments
This section to be completed by Contractor Ecologist and HSEQ Manager for clearing of trees, logs, rocky features, and other habitat features, with reference to constraints mapping.	
Has the limit of clearing been clearly delineated?	☐ Yes ☐ No
All trees / vegetation / habitat to be retained identified and exclusion zones fenced off?	☐ Yes ☐ No
State how identified:	
Have habitat trees been identified and appropriately marked?	☐ Yes ☐ No ☐ N/A
State how identified:	
Are specific targeted surveys required?	☐ Yes ☐ No
State how survey was completed, including results:	
Is there a risk of weed infestation or spread?	☐ Yes ☐ No

Are any animals present? **(If *Yes*, relocation required)**	☐ Yes ☐ No
Are any active nests/burrows present? **(If *Yes*, relocation required)**	☐ Yes ☐ No
If soil disturbance is to occur, has an Erosion and Sediment Control Plan been created, and have these controls been installed?	☐ Yes ☐ No
Following clearing works is planting required to stabilise the soil and prevent weed invasion? This is a requirement unless approved by the HSEQ	☐ Yes ☐ No
Have relevant workers been given toolbox talks on limit of clearing, fauna handling procedures and any other SHE Controls?	☐ Yes ☐ No
Can habitat features be re-used for habitat enhancement?	☐ Yes ☐ No
Can the habitat feature be re-used immediately?	☐ Yes ☐ No
If not re-used immediately, where will it be stockpiled*?	

Comments:

APPROVALS

Inspection completed by Contractor Ecologist (if required): **Date:**

Contractor Ecologist Signature Required

Approval by HSEQ Manager: **Date:**

HSEQ Manager Signature Required

* Stockpiles must not be placed within the dripline (extent of foliage cover) of any native tree.

SIGN-OFF (ONCE WORKS COMPLETED)

Have the conditions of the permit been met? **Date:**

HSEQ Manager Signature Required

B.2 SAMPLE THREATENED SPECIES REGISTER

Date	Species	Location and time captured	Location and time released	Behaviour and condition on release	Details of any injuries/ death	Contact details of vet/wildlife handler if transferred to their care

B.3 SAMPLE HERBICIDE APPLICATION RECORD

NSW GOVERNMENT Industry & Investment

Location, Applicator, Date of Application

Property/Holding: (residential address)					Date:
Applicator's Full Name:			Owner (if not applicator):		
Address:			Address:		
		Phone:			Phone:
Mobile:	Fax:	Email:	Mobile:	Fax:	Email:
Sensitive Areas (including distances, buffers): N / W / Treated Area / E / S			Comments (including risk control measures for sensitive areas):		

Host/Pest

Paddock Number/Name:	Paddock Area:	Order of Paddocks Sprayed:
Crop/Situation:	Type of Animals:	
Crop/Pasture Variety:	Age/Growth Stage:	
Growth Stage:	Mob/Paddock/Shed:	
Pest/Disease/Weed:	Animals — Number Treated:	
	Pest Density/Incidence: Heavy ❑ Medium ❑ Light ❑	

Application Data

Full Label Product Name:		Rate/Dose:	Water Rate L/ha:	
Permit No.:	Expiry Date:	Additives/Wetters:		
Total L or kg:	WHP:	ESI*:	Date Suitable for Sale:	
Equipment Type:		Nozzle Type:	Nozzle Angle:	Pressure:
Date Last Calibrated:	Water Quality (pH or description):			

Weather

Showers ❑ Overcast ❑ Light Cloud ❑ Clear Sky ❑

Rainfall (24 hours before and after)
Before: mm During: mm After: mm

Time (show time in this column)	Temperature °C	Relative Humidity (%)	Wind Speed	Direction	Variability (e.g. gusting)
Start					
Finish					

Comments:

* When using herbicides in mixtures with fungicides and insecticides, an ESI may apply to the non-herbicide component of the mixture.

B.4 SAMPLE PESTICIDE APPLICATION RECORD

Pesticide Application Record Sheet

NSW GOVERNMENT Industry & Investment

Location, Applicator, Date of Application

Property/Holding: (residential address)					Date:
Applicator's Full Name:			Owner (if not applicator):		
Address:			Address:		
		Phone:			Phone:
Mobile:	Fax:	Email:	Mobile:	Fax:	Email:
Sensitive Areas (including distances, buffers): N / W / Treated Area / E / S			Comments (including risk control measures for sensitive areas):		

Host/Pest

Paddock Number/Name:	Paddock Area:	Order of Paddocks Sprayed:
Crop/Situation:	Type of Animals:	
Crop/Pasture Variety:	Age/Growth Stage:	
Growth Stage:	Mob/Paddock/Shed:	
Pest/Disease/Weed:	Animals — Number Treated:	
	Pest Density/Incidence: Heavy ❑ Medium ❑ Light ❑	

Application Data

Full Label Product Name:		Rate/Dose:	Water Rate L/ha:	
Permit No.:	Expiry Date:	Additives/Wetters:		
Total L or kg:	WHP:	ESI*:	Date Suitable for Sale:	
Equipment Type:		Nozzle Type:	Nozzle Angle:	Pressure:
Date Last Calibrated:	Water Quality (pH or description):			

Weather

Showers ❑ Overcast ❑ Light Cloud ❑ Clear Sky ❑

Rainfall (24 hours before and after)
Before: mm During: mm After: mm

Time (show time in this column)	Temperature °C	Relative Humidity (%)	Wind Speed	Direction	Variability (e.g. gusting)
Start					
Finish					

Comments:

* When using herbicides in mixtures with fungicides and insecticides, an ESI may apply to the non-herbicide component of the mixture.

B.5 SAMPLE VEHICLE HYGIENE REGISTER

Date	Time in	Vehicle type	Destination	Driver name	Driver contact no.	Driver registration	Entrance wash (Y/N)	Exit wash (Y/N)	Time out	Inspection staff initials

APPENDIX C AGENCY INPUT ON BMP

C.1 BIODIVERSITY CONSERVATION DIVISION COMMENTS ON DRAFT

Our ref: DOC20/409481
Senders ref: 20-070

Ainslee Roser
Environmental Consultant
NGH Consulting
ainslee.r@nghconsulting.com.au

Dear Ainslee,

Wollar Solar Farm - Biodiversity Management Plan

Thank you for your email dated 28 May 2020 to the Biodiversity and Conservation Division (BCD) requesting review of the revised Wollar Solar Farm Biodiversity Management Plan (BMP).

BCD has reviewed the revised BMP and accompanying Groundcover Management Plan.

Successful management plans include tailored, quantitative performance measures and targets, completion criteria, monitoring and trigger points for corrective action which adhere to the SMART principles (specific, measurable, achievable, realistic, timely). The BMP generally adheres to these principles although it would be improved with the inclusion of clear quantitative triggers in Table 8.1.

It is noted that a target of weed cover exceeding 10% of groundcover is used in the Groundcover Management Plan. This is included as a performance criterion for groundcover management in Table 8-1 and for weeds across the project site during construction in Table 9-2. However, this is not clearly articulated in some sections of Table 8-1, for example on page 56 where performance is stated as "*A general reduction in the abundance of weeds in exclusion zones during the operation period*". It is also noted that only priority weeds are included in the operational stage in Table 9-2. A weed cover of less than 10% of groundcover should be consistently referred to as a target throughout the BMP.

In order to facilitate the finalisation of the Wollar Solar Farm BMP, BCD recommends:

- Table 8.1 be updated with clear quantitative performance criteria and triggers for additional actions; and
- Weed cover targets are consistent throughout the BMP.

Should you require further clarification on the items above please contact David Geering, Senior Conservation Planning Officer, via david.geering@environment.nsw.gov.au or 02 6883 5335.

Yours sincerely

Samantha Wynn
Senior Team Leader Planning - North West
Biodiversity and Conservation Division

4 June 2020

APPENDIX D SOIL SURVEY REPORT

SOIL SURVEY REPORT

PROPOSED
WOLAR SOLAR FARM

MAY 2019

DM McMahon Pty Ltd
6 Jones St (PO Box 6118)
East Wagga Wagga NSW 2650
t (02) **6931 0510** **www.dmmcmahon.com.au**

SOIL SURVEY REPORT

PROPOSED WOLLAR SOLAR FARM

May 2019

Project brief

At the request of Louiza Ramone of NGH Environmental Pty Ltd, soil sampling, analysis and reporting was carried out to assess the site in April 2019 for a proposed solar farm. The document provides information about the site and soil conditions from field observations and laboratory analysis.

Site identification

Address: 96 Maree Road, Tichular & 1066 Barigan Road, Barigan NSW.
Real property description: Lot 1 (DP 650653), Lots 10 & 11 (DP 1090027), Lot 7303 (DP 1139558) & Lots 22 – 27, 30, 45, 46, 51, 60 – 63, 69, 75 – 80, 92, 105 – 107 & 153 (DP 755430).
Centre co-ordinate: 776826E 6409385N MGA GDA z55
Property size: (investigated area) 465 ha approximately
Owner: Terry and Gail Marksell
Local Council Area: Mid-Western Regional Council
Present use: Broadacre Agriculture
Development Application Reference: N/A
Report identification: 5818

Certification

Name	Signed	Date	Revision Number
David McMahon CEnvP BAppSc SA GradDip WRM MEnvMgmt		20/05/19	00

Contents

List of Figures

List of Tables

Attachments

DM McMahon Pty Ltd 6 Jones St (PO Box 6118) Wagga Wagga NSW 2650
t (02) **6931 0510** **www.dmmcmahon.com.au**

1.0 Introduction

The report presents the results of a soil survey carried out by DM McMahon Pty Ltd (McMahon) for the proposed Wollar Solar Farm near Wollar, NSW.

The soil and land survey were commissioned by Louiza Romane of NGH Environmental Pty Ltd and was undertaken in general accordance with the provided scope of works as can be seen in **Section 3**. Zach Bradley of McMahon conducted a soil survey on 15 April 2019 using standard soil surveying techniques. The survey was carried out utilising an excavator to expose the soil profile to a depth of approximately 1.5 metres. Sampling and classification of in situ soils was carried out as per the Australian Soil and Land Survey Field Handbook (2009) and The Australian Soil Classification (ASC) (Isbell, 1996). Density of investigation pits was determined via Guidelines for Surveying Soil and Land Resources (2008) where selection of a 'Moderately High (Detailed)' intensity level was deemed appropriate for satisfying the objectives for detailed project planning.

2.0 Site characteristics

A desktop review and investigation of the topography, hydrology, soil, lithology, geology and hydrogeology of the site has been undertaken and are as follows.

2.1 Topography

The site is located over the Munghorn 1:25 000 Topographic Map (Sheets 8833-2S) at an elevation range of approximately 400m to 470m AHD. The landform of the site consists of gently inclined to steep slopes with open drainage lines and depressions forming the foot slopes to the surrounding mountains. Two large open drainages known as Spring Flat and Wollar Creeks, run parallel through the site towards the north north-east. Numerous smaller open depressions and drainage lines feed into the creeks from both sides from the surrounding ranges.

2.2 Vegetation

The site is currently used for broad acre agriculture, predominantly grazing including some areas of broadleaf cover crops. At the time of the soil survey, the majority of the site was covered with annual and perennial dry grasses with a few paddocks sown to pasture. Some broadleaf weed species such as thistles and burrs were present on site but were not prevalent, weed species were usually concentrated to the steeper slopes and around drainages. There are established eucalypt trees scattered throughout the property, mostly in clumps and along the drainages, depressions or property boundaries. A more detailed assessment of vegetation present can be seen in the NGH Environmental Impact Statement (NGH Environmental, 2019) for the site.

2.3 Weather

The mean rainfall for the Mudgee Airport AWS weather station (35km away) is approximately 663.2 mm per annum. The wettest months are December, November and January; with rainfall favouring the summer months. The mean maximum temperatures range from 1.4 ºC in July to 31.0 ºC in January and mean minimum temperatures range from 1.1 ºC in July to 16.1 ºC in January. Historical records retrieved from the Mudgee Airport AWS 062101 weather station (Bureau of Meteorology, 2019).

2.4 Hydrology

The site is located within the Goulburn River catchment with open drainages including Spring Flat Creek and Wollar Creek. Wollar Creek is fed by Spring Creek, Barigan Creek, Dry Creek and Brokers Creek, and runs NNE through the property parallel to Spring Flat Creek. Spring Flat Creek drains into Wollar Creek 1km north of the site. Wollar Creek drains into the Goulburn River which

meanders east through the Goulburn River National Park before draining into the Hunter River. The Hunter River terminates at the Fullerton Cove and Newcastle Harbor inlets which connect to the South Pacific Ocean. Upwards of 20 farm dams are present across the site, holding varying volumes of water, in varying condition and usually located along drainage and creek lines.

2.5 Soil & landform

The site lies with the mapping unit Barigan Creek (**bc**) from the Soil Landscapes of the Dubbo 1:250 000 Sheet, Murphy and Lawrie (1998). The mapping unit **bc** is described as:

Topography is lower slopes of sandstone plateaux escarpments, low undulating rises and creek flats. Horizontal beds of sandstone outcrop as benches. Elevations vary from 360 m - 470 m above sea level. Slopes between 2 - 10%. Local relief varies between 10 - 30 m. Stream channels are tributaries to larger streams.

Common soils are Yellow Podzolic Soils (Dy2.31; Dy2.41; Dy2.41) on lower slopes and along drainage lines. Red Podzolic Soils (Dr2.21) on higher colluvial slopes, benches and rises.

Limitations include high erosion hazard under cropping or where there is low surface cover; salinity in localised areas in drainage depressions.

2.6 Geology & lithology

The site geology forms part of the broader Sydney Basin with the associated geological units including the Illawarra Coal Measures and the Shoalhaven Group. Parent rock includes Permian sedimentary forms of shale, sandstone, conglomerate, chert, coal and torbanite, siltstone, sandstone, red-brown and green mudstone. In-situ colluvial and alluvial parent material also occupy the site.

2.7 Hydrogeology

From the Geoscience Australia hydrogeology dataset, the groundwater beneath the site is described as porous, extensive aquifers of low to moderate productivity over the south western extent of the site; and fractured or fissured, extensive aquifers of low to moderate productivity over the north eastern extent of the site.

3.0 Investigation scope of works

The specifications for the site investigation and soil survey are as follows, **Table 1**:

Table 1: *Scope of works*

Item	Description	Description
1.	Where available, review provided plans and other general related documents to gain a comprehensive understanding of the proposed project.	-
2.	Undertake a desktop study of local landform, geological, lithological & hydrogeological conditions.	See **Section 2.0**
3.	Conduct Dial Before You Dig search.	-
4.	Carry out field investigations by reference to Guidelines for Surveying Soil and Land Resources (2008) & AS1726:1993 Geotechnical Site Investigations.	25 pits in total. Samples of topsoils - A (A1, A2); and subsoils - B (B1, B2) and C horizons were taken when present to adequately classify soils as per the Australian Soil Classification (ASC).
5.	Analyse soils in situ and at NATA accredited laboratory to AS/RMS methods.	8 x representative samples for topsoil analysis – pH, EC, nutrient and cation status. 16 x representative samples for subsoil analysis – pH, EC, dispersion.
6.	Generate laboratory reports and review results.	-
7.	Compile results in report detailing methodology, desktop study, physical conditions, field work results, test locations, bore logs, in-situ test results, laboratory results and discussion.	-
8.	Recommendations for erosion control and prevention measures and management recommendations for earthworks.	-

4.0 Results

4.1 Field survey

A soil survey was conducted on 15 April 2019 using standard soil surveying techniques and a map of the investigated site and investigation pit locations can be seen as follows, **Figure 1**.

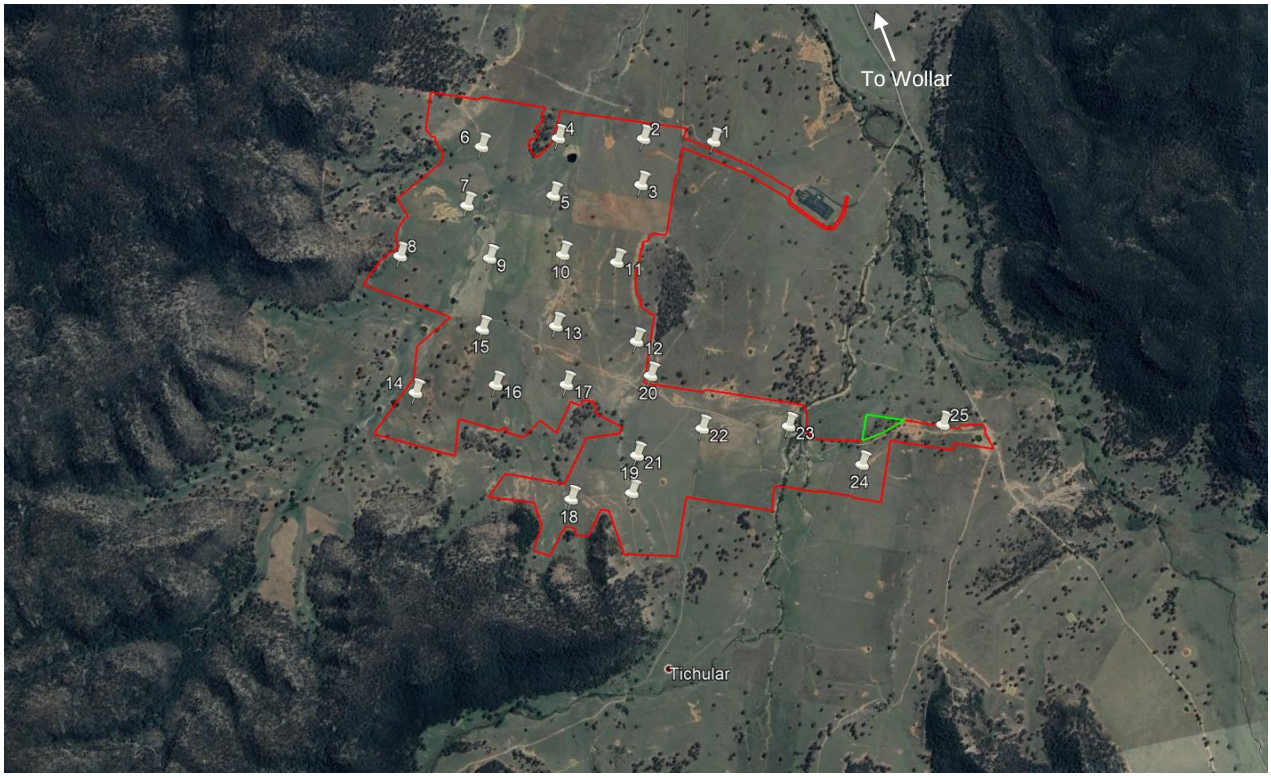


Figure 1: *Soil survey investigation pit locations with* ***Development Footprint*** *and* ***Potential Expansion Area.***

Sampling and classification of in situ soils was carried out as per the Australian Soil and Land Survey Field Handbook (2009) and The Australian Soil Classification, (Isbell, 1996). Density of investigation pits was determined via Guidelines for Surveying Soil and Land Resources (2008) where selection of a 'Moderately High (Detailed)' intensity level was deemed appropriate for satisfying the objectives for detailed project planning. Soils encountered were typical of the locale, generally falling into reconnaissance survey classes. Slight variations in profiles exist due to remnant parent formations, drainage plains and the complex soil sequences that are associated with such. Soil moisture contents varied between soil types but were generally found to be moderately moist to dry in the topsoil and subsoil and usually drier with depth. Free groundwater was not encountered to the investigated depth.

4.2 Typical soil profiles

Soils can be classified into a typical soil profile across the site as per the Australian Soil Classification (ASC) system (Isbell, 1996). Representative photographs from profiles examined on site can be seen below with a brief description of the profile characteristics. All soil pits investigated were located on managed agricultural lands. Field soil log sheets can be seen attached. Descriptions of the typical soil type encountered; Chromosols can be seen as follows.

4.2.2 Chromosols

Chromosols have a strong texture contrast between A and B horizons. There is a clear or abrupt textural B horizon in which the upper portion of the horizon (0.2m) is not strongly acid and not sodic. These soils are the most commonly encountered soils under agricultural use in Australia.

Figure 2:*Typical Chromosol profiles encountered on site*

Topsoil

Brown fine silty clay loams (darker, peaty soils with higher water content in the lower lying drainage areas), granular. pH (1:5 soil/water) 5.5 – 7.9 in the A horizon; to 10-40cm (average of 20cm) depth. Pronounced A2 horizon on the flatter low-lying areas. High organic matter at the time of investigation. Clear to diffuse boundary to subsoils as described below.

Subsoils

Moderately massive or polyhedral well developed structures across the majority of site with parent rock encountered within 1.5m on the higher elevated areas. Hues vary across the site with combination of yellow, red, grey and black encountered across different landforms in the B and C horizons (where encountered). Significant mottling occurred across the entire extent of the site, usually in the lower B horizon or C horizon. Texture included mainly medium to heavy clays with some sandy clays in areas of significantly weathered underlying parent material.

4.3 Laboratory analysis

Eight representative topsoil samples were obtained and analysed at a NATA accredited laboratory for the establishment of baseline soil data that may be referred to and used in preparation of a site decommissioning plan. Laboratory COA can be found in the attachments and topsoil soil parameters can be seen summarised in **Table 2**. 12 subsoil samples were also analysed for pH and EC, and tested for dispersion, **Table 3**.

4.3.1 Topsoil analysis

4.3.1.1 pH & Electrical Conductivity

Topsoil pH (1:5 soil/water) ranged from 5.5 – 7.9 and can be classed as ‘Moderately Alkaline’(8.4-7.9); ‘Neutral’ (7.3-6.6); ‘Slightly acid’ (6.5-6.1); and ‘Strongly acid’ (5.5-5.1) (Bruce & Rayment,

1982). Electrical Conductivity (EC) ranged from 0.04 to 0.18 dS/m and therefore the salinity rating was 'very low' (Agriculture Victoria, 2011).

4.3.1.2 Cation Exchange Capacity, Exchangeable Sodium Percentage & Dispersion

Cation Exchange Capacity (CEC) ranges from 4.5 to 12.8 cmol (+)/kg. CEC of the soils is rated by Hazelton and Murphy (2007), as 'moderate' (12-25), 'low' (6 – 12) and 'very low' (<6). Exchangeable Sodium Percentage (ESP) ranges from <1% to 10%. Soils are classified as 'non-sodic' when the ESP is <6%; and may be sodic and susceptible to dispersion if >6% (Agriculture Victoria, 2011).

4.3.1.3 Colwell Phosphorus and Phosphorus Buffering Index

Colwell P (plant available phosphorus) ranges from <5 to 16mg/kg, which is classed as 'very low' to 'moderate' (Hazelton and Murphy, 2007). Phosphorus Buffering Index (PBI) ranged from 35 to 97 and can be classed from 'low' (71-140), 'very low' (36-70), to 'very very low'(15-35) (Agriculture Victoria, 2011).

4.3.1.4 Calcium: Magnesium Ratio

Ca:Mg ratio ideally should be at least 2:1. Higher calcium contents are acceptable however higher magnesium content may result in soil dispersion (Agriculture Victoria, 2011). Ca:Mg determined for topsoils returned results ranging from 0.8 – 5.4.

4.3.1.5 Soil infiltration rates and water holding capacity

Water holding capacity is variable across the site with topsoils determined as moderate based on available water by percentage (24%) and have a moderate permanent wilting point (~16%). Water holding capacity for subsoils is lower due to a higher clay content which has a lower available water percentage (13%) and higher permanent wilting point (34%) but can also be classed as moderate (Hazleton & Murphy 2007).

Topsoil infiltration based on texture and degree of structure for weakly pedal clay loams is inferred to be around 5-20mm per hour. This is given a low to very low rating for saturated hydraulic conductivity, meaning poor infiltration may lead to overland flow and erosion on slopes (Hazleton & Murphy 2007). Infiltration in subsoils is rated to be low to moderate with a permeability of 2.5-50mm per hour. Subsoils may have poor infiltration leading to overland flow and erosion on slopes especially very steep slopes (Hunt & Gilkes 1992).

5.0 Summary of test results

Please see next page.

Table 2: *Topsoil - Results of laboratory testing*

Parameter	Units	Sample Identification							
		1, 2, 3, 5	4, 6, 7, 18	8, 15, 16, 21	9, 10, 11, 12, 14	13	17, 20, 22	19	23, 24, 25
pH (1:5 Water)	pH unit	6.6	6.7	6.9	6.6	7.9	6.2	6.2	5.5
pH (1:5 CaCl2)	pH unit	5.6	5.6	6.6	5.7	7.0	5.2	5.1	4.7
Electrical Conductivity	dS/m	0.04	0.04	0.18	0.09	0.12	0.06	0.04	0.07
Chloride	mg/kg	<10	<10	<10	34	51	26	<10	18
Nitrate Nitrogen	mg/kg	2	3	9	2	1	1	1	20
Ammonium Nitrogen	mg/kg	2	2	2	2	<1	3	2	6
Phosphorus (Colwell)	mg/kg	<5	<5	6	<5	<5	5	<5	16
PBI	-	46	42	74	74	97	74	39	35
Sulphur (KCl40)	mg/kg	<1	<1	3	23	22	7	2	6
CEC	cmol(+)/kg	7.0	10.2	12.8	8.1	9.0	7.9	7.5	4.5
Calcium (Amm-acet.)	cmol(+)/kg	4.7	7.8	9.8	4.1	3.2	3.4	4.9	3.0
Magnesium (Amm-acet.)	cmol(+)/kg	1.2	1.5	1.8	2.8	4.2	3.4	1.6	0.8
Sodium (Amm-acet.)	cmol(+)/kg	<0.02	<0.02	<0.02	0.4	0.90	0.18	<0.02	0.04
Potassium (Amm-acet.)	cmol(+)/kg	0.95	0.95	1.20	0.75	0.75	0.90	0.96	0.59
Available Potassium	mg/kg	370	370	460	290	290	350	380	230
Aluminium (KCl)	cmol(+)/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aluminium % Cations	%	1.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Calcium % Cations	%	68.0	76.0	77.0	51.0	36.0	43.0	65.0	67.0
Magnesium % Cations	%	17.0	14.0	14.0	35.0	46.0	43.0	22.0	19.0
Sodium % Cations (ESP)	%	<1.00	<1.00	<1.00	5.00	10.00	2.20	<1.00	0.97
Potassium % Cations	%	14.00	9.30	9.30	9.30	8.30	11.00	13.00	13.00
Cal/Mag Ratio	-	3.9	5.2	5.4	1.5	0.8	1.0	3.1	3.6

Table 3: *Subsoil - Results of laboratory testing*

Pit/Sample	Horizon	pH (1:5 soil/water)	Electrical Conductivity	Dispersion[+]
Units	**-**	**-**	**µS/cm**	**-**
1/2	B	6.9	0.04	P
2/2	B1	7.0	0.03	*
4/2	B1	7.0	0.02	C
5/2	A2	6.7	0.06	*
6/2	A2	7.0	0.01	*
8/2	B	6.8	0.01	*
10/2	B1	7.2	0.33	*
11/2	B	7.4	0.04	*
13/2	B	7.2	0.45	*
14/2	A2	7.4	0.02	*
15/2	B1	7.1	0.03	N
18/2	B1	7.8	0.05	*
20/2	B	5.6	0.01	N
21/2	B	6.7	0.03	P
23/2	B	6.5	0.01	P
25/2	B	6.7	0.16	N

[+]*Dispersion testing results were rated N, P or C being Nil, Partial or Complete dispersion.*

** Denotes slaking but no dispersion.*

6.0 Comments and recommendations

The discussion and recommendations provided below are based on field observations and testing at discrete locations.

6.1 Potential limitations

Potential landscape limitations have been summarised below, **Table 4**.

Table 4: *Potential landscape limitation assessment*

Soil Type	Erosion Hazard	Salinity Risk	Acid Soil	Waterlogging Risk	Acid Sulphate Soils	Infrastructure
Chromosol	LOW	LOW	NO	MODERATE	NO	LOW

As follows is the soil landscape map (eSpade, 2019) which has been generally validated by the soil survey through laboratory and field techniques. As such, management practices can be grouped into management classes of the 'Barigan Creek' (**bc**) Soil Landscape with Chromosols being represented across the site, **Figure 3**. This report identifies management practices for units in **Section 6.5** below.

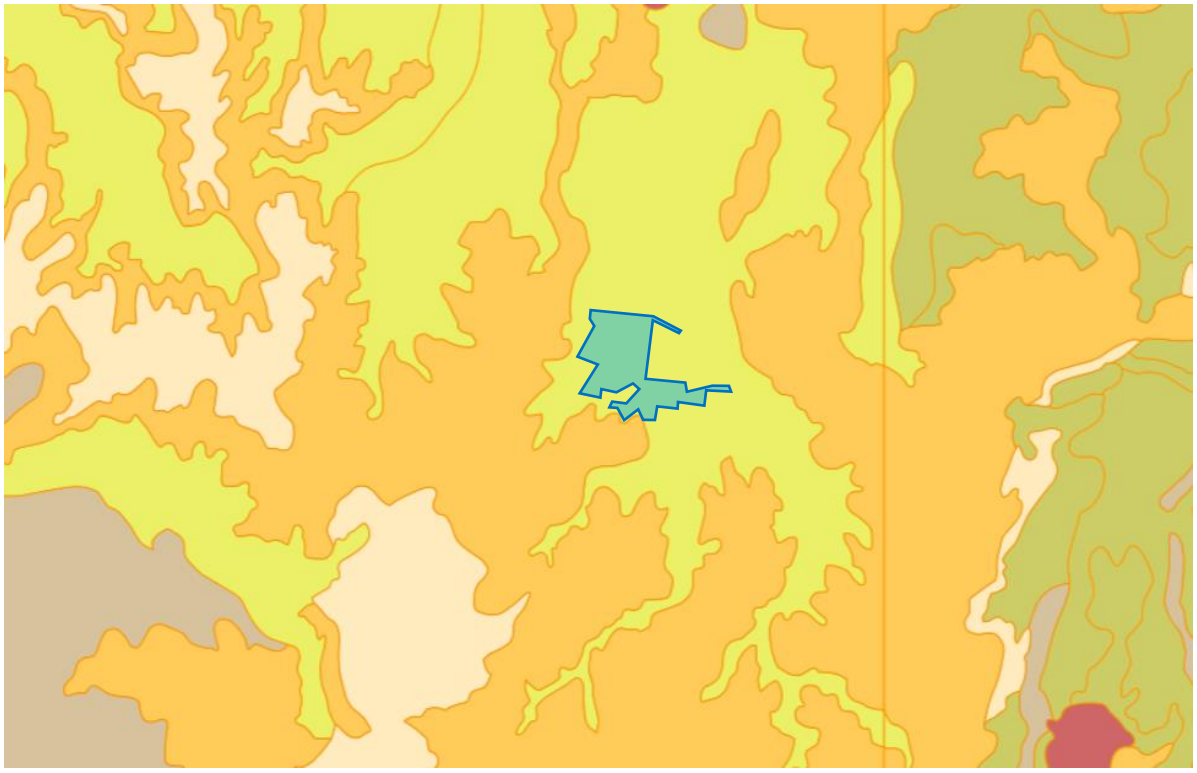


Figure 3: *Digital Atlas of Australian Soils mapping units with site overlay (**Barigan Creek**, **Lees Pinch**, and **Growee**)*

6.2 Erosion control

To mitigate the occurrence of erosion the following primary principles should be adhered to, particularly throughout the construction period of the project. Best Management Practices (BMPs) should be employed where applicable to further reduce the risk of potential erosion and sediment control.

- Integrate project design with any site constraints.
- Preserve and stabilise drainageways.
- Minimise the extent and duration of disturbance.
- Control stormwater flows onto, through and from the site in stable drainage structures.
- Install perimeter controls.
- Stabilise disturbed areas promptly.
- Protect steep slopes.
- Employ the use of sediment control measures to prevent off and on-site damage.
- Protect inlets, storm drain outlets and culverts.
- Provide access and general construction controls.
- Inspect and maintain sediment and erosion control measures regularly.

The risk of erosion on site due to construction activities is considered moderate due to the variable relief and generally low salinity and sodicity of topsoils and subsoils. Excavation of subsoils should be limited where possible, and excavated subsoils should be stockpiled and contained to avoid potential dispersion and sediment transfer. Ground cover around the structures should be maintained where possible. Maintenance of ground cover will also aid in the prevention of topsoil losses from runoff erosion. Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004) and Volume 2A & 2C (DECC, 2008) should be consulted further in the development of an Erosion and Sediment Control Plan (ESCP).

6.3 Acid sulphate soils

'Acid sulphate soils' is the common name given to naturally occurring soils containing iron sulphides. Exposure of the sulphides present in these soils to oxygen from drainage or excavation will lead to the generation of sulphuric acid. Field pH of these soils in their undisturbed state is generally pH 4 or less.

Landscape characteristics such as; the dominance of mangroves, reeds, rushes and other marine/estuarine or swamp-tolerant vegetation, low lying areas, back swamps or scalded areas of coastal estuaries and floodplains and sulphurous smell following rain after prolonged dry periods (Stone *et al*, 1998) after soil disturbance were not observed. There was no evidence of a jarositic horizon or jarosite precipitates or coatings on any root channels or cracks in the soil.

From the soil survey conducted, it has been assessed that acid sulphate soils are not present on site.

6.4 Potential impacts on salinity, groundwater resources and hydrology

Current operational procedures include pastures and grazing. Associated water features across the investigated area include upwards of 25 dams and various open drainage channels and depressions including Wollar Creek. There are no registered groundwater bores on site and one registered bore within 1km of the site boundary. Most of the paddocks on the higher ground had maintained ground cover at the time of the investigation. Given the majority of soils on site are classified as 'non-sodic' and are of low salinity, the risk of salt build-up in discharge areas is low. However, there were some sodic soils identified from the

analysis (BH13) which may pose higher risk of salt build up and discharge. Changing direction of surface waters and any run-on should be avoided as local changes in the water regime are likely to further mobilise any salts stored in the soil. Deep rooted vegetation should be maintained where present and established where absent, ground clearing should be minimised.

6.5 Soil characteristics and management responses

6.5.2 Chromosols

Table 5: *Chromosol characteristics and management responses.*

Soil property	Behaviour of soil to activity or environment	Management responses/measures
Soil surface		
These soils generally have a moderate to weak structure in the surface with a firm to hard setting surface condition.	A firm to hard setting surface will generally have poor initial infiltration resulting in a large proportion of water running off causing erosion.	Surface infiltration rate can be increased through the incorporation of composted organic matter and by maintaining vegetative cover.
	A hard setting surface will also cause poor germination and seedling emergence.	Soil structure and moisture holding capacity can be improved through the incorporation of composted organic matter leading to better seedling establishment.
	A sandy to loamy surface with poor structure can have low soil strength causing trafficability issues.	Trafficability of these soils may be difficult when wet, however the use of gravel road surfaces may improve site access.
	If sandy to loamy surface soil with poor structure and low soil strength is overworked or excessively trafficked there is a high potential to generate dust.	Limit traffic and do not disturb unless necessary to avoid destruction of the limited soil structure. Construct gravel roads on site and limit access off these roads. Consider the use of stabilisation products.
Expansive clays		
These soils contain little to no expansive clays.	-	-
Clay subsoils		
These soils contain non-sodic, slightly acidic to slightly alkaline clay subsoils that may be mottled.	These soils have imperfect drainage and lower landscape positions and can stay wet for extended periods of time. Subsoil permeability is moderate.	Subsoil material is unsuitable for use on the soil surface and should be adequately covered with topsoil. Appropriate drainage design and materials (i.e. sand and gravel) can improve site access for construction. Depending on subsoil structure, plant roots are generally able to extend into the subsoil material without restriction. Gypsum additions can be used to assist structure improvement where required.

Soil property	Behaviour of soil to activity or environment	Management responses/measures
Dispersion		
These soils are generally non-dispersive;	Although not generally dispersive, these soils are still susceptible to rill, sheet and stream bank erosion.	Maintain cover to reduce sheet and rill erosion. Stream bank erosion managed by maintaining vegetative cover and encouraging plants with fibrous root systems. Do not concentrate water flow unless using appropriate erosion and sediment control treatments. Erosion and sediment controls may need to be installed to manage drainage, erosion and prevent movement of sediment off-site.
Salinity		
These soils can have high salt levels (depending on parent material and landscape practices) particularly on lower slopes.	High salt levels will affect plant growth and will also impact water quality if leached or washed off.	If irrigating salty soils, maintain a leaching profile to reduce salt levels (salinity management handbook (DERM 2011) contains thresholds for different plants). Treat salty soils as dispersive soils, even if field testing results are negative, because salt can mask dispersion.
	Salt can cause scalding, erosion and damage to infrastructure.	Discharge salinity expressions can be managed by reducing water inputs and by increasing soil water use at the site or upslope if possible. Soil amelioration with gypsum and planting salt tolerant species may assist scald areas.
Fertility		
These soils generally have a low to moderate fertility.	The sandy surface and pale subsurface layers (where present) generally mean that nutrient content is low in these soils, as is their ability to hold onto nutrients.	Fertiliser additions may improve plant growth, particularly nitrogen, phosphorus, and potassium. To limit leaching/loss of nutrients, specific fertiliser rates should be divided up into regular smaller applications during the growing season, rather than one single application. Increasing organic matter content with composted organics will improve the fertility and assist nutrient retention in these soils.

Soil property	Behaviour of soil to activity or environment	Management responses/measures
Revegetation		
These soils are poorly to imperfectly drained with low to moderate fertility, highly alkaline subsoils and low plant available water holding capacity.	Plant species need be selected that are adapted to these conditions.	Addition of gypsum may be required to alleviate dispersion risk. Increasing organic matter content with composted organics will improve fertility, assist nutrient retention and improve moisture holding capacity of these soils. Relieve any compaction present and ensure adequate fertility for quick establishment. These soils will require frequent, low volume watering due to the dense subsoils. Protect surface with mulch material to reduce raindrop induced crusted or hard setting surface. Fertiliser additions should be divided up into regular smaller applications during the growing season to limit leaching of nutrients. Dense subsoil material significantly restricts plant root extension into the subsoil. Stabilisation and revegetation targets and timeframes should be in accordance with IECA (2008) guidelines.
Soil handling		
Some of these soils have very salty and/ or dispersive subsoils and potentially dusty topsoil.	The objective of soil handling is to minimise off site impacts and maximise the productive capacity of the soil on site consistent with the intended use.	Topsoil stripping should maximise available reserves and should avoid mixing with alkaline, salty and/or sodic subsoils – a simple survey of the site is recommended. Topsoil and subsoil stockpiles should be kept separate. Reinstate soil in the order they were removed (i.e. deeper subsoil below upper subsoil). Final placement of dispersive materials should be covered with adequate topsoil material to protect from erosion. Installation of erosion and sediment control structures may be required where soil is exposed. Trafficability of these soils may be difficult when wet, the use of gravel road surfaces may improve site access. Minimise the handling of topsoil material and ensure traffic is concentrated on constructed road surfaces.

7.0 Notes relating to results

Groundwater

No free groundwater was encountered during the investigation. A groundwater table or seepage may be present at other times and fluctuations in groundwater levels and seepage could occur due to rainfall, changes in temperature and other factors.

Test pit logging

The information supplied in the log sheets is based on a visual and tactile assessment with consideration given to field conditions at the time of testing. The log sheets can include inferred data based on the experience of the consultant as well as factual data from in situ testing.

8.0 Disclaimer

The information contained in this report has been extracted from field and laboratory sources believed to be reliable and accurate. DM McMahon Pty Ltd will not assume any responsibility for the misinterpretation of information supplied in this report. The accuracy and reliability of recommendations identified in this report need to be evaluated with due care according to individual circumstances. It should be noted that the recommendations and findings in this report are based solely upon the said site location and the ground level conditions at the time of testing. The results of the said investigations undertaken are an overall representation of the conditions encountered. The properties of the soil within the location may change due to variations in ground conditions outside of the tested area. The author has no control or liability over site variability that may warrant further investigation that may lead to significant design changes.

9.0 References

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10.0 Attachments

Attachment	Details
A. Log sheets	5 pages
B. Laboratory reports	16 pages

McMahon EARTH SCIENCE

SOIL SURVEY FIELD SHEET

Job No:	5339
Project:	Wollar Solar Farm
Site:	Wollar Solar Farm

Site Identity	Sample	Co-ordinates MGA GDA94 z55	Layer	Layer Top (m)	Layer Bottom (m)	Horizon	Boundary	Colour	Munsell Code	Texture	Moisture	Consistence	Mottles	Mottle Type	Structure	Coarse Fragments	Fragment Size (mm)	Fragment (%)	Comments
1	1/1	777077 E	1	0.0	0.20	A	-	-B	5YR 3/3	ZCL	D	4	-	-	SB	-	-	-	
	1/2	6410438 N	2	0.20	0.80	B	C	BR	2.5YR 4/6	MC	T	5	-	-	M	-	-	-	
	1/3		3	0.80	1.50	C	D	GY	10YR 6/6	HC	D	6	2	R, D	M	Y	<100	40	
2	2/1	776629 E	1	0.00	0.20	A	-	-B	5YR 3/3	ZCL	D	4	-	-	SB	-	-	-	
	2/2	6410470 N	2	0.20	0.60	B1	C	+R	2.5YR 3/6	MC	M	5	-	-	M	-	-	-	
	2/3		3	0.60	1.20	B2	G	BY	10YR 4/4	MC	M	6	-	R, G	M	-	-	-	
	2/4		4	1.20	1.50	C	D	BY	10YR 4/5	HC	D	6	-	G, D	M	Y	<50	10	
3	3/1	776605 E	1	0.00	0.20	A	-	RB	7.5YR 3/4	FSCL	T	4	-	-	SB	-	-	-	
	3/2	6410176 N	2	0.20	0.50	B1	C	+R	2.5YR 3/6	MC	M	5	-	-	M	-	-	-	
	3/3		3	0.50	1.20	B2	G	RY	10YR 4/6	HC	D	6	-	G, D	M	-	-	-	
	3/4		4	1.20	1.50	C	D	GY	10YR 6/6	HC	D	6	-	G, D	PH	Y	<30	10	
4	4/1	776086 E	1	0.00	0.20	A1	-	+B	5YR 3/1	FSCL	T	4	-	-	SB	-	-	-	
	4/2	6410490 N	2	0.20	0.50	A2	C	-B	5YR3/3	ZC	D	3	-	-	M	-	-	-	
	4/3		3	0.50	0.80	B1	C	GB	10YR 4/2	HC	T	6	-	Y, R	PH	-	-	-	
	4/4		4	0.80	1.50	B2	D	GBL	7.5YR 4/1	HC	D	6	-	Y, R	PH	Y	<10	<5	
5	5/1	776044 E	1	0.00	0.40	A	-	GB	10YR 4/2	ZCL	D	4	-	-	M	-	-	-	
	5/2	6410126 N	2	0.40	1.00	B1	C	Y	10YR 6/6	HC	T	6	-	G, Y	M	-	-	-	
	5/3		3	1.00	1.50	B2	D	YG	10YR 5/3	HC	D	6	-	R, Y, D	M	Y	<10	<5	

McMahon EARTH SCIENCE

SOIL SURVEY FIELD SHEET

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Site: Wollar Solar Farm

Site Identity	Sample	Co-ordinates MGA GDA94 z55	Layer	Layer Top (m)	Layer Bottom (m)	Horizon	Boundary	Colour	Munsell Code	Texture	Moisture	Consistence	Mottles	Mottle Type	Structure	Coarse Fragments	Fragment Size (mm)	Fragment (%)	Comments
6	6/1	775597 E	1	0.00	0.40	A1	-	BR	7.5YR 3/3	FSCL	T	4	-	-	G	-	-	-	
	6/2	6410445 N	2	0.40	1.00	A2	C	GY	2.5YR 3/1	MC	D	5	-	-	M	-	-	-	
	6/3		3	1.00	1.50	B	D	Bl	2.5YR 5/4	HC	D	6	-	G,B	PH	Y	<20	<5	
7	7/1	775494 E	1	0.00	0.40	A	-	B	7.5YR 3/3	FZCL	T	4	-	-	G	-	-	-	
	7/2	6410076 N	2	0.40	0.60	B1	C	RY	10YR 4/6	LMC	D	5	-	R, G	M	-	-	-	
	7/3		3	0.60	0.80	B2	C	GR	7.5YR 4/6	HC	T	6	-	Y	PH	-	-	-	
	7/4		4	0.80	1.50	C	D	G	2.5YR 5/3	HC	T	6	-	RY	PH	Y	<10	<5	
8	8/1	775065 E	1	0.00	0.20	A	-	B	7.5YR 3/3	FZCL	D	3	-	-	G	Y	<50	10	
	8/2	6409764 N	2	0.20	0.60	B	C	BR	2.5YR4/6	MC	M	5	-	B	M	-	-	-	
	8/3		3	0.60	0.80	C	D	YG	10YR5/3	HC	D	5	-	R, B	M	Y	<20	10	
9	9/1	775629 E	1	0.00	0.20	A	-	-B	5YR 3/3	ZCL	D	4	-	-	G	-	-	-	
	9/2	6409738 N	2	0.20	1.00	B	C	BY	10YR4/4	SCL	M	5	-	G, R	M	-	-	-	
	9/3		3	1.00	1.50	C	D	YG	10YR 5/3	LC	T	5	-	R, D, C	M	-	-	-	
10	10/1	776095 E	1	0.00	0.10	A	-	YB	7.5YR 4/4	FZCL	T	3	-	-	G	-	-	-	
	10/2	6409748 N	2	0.10	0.40	B1	C	+B	5YR 3/3	CL	M	3	-	-	G	-	-	-	
	10/3		3	0.40	0.60	B2	C	G	2.5YR 3/3	MC	M	5	-	R, Y	M	-	-	-	
	10/4		4	0.60	1.50	C	D	RY	10YR 4/6	HC	T	6	-	G	M	-	-	-	

McMahon EARTH SCIENCE

SOIL SURVEY FIELD SHEET

Job No:	5339
Project:	Wollar Solar Farm
Site:	Wollar Solar Farm

Site Identity	Sample	Co-ordinates MGA GDA94 z55	Layer	Layer Top (m)	Layer Bottom (m)	Horizon	Boundary	Colour	Munsell Code	Texture	Moisture	Consistence	Mottles	Mottle Type	Structure	Coarse Fragments	Fragment Size (mm)	Fragment (%)	Comments
11	11/1	776438 E	1	0.00	0.10	A	-	-B	5YR 3/3	ZCL	D	4	-	-	G	-	-	-	
	11/2	6409688 N	2	0.10	0.50	B	C	BY	10YR 4/4	HC	T	5	-	R	M	-	-	-	
	11/3		3	0.50	1.50	C	D	GY	7.5YR 4/6	LC	D	6	-	G, Y, B	PH	Y	<10	10	
12	12/1	776549 E	1	0.00	0.10	A	-	YB	7.5YR 4/4	FZCL	T	3	-	-	G	-	-	-	
	12/2	6409184 N	2	0.10	0.40	B	C	BY	10YR 4/4	MC	D	5	-	-	M	-	-	-	
	12/3		3	0.40	0.80	C	D	G	2.5YR 5/3	HC	T	5	Y	R	PL	Y	<100	20	
13	13/1	776039 E	1	0.00	0.10	A1	-	RB	7.5YR 3/4	FZCL	D	3	-	-	G	-	-	-	
	13/2	6409296 N	2	0.10	0.30	A2	D	R	2.5YR 4/8	HC	D	5	Y	G	M	-	-	-	
	13/3		3	0.30	1.00	B	D	GR	7.5YR 4/6	HC	D	5	-	-	PH	-	-	-	
	13/4		4	1.00	1.50	C	D	R	2.5YR 4/8	CS	D	5	-	GY	PH	Y	<20	10	
14	14/1	775138 E	1	0.00	0.10	A1	-	-B	5YR 3/3	FZCL	D	3	-	-	G	-	-	-	
	14/2	6408900 N	2	0.10	0.30	A2	C	GY	10YR 6/6	ZL	D	5	-	-	G	-	-	-	
	14/3		3	0.30	1.00	B	C	GR	7.5YR 4/6	HC	D	5	-	-	PH	-	-	-	
	14/4		4	1.00	1.50	C	D	R	2.5YR 4/8	CS	D	5	-	GY	PH	Y	<20	10	
15	15/1	775568 E	1	0.0	0.20	A	-	RY	10YR 4/6	ZCL	D	3	-	-	SB	-	-	-	
	15/2	6409288 N	2	0.20	0.60	B1	C	R	2.5YR 4/8	HC	T	5	-	-	M	-	-	-	
	15/3		3	0.60	1.00	B2	C	Y	10YR 6/6	MC	D	6	Y	R, W	M	Y	<10	80	
	15/4		4	1.00	1.50	C	D	W	2.5YR 7/2	HC	D	6	Y	Y, R	P	Y	<100	90	

McMahon EARTH SCIENCE

SOIL SURVEY FIELD SHEET

Job No:	5339
Project:	Wollar Solar Farm
Site:	Wollar Solar Farm

Site Identity	Sample	Co-ordinates MGA GDA94 z55	Layer	Layer Top (m)	Layer Bottom (m)	Horizon	Boundary	Colour	Munsell Code	Texture	Moisture	Consistence	Mottles	Mottle Type	Structure	Coarse Fragments	Fragment Size (mm)	Fragment (%)	Comments
16	16/1	775648 E	1	0.00	0.30	A	-	+B	5YR 3/1	ZCL	D	6	Y	Y,W	G	Y	<200	5	
	16/2	6408934 N	2	0.30	0.50	B	C	BY	10YR 4/4	HC	D	5	Y	B, W	PH	Y	<20	80	
	16/3		3	0.50	1.50	C	C	W	2.5YR 7/2	LC	T	6	Y	R	M	-	-	-	
17	17/1	776097 E	1	0.00	0.20	A	-	RB	7.5YR 4/4	FZCL	D	3	-	-	G	-	-	-	
	17/2	6408923 N	2	0.20	0.60	B	C	R	10YR 4/4	HC	T	4	Y	G	M	-	-	-	
	17/3		3	0.60	1.00	C	D	RY	2.5YR 5/3	MC	D	6	Y	G, W	PL	-	-	-	
	17/4		4	1.00	1.70	D	D	G	2.5YR 5/4	HC	T	6	Y	Y	PL	-	-	-	
18	18/1	776109 E	1	0.00	0.40	A2	-	-B	5YR 3/3	FZCL	D	3	-	-	G	-	-	-	
	18/2	6408201 N	2	0.40	0.60	B1	D	B	7.5YR3/3	ZCL	T	4	Y	W	M	-	-	-	
	18/3		3	0.60	1.50	B2	D	B	7.5YR3/4	MC	T	5	Y	YRW	M	Y	<20	5	
19	19/1	776493 E	1	0.00	0.10	A	-	B	7.5YR 3/3	ZCL	D	4	-	-	G	-	-	-	
	19/2	6408238 N	2	0.10	0.40	B	C	BR	2.5YR 4/6	MC	T	5	Y	YW	M	-	-	-	
	19/3		3	0.40	0.70	-	D	B	7.5YR 3/3	HC	T	6	-	-	PH	-	-	-	
20	20/1	776632 E	1	0.00	0.10	A	-	B	7.5YR 3/3	FZCL	T	3	-	-	G	-	-	-	
	20/2	6408910 N	2	0.10	0.30	B	C	YR	5YR 5/6	MC	M	4	Y	G	M	-	-	-	
	20/3		3	0.30	0.60	C	D	G	2.5YR 5/4	HC	M	5	Y	RY	M	Y	<10	<5	
21	21/1	776532 E	1	0.00	0.10	A	-	B	7.5YR 3/3	FZCL	T	3	-	-	G	-	-	-	
	21/2	6408465 N	2	0.10	0.40	B	C	YR	5YR 5/6	MC	T	5	Y	BGY	M	-	-	-	
	21/3		3	0.40	0.80	C	D	G	2.5YR 5/4	HC	D	6	Y	YRG	M	Y	<10	<5	

McMahon EARTH SCIENCE

SOIL SURVEY FIELD SHEET

Job No:	5339
Project:	Wollar Solar Farm
Site:	Wollar Solar Farm

Site Identity	Sample	Co-ordinates MGA GDA94 z55	Layer	Layer Top (m)	Layer Bottom (m)	Horizon	Boundary	Colour	Munsell Code	Texture	Moisture	Consistence	Mottles	Mottle Type	Structure	Coarse Fragments	Fragment Size (mm)	Fragment (%)	Comments
22	22/1	776951 E	1	0.00	0.20	A	-	B	7.5YR 3/3	FZCL	M	3	-	-	G	-	-	-	
	22/2	6408623 N	2	0.30	1.20	B1	C	R	2.5YR 4/8	HC	M	5	Y	Y	M	-	-	-	
	22/3		3	0.50	1.50	B2	D	YR	5YR 5/6	MC	T	6	Y	B, Y, G	M	Y	<10	<5	
23	23/1	777503 E	1	0.00	0.30	A	-	B	7.5YR 3/3	FZCL	M	3	-	-	G	-	-	-	
	23/2	6408674 N	2	0.30	1.00	B	C	GY	10YR 6/6	MC	T	6	Y	R	M	Y	<20	<5	
	23/3		3	1.00	1.50	C	D	G	2.5YR 3/3	HC	D	6	Y	Y, R, W	M	-	-	-	
24	24/1	777964 E	1	0.00	0.10	A	-	+B	5YR 3/1	FZCL	T	3	-	-	G	-	-	-	
	24/2	6408366 N	2	0.10	0.60	B	C	B	7.5YR 3/3	ZCL	D	4	-	-	G	-	-	-	
	24/3		3	0.60	1.50	C	D	BG	5YR 4/2	MC	D	6	-	-	M	-	-	-	
25	25/1	778484 E	1	0.00	0.20	A	-	YB	7.5YR 4/4	ZCL	D	4	-	-	M	-	-	-	
	25/2	6408605 N	2	0.20	0.60	B	C	BR	5YR 5/6	HC	D	5	Y	YW	M	-	-	-	
	25/3		3	0.60	0.70	C	D	G	ROCK	-	D	-	-	-	-	Y	<100	<90	

Nutrient Advantage®

Nutrient Advantage Advice® Nutrient Report

DM McMahon Ptv Ltd
PO BOX 6118

WAGGA WAGGA
NSW 2650

Report Print Date: 01/05/2019
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: WALLAR 5818

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019385
Paddock Name: WALLAR 5818
Sample Name: SAMPLES 1 2 3 5
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 29/04/2019

Analyte / Assay	Units	Value
pH (1:5 Water)		6.6
pH (1:5 CaCl2)		5.6
Electrical Conductivity (1:5 water)	dS/m	0.04
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	2
Ammonium Nitrogen	mg/kg	2
Phosphorus (Colwell)	mg/kg	<5
Phosphorus Buffer Index		46
Sulphur (KCl40)	mg/kg	<1
Cation Exch. Cap. (CEC)	cmol(+)/kg	7.0
Calcium (Amm-acet.)	cmol(+)/kg	4.7
Magnesium (Amm-acet.)	cmol(+)/kg	1.2
Sodium (Amm-acet.)	cmol(+)/kg	<0.02
Potassium (Amm-acet.)	cmol(+)/kg	0.95
Available Potassium	mg/kg	370
Aluminium (KCl)	cmol(+)/kg	0.1
Aluminium % of Cations	%	1.5
Calcium % of Cations	%	68.0
Magnesium % of Cations	%	17.0
Sodium % of Cations (ESP)	%	<1.00
Potassium % of Cations	%	14.00
Calcium/Magnesium Ratio		3.9

Analyses conducted by **Nutrient Advantage Laboratory Services**
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NATA Accreditation No: 11958
Tel: 1800 803 453
Certificate of Analysis is available upon request.
Email: lab.feedback@incitecpivot.com.au

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019385	**Test Code:**	E11
Paddock Name:	WALLAR 5818	**Sample Type:**	Soil
Sample Name:	SAMPLES 1 2 3 5	**Sampling Date:**	29/04/2019
Sample Depth (cm):	0 **To** 10		

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Nutrient Advantage Advice® Nutrient Report

DM McMahon Ptv Ltd
PO BOX 6118

WAGGA WAGGA
NSW 2650

Report Print Date: 01/05/2019
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: WALLAR 5818

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019386
Paddock Name: WALLAR 5818
Sample Name: SAMPLES 4 6 7 18
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 29/04/2019

Analyte / Assay	Units	Value
pH (1:5 Water)		6.7
pH (1:5 CaCl2)		5.6
Electrical Conductivity (1:5 water)	dS/m	0.04
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	3
Ammonium Nitrogen	mg/kg	2
Phosphorus (Colwell)	mg/kg	<5
Phosphorus Buffer Index		42
Sulphur (KCl40)	mg/kg	<1
Cation Exch. Cap. (CEC)	cmol(+)/kg	10.2
Calcium (Amm-acet.)	cmol(+)/kg	7.8
Magnesium (Amm-acet.)	cmol(+)/kg	1.5
Sodium (Amm-acet.)	cmol(+)/kg	<0.02
Potassium (Amm-acet.)	cmol(+)/kg	0.95
Available Potassium	mg/kg	370
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	76.0
Magnesium % of Cations	%	14.0
Sodium % of Cations (ESP)	%	<1.00
Potassium % of Cations	%	9.30
Calcium/Magnesium Ratio		5.2

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019386	**Test Code:**	E11
Paddock Name:	WALLAR 5818	**Sample Type:**	Soil
Sample Name:	SAMPLES 4 6 7 18	**Sampling Date:**	29/04/2019
Sample Depth (cm):	0 **To** 10		

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Analyses performed on soil dried at 40 degrees Celsius and ground to <2mm (excluding moisture assay)
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NSW 2650

Report Print Date: 01/05/2019
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: WALLAR 5818

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019387
Paddock Name: WALLAR 5818
Sample Name: SAMPLES 8 15 16 21
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 29/04/2019

Analyte / Assay	Units	Value
pH (1:5 Water)		6.9
pH (1:5 CaCl2)		6.6
Electrical Conductivity (1:5 water)	dS/m	0.18
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	9
Ammonium Nitrogen	mg/kg	2
Phosphorus (Colwell)	mg/kg	6
Phosphorus Buffer Index		74
Sulphur (KCl40)	mg/kg	3
Cation Exch. Cap. (CEC)	cmol(+)/kg	12.8
Calcium (Amm-acet.)	cmol(+)/kg	9.8
Magnesium (Amm-acet.)	cmol(+)/kg	1.8
Sodium (Amm-acet.)	cmol(+)/kg	<0.02
Potassium (Amm-acet.)	cmol(+)/kg	1.20
Available Potassium	mg/kg	460
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	77.0
Magnesium % of Cations	%	14.0
Sodium % of Cations (ESP)	%	<1.00
Potassium % of Cations	%	9.30
Calcium/Magnesium Ratio		5.4

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019387	**Test Code:**	E11
Paddock Name:	WALLAR 5818	**Sample Type:**	Soil
Sample Name:	SAMPLES 8 15 16 21	**Sampling Date:**	29/04/2019
Sample Depth (cm):	0 **To** 10		

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Report Print Date: 01/05/2019
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: WALLAR 5818

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019388
Paddock Name: WALLAR 5818
Sample Name: SAMPLES 9 10 11 12 14
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 29/04/2019

Analyte / Assay	Units	Value
pH (1:5 Water)		6.6
pH (1:5 CaCl2)		5.7
Electrical Conductivity (1:5 water)	dS/m	0.09
Chloride	mg/kg	34
Nitrate Nitrogen	mg/kg	2
Ammonium Nitrogen	mg/kg	2
Phosphorus (Colwell)	mg/kg	<5
Phosphorus Buffer Index		74
Sulphur (KCl40)	mg/kg	23
Cation Exch. Cap. (CEC)	cmol(+)/kg	8.1
Calcium (Amm-acet.)	cmol(+)/kg	4.1
Magnesium (Amm-acet.)	cmol(+)/kg	2.8
Sodium (Amm-acet.)	cmol(+)/kg	0.40
Potassium (Amm-acet.)	cmol(+)/kg	0.75
Available Potassium	mg/kg	290
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	51.0
Magnesium % of Cations	%	35.0
Sodium % of Cations (ESP)	%	5.00
Potassium % of Cations	%	9.30
Calcium/Magnesium Ratio		1.5

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019388	**Test Code:**	E11
Paddock Name:	WALLAR 5818	**Sample Type:**	Soil
Sample Name:	SAMPLES 9 10 11 12 14	**Sampling Date:**	29/04/2019
Sample Depth (cm):	0 **To** 10		

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Report Print Date: 01/05/2019
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: WALLAR 5818

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019389
Paddock Name: WALLAR 5818
Sample Name: SAMPLE 13
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 29/04/2019

Analyte / Assay	Units	Value
pH (1:5 Water)		7.9
pH (1:5 CaCl2)		7.0
Electrical Conductivity (1:5 water)	dS/m	0.12
Chloride	mg/kg	51
Nitrate Nitrogen	mg/kg	1
Ammonium Nitrogen	mg/kg	<1
Phosphorus (Colwell)	mg/kg	<5
Phosphorus Buffer Index		97
Sulphur (KCl40)	mg/kg	22
Cation Exch. Cap. (CEC)	cmol(+)/kg	9.0
Calcium (Amm-acet.)	cmol(+)/kg	3.2
Magnesium (Amm-acet.)	cmol(+)/kg	4.2
Sodium (Amm-acet.)	cmol(+)/kg	0.90
Potassium (Amm-acet.)	cmol(+)/kg	0.75
Available Potassium	mg/kg	290
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	36.0
Magnesium % of Cations	%	46.0
Sodium % of Cations (ESP)	%	10.00
Potassium % of Cations	%	8.30
Calcium/Magnesium Ratio		0.8

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019389	**Test Code:**	E11
Paddock Name:	WALLAR 5818	**Sample Type:**	Soil
Sample Name:	SAMPLE 13	**Sampling Date:**	29/04/2019
Sample Depth (cm):	0 **To** 10		

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Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: WALLAR 5818

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019390
Paddock Name: WALLAR 5818
Sample Name: SAMPLES 17 20 22
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 29/04/2019

Analyte / Assay	Units	Value
pH (1:5 Water)		6.2
pH (1:5 CaCl2)		5.2
Electrical Conductivity (1:5 water)	dS/m	0.06
Chloride	mg/kg	26
Nitrate Nitrogen	mg/kg	1
Ammonium Nitrogen	mg/kg	3
Phosphorus (Colwell)	mg/kg	5
Phosphorus Buffer Index		74
Sulphur (KCl40)	mg/kg	7
Cation Exch. Cap. (CEC)	cmol(+)/kg	7.9
Calcium (Amm-acet.)	cmol(+)/kg	3.4
Magnesium (Amm-acet.)	cmol(+)/kg	3.4
Sodium (Amm-acet.)	cmol(+)/kg	0.18
Potassium (Amm-acet.)	cmol(+)/kg	0.90
Available Potassium	mg/kg	350
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	43.0
Magnesium % of Cations	%	43.0
Sodium % of Cations (ESP)	%	2.20
Potassium % of Cations	%	11.00
Calcium/Magnesium Ratio		1.0

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019390	**Test Code:**	E11
Paddock Name:	WALLAR 5818	**Sample Type:**	Soil
Sample Name:	SAMPLES 17 20 22	**Sampling Date:**	29/04/2019
Sample Depth (cm):	0 **To** 10		

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Report Print Date: 01/05/2019
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: WALLAR 5818

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019391
Paddock Name: WALLAR 5818
Sample Name: SAMPLE 19
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 29/04/2019

Analyte / Assay	Units	Value
pH (1:5 Water)		6.2
pH (1:5 CaCl2)		5.1
Electrical Conductivity (1:5 water)	dS/m	0.04
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	1
Ammonium Nitrogen	mg/kg	2
Phosphorus (Colwell)	mg/kg	<5
Phosphorus Buffer Index		39
Sulphur (KCl40)	mg/kg	2
Cation Exch. Cap. (CEC)	cmol(+)/kg	7.5
Calcium (Amm-acet.)	cmol(+)/kg	4.9
Magnesium (Amm-acet.)	cmol(+)/kg	1.6
Sodium (Amm-acet.)	cmol(+)/kg	<0.02
Potassium (Amm-acet.)	cmol(+)/kg	0.96
Available Potassium	mg/kg	380
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	65.0
Magnesium % of Cations	%	22.0
Sodium % of Cations (ESP)	%	<1.00
Potassium % of Cations	%	13.00
Calcium/Magnesium Ratio		3.1

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019391	**Test Code:**	E11
Paddock Name:	WALLAR 5818	**Sample Type:**	Soil
Sample Name:	SAMPLE 19	**Sampling Date:**	29/04/2019
Sample Depth (cm):	0 **To** 10		

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Report Print Date: 01/05/2019
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: WALLAR 5818

Grower Name : D M MCMAHON PTY LTD
Sample No: 022019392
Paddock Name: WALLAR 5818
Sample Name: SAMPLES 23 24 25
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 29/04/2019

Analyte / Assay	Units	Value
pH (1:5 Water)		5.5
pH (1:5 CaCl2)		4.7
Electrical Conductivity (1:5 water)	dS/m	0.07
Chloride	mg/kg	18
Nitrate Nitrogen	mg/kg	20
Ammonium Nitrogen	mg/kg	6
Phosphorus (Colwell)	mg/kg	16
Phosphorus Buffer Index		35
Sulphur (KCl40)	mg/kg	6
Cation Exch. Cap. (CEC)	cmol(+)/kg	4.5
Calcium (Amm-acet.)	cmol(+)/kg	3.0
Magnesium (Amm-acet.)	cmol(+)/kg	0.8
Sodium (Amm-acet.)	cmol(+)/kg	0.04
Potassium (Amm-acet.)	cmol(+)/kg	0.59
Available Potassium	mg/kg	230
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	67.0
Magnesium % of Cations	%	19.0
Sodium % of Cations (ESP)	%	0.97
Potassium % of Cations	%	13.00
Calcium/Magnesium Ratio		3.6

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022019392	**Test Code:**	E11
Paddock Name:	WALLAR 5818	**Sample Type:**	Soil
Sample Name:	SAMPLES 23 24 25	**Sampling Date:**	29/04/2019
Sample Depth (cm):	0 **To** 10		

The results reported pertain only to the sample submitted.
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APPENDIX E AGENCY APPROVAL OF BMP